Twin Cities Campus

Ecology, Evolution and Behavior M.S.

Ecology, Evolution & Behavior
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
Email: eebgrad@umn.edu
Website: http://www.cbs.umn.edu/explore/departments/eeb/graduate/about-program

- Program Type: Master's
- Requirements for this program are current for Fall 2018
- Length of program in credits: 30
- This program requires summer semesters for timely completion.
- Degree: Master of Science

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

The graduate program in ecology, evolution, and behavior (EEB) links faculty and students interested in the biology of organisms from molecules to ecosystems. Studies address questions from molecular mechanisms of evolution, the interactions of organisms in social groups and populations, the distributions and abundances of species in communities and ecosystems, to global biogeochemical processes. The program provides broad training in the general areas of ecology, evolution, and animal behavior, and specialized courses and research in vertebrate and invertebrate zoology; behavior and ethology; evolution; population genetics; molecular evolution; systematics; population, community, and ecosystem ecology; global ecology; limnology; ecology of vegetation; and theoretical ecology. Opportunities for field research are available in Africa, Central America, and other parts of the world, as well as in local ecosystems, including the Cedar Creek Ecosystem Science Reserve and Itasca Biological Station. Seminars and individually designed tutorials are an important part of student programs and provide an exciting intellectual environment.

Program Delivery
This program is available:
- via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission
Other requirements to be completed before admission:
Courses in inorganic chemistry, organic chemistry, biochemistry, general physics, one year of college calculus, animal biology, genetics, physiology, and plant biology are strongly recommended and provide an important background to pursue graduate work in EEB. Proficiency in a foreign language is not required but is strongly recommended for students who expect to pursue field work in a country where English is not the native language. Deficiencies must be made up early in the graduate program.

Special Application Requirements:
Students are admitted only in fall semester. Deadline for application is December 1. Refer to the EEB website for more details.

International applicants must submit score(s) from one of the following tests:
- TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
  - Paper Based - Total Score: 550
- IELTS
  - Total Score: 6.5
- MELAB
  - Final score: 80

Key to test abbreviations (TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

© 2005 by the Regents of the University of Minnesota
The University of Minnesota is an equal opportunity educator and employer.
Information current as of August 31, 2018
Program Requirements

**Plan A:** Plan A requires 20 major credits, 0 credits outside the major, and 10 thesis credits. The final exam is written and oral.

**Plan B:** Plan B requires 30 major credits and 0 credits outside the major. The final exam is written and oral.

This program may be completed with a minor.

Use of 4xxx courses towards program requirements is not permitted.

A minimum GPA of 3.0 is required for students to remain in good standing.

At least 2 semesters must be completed before filing a Degree Program Form.

The MS is offered under both Plan A (with thesis) and Plan B (without thesis). Plan A requires 20 course credits in the major and 10 thesis credits. Plan B requires 30 course credits and a research paper. Students pursuing the joint JD/MS degree have the exception that some Law courses can be "cross counted" for credit. Degree programs are planned by the student and an advisory committee of three faculty members to meet the student's interests and needs.

**EEB Foundations course:** EEB 8201-8202

All students are expected to complete EEB 8201-8202 their first year. The goal of this course is to provide students in their first year with foundation of knowledge in ecology, evolution and behavior.

EEB 8201 - Graduate Foundations in Ecology, Evolution and Behavior - Semester 1 (4.0 cr)
EEB 8202 - Graduate Foundations in Ecology, Evolution and Behavior - Semester 2 (4.0 cr)

**Electives/Supporting Courses**

Plan A students select a minimum of 12 coursework credits and Plan B students select a minimum of 22 elective credits, in consultation with the advisor. Electives may include courses in statistics or history of science if additional background is needed.

**EEB 5042** - Quantitative Genetics (3.0 cr)
**or EEB 5053** - Ecology: Theory and Concepts (4.0 cr)
**or EEB 5068** - Plant Physiological Ecology (3.0 cr)
**or EEB 5221** - Molecular Evolution (3.0 cr)
**or EEB 5322** - Evolution and Animal Cognition (3.0 cr)
**or EEB 5327** - Behavioral Ecology (3.0 cr)
**or EEB 5371** - Principles of Systematics (3.0 cr)
**or EEB 5407** - Ecology (3.0 cr)
**or EEB 5409** - Evolution (3.0 cr)
**or EEB 5601** - Limnology (3.0 cr)
**or EEB 5605** - Limnology Laboratory (2.0 cr)
**or EEB 5609** - Ecosystem Ecology (3.0 cr)
**or EEB 8150** - EEB Lab Tours (1.0 cr)
**or EEB 8151** - EEB Lab Tours (1.0 cr)
**or EEB 8200** - Sustainability Science Distributed Graduate Seminar (3.0 cr)
**or EEB 8301** - Prelim Proposal Writing Seminar (1.0 cr)
**or EEB 8302** - EEB Written Prelim Workshop (1.0 cr)
**or EEB 8360** - Behavioral Biology Seminar (1.0 cr)
**or EEB 8500** - NSF GRF Graduate Research Fellowship Proposal Writing Seminar (1.0 cr)
**or EEB 8601** - Introduction to Stream Restoration (3.0 cr)
**or EEB 8602** - Stream Restoration Practice (2.0 cr)
**or EEB 8641** - Spatial Ecology (3.0 cr)
**or EEB 8890** - Seminar on Current Topics (1.0 - 3.0 cr)
**or EEB 8990** - Graduate Seminar (1.0 - 3.0 cr)
**or EEB 8991** - Independent Study: Ecology, Evolution, and Behavior (1.0 - 10.0 cr)

**or Courses Outside of EEB**

Students may select graduate-level courses outside of EEB in consultation with their advisor.

**AGRO 5121** - Applied Experimental Design (4.0 cr)
**or BIOL 8100** - Improvisation for Scientists (1.0 cr)
**or DSSC 8111** - Approaches to Knowledge and Truth: Ways of Knowing in Development Studies and Social Change (3.0 cr)
**or EPSY 5262** - Intermediate Statistical Methods (3.0 cr)
**or FW 8051** - Statistical Modeling of Ecological Data using R and WinBugs/JAGS (4.0 cr)
Ethics Requirement
A four-session ethics seminar offered during the Friday Noon Seminar series. Required areas of ethics include: Academic and Research Community; Authorship; Peer Review and Research Conduct.

Plan A

Plan A Thesis
Take exactly 10 credit(s) from the following:
• EEB 8777 - Thesis Credits: Master's (1.0 - 18.0 cr)

Joint- or Dual-degree Coursework: JD/MS-Ecology, Evolution, and Behavior Student may take a total of 12 credits in common among the academic programs.
Twin Cities Campus
Ecology, Evolution and Behavior Minor
Ecology, Evolution & Behavior
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
140 Gortner Laboratory, 1479 Gortner Ave, St. Paul, MN 55108 (612-624-6770, fax: 612-624-6777)
Email: eebgrad@umn.edu
Website: http://www.cbs.umn.edu/explore/departments/eeb/graduate/about-program

• Program Type: Graduate minor related to major
• Requirements for this program are current for Fall 2018
• Length of program in credits (Masters): 6
• Length of program in credits (Doctorate): 12
• This program does not require summer semesters for timely completion.

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

The graduate program in Ecology, Evolution, and Behavior (EEB) links faculty and students interested in the biology of organisms from molecules to ecosystems. Studies address questions from molecular mechanisms of evolution, the interactions of organisms in social groups and populations, the distributions and abundances of species in communities and ecosystems, to global biogeochemical processes. The program provides broad training in the general areas of ecology, evolution, and animal behavior, and specialized courses and research in vertebrate and invertebrate zoology; behavior and ethology; evolution; population genetics; molecular evolution; systematics; population, community, and ecosystem ecology; global ecology; limnology; ecology of vegetation; and theoretical ecology. Opportunities for field research are available in Africa, Central America, and other parts of the world, as well as in local ecosystems, including the Cedar Creek Ecosystem Science Reserve and Itasca Biological Station. Seminars and individually designed tutorials are an important part of student programs and provide an exciting intellectual environment.

Program Delivery
This program is available:
• via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission
For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

Program Requirements
Use of 4xxx courses towards program requirements is not permitted.

Program Sub-plans
Students are required to complete one of the following sub-plans.
Students may not complete the program with more than one sub-plan.

Masters
Master's Course List
Take 6 or more credit(s) from the following:
• EEB 5xxx
• EEB 8xxx

Doctoral
Doctoral Course List
Take 12 or more credit(s) from the following:
• EEB 5xxx
• EEB 8xxx

© 2005 by the Regents of the University of Minnesota
The University of Minnesota is an equal opportunity educator and employer.
Information current as of August 31, 2018
Twin Cities Campus
Ecology, Evolution and Behavior Ph.D.
Ecology, Evolution & Behavior
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
Ecology, Evolution, and Behavior Graduate Program, 140 Gortner Laboratory, 1479 Gortner Avenue, St. Paul, MN 55108 (612-624-6770, fax: 612-624-6777)
Email: eebgrad@umn.edu
Website: http://www.cbs.umn.edu/explore/departments/eeb/graduate/about-program

- Program Type: Doctorate
- Requirements for this program are current for Fall 2018
- Length of program in credits: 48
- This program does not require summer semesters for timely completion.
- Degree: Doctor of Philosophy

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

The graduate program in ecology, evolution, and behavior (EEB) links faculty and students interested in the biology of organisms from molecules to ecosystems. Studies address questions from molecular mechanisms of evolution, the interactions of organisms in social groups and populations, the distributions and abundances of species in communities and ecosystems, to global biogeochemical processes. The program provides broad training in the general areas of ecology, evolution, and animal behavior, and specialized courses and research in vertebrate and invertebrate zoology; behavior and ethology; evolution; population genetics; molecular evolution; systematics; population, community, and ecosystem ecology; global ecology; limnology; ecology of vegetation; and theoretical ecology. Opportunities for field research are available in Africa, Central America, and other parts of the world, as well as in local ecosystems, including the Cedar Creek Ecosystem Science Reserve and Itasca Biological Station. Seminars and individually designed tutorials are an important part of student programs and provide an exciting intellectual environment.

Program Delivery
This program is available:
- via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission
Other requirements to be completed before admission:
Courses in inorganic chemistry, organic chemistry, biochemistry, general physics, one year of college calculus, animal biology, genetics, physiology, and plant biology are strongly recommended and provide an important background to pursue graduate work in EEB. Proficiency in a foreign language is not required but is strongly recommended for students who expect to pursue field work in a country where English is not the native language. Deficiencies must be made up early in the graduate program.

Special Application Requirements:
Students are admitted only in fall semester. Deadline for application is December 1. Refer to the EEB website for more details.

International applicants must submit score(s) from one of the following tests:
- TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
  - Paper Based - Total Score: 550
- IELTS
  - Total Score: 6.5
- MELAB
  - Final score: 80

Key to test abbreviations (TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.
Program Requirements
24 credits are required in the major.
24 thesis credits are required.

This program may be completed with a minor.

Use of 4xxx courses towards program requirements is not permitted.

A minimum GPA of 3.00 is required for students to remain in good standing.

At least 2 semesters must be completed before filing a Degree Program Form.

Significant field or laboratory experience, proficiency in using computers in research, and competence in advanced statistics are required. Students are expected to gain some appreciation of history or philosophy of science and are required to teach a minimum of two semesters at 50 percent time. Course plans are discussed and agreed upon by the student and an advisory committee of three to five faculty members.

Required EEB Coursework
Take the following courses for a total of 13 credits:
EEB 8150 - EEB Lab Tours (1.0 cr)
EEB 8151 - EEB Lab Tours (1.0 cr)
EEB 8201 - Graduate Foundations in Ecology, Evolution and Behavior Semester 1 (4.0 cr)
EEB 8202 - Graduate Foundations in Ecology, Evolution and Behavior - Semester 2 (4.0 cr)
EEB 8301 - Prelim Proposal Writing Seminar (1.0 cr)
EEB 8302 - EEB Written Prelim Workshop (1.0 cr)
EEB 8500 - NSF GRF Graduate Research Fellowship Proposal Writing Seminar (1.0 cr)

Elective Coursework
Select at least 11 elective credits, in consultation with the advisor. Electives may include courses in statistics or history of science if additional background is needed.
Take 0 - 24 course(s) totaling 11 - 24 credit(s) including 0 - 24 sub-requirements(s) from the following:
- EEB 5068 - Plant Physiological Ecology (3.0 cr)
- EEB 5221 - Molecular Evolution (3.0 cr)
- EEB 5322 - Evolution and Animal Cognition (3.0 cr)
- EEB 5327 - Behavioral Ecology (3.0 cr)
- EEB 5371 - Principles of Systematics (3.0 cr)
- EEB 5407 - Ecology (3.0 cr)
- EEB 5409 - Evolution (3.0 cr)
- EEB 5601 - Limnology (3.0 cr)
- EEB 5605 - Limnology Laboratory (2.0 cr)
- EEB 5609 - Ecosystem Ecology (3.0 cr)
- EEB 8100 - EEB Department Seminar (1.0 cr)
- EEB 8200 - Sustainability Science Distributed Graduate Seminar (3.0 cr)
- EEB 8360 - Behavioral Biology Seminar (1.0 cr)
- EEB 8601 - Introduction to Stream Restoration (3.0 cr)
- EEB 8602 - Stream Restoration Practice (2.0 cr)
- EEB 8641 - Spatial Ecology (3.0 cr)
- EEB 8980 - Seminar on Current Topics (1.0 - 3.0 cr)
- EEB 8990 - Graduate Seminar (1.0 - 3.0 cr)
- BIOL 8100 - Improvisation for Scientists (1.0 cr)
- EEB 8991 - Independent Study: Ecology, Evolution, and Behavior (1.0 - 10.0 cr)
- EEB 8994 - Directed Research (1.0 - 5.0 cr)

Courses outside of EEB
Courses from the following, or other coursework selected in consultation with the advisor, may be used to fulfill the 24-credit minimum requirement.
Take 0 - 24 course(s) totaling 0 - 24 credit(s) including exactly 0 sub-requirements(s) from the following:
- AQRO 5121 - Applied Experimental Design (4.0 cr)
- BIOL 8100 - Improvisation for Scientists (1.0 cr)
- DSSC 8111 - Approaches to Knowledge and Truth: Ways of Knowing in Development Studies and Social Change (3.0 cr)
- EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
- FW 8051 - Statistical Modeling of Ecological Data using R and WinBugs/JAGS (4.0 cr)
- HSCI 5211 - Biology and Culture in the 19th and 20th Centuries [CIV] (3.0 cr)
• HSCI 5242 - Navigating a Darwinian World (3.0 cr)
• HSCI 5244 - Nature's History: Science, Humans, and the Environment (3.0 cr)
• HSCI 8920 - Seminar: History of Biological Sciences (3.0 cr)
• PA 5701 - Science and State (3.0 cr)
• PA 5721 - Energy Systems and Policy (3.0 cr)
• PHIL 5602 - Scientific Representation and Explanation (3.0 cr)
• PHIL 8620 - Seminar: Philosophy of the Biological Sciences (3.0 cr)
• PUBH 6450 - Biostatistics I (4.0 cr)
• STAT 5101 - Theory of Statistics I (4.0 cr)
• STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
• STAT 5302 - Applied Regression Analysis (4.0 cr)
• STAT 5303 - Designing Experiments (4.0 cr)
• STAT 5601 - Nonparametric Methods (3.0 cr)
• FNRM 5262 - Remote Sensing and Geospatial Analysis of Natural Resources and Environment (3.0 cr)
• BIOL 5272 - Applied Biostatistics (4.0 cr)
• HSCI 8112 - Historiography of Science, Technology, and Medicine (3.0 cr)
• TH 5950 - Topics in Theatre (1.0 - 4.0 cr)

Ethics requirement
A four-session ethics seminar offered during the Friday Noon Seminar series. Required areas of ethics include: Academic and Research Community; Authorship; Peer Review and Research Conduct.

Thesis Credits
Take 24 doctoral thesis credits.
EEB 8888 - Thesis Credit: Doctoral (1.0 - 24.0 cr)

Joint- or Dual-degree Coursework: JD/PhD-Ecology, Evolution, and Behavior
Student may take a total of 12 credits in common among the academic programs.
Twin Cities Campus
Microbial Ecology Minor
College of Biological Sciences - Adm
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
Microbial Ecology Minor Program, University of Minnesota, 439 Borlaug Hall, 191 Upper Buford Circle, Saint Paul, MN 55108 (612-624-2706)
Email: micecol@umn.edu

- Program Type: Graduate free-standing minor
- Requirements for this program are current for Fall 2018
- Length of program in credits (Masters): 6
- Length of program in credits (Doctorate): 12
- This program does not require summer semesters for timely completion.

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

This minor is available to master's (M.S.) and doctoral (Ph.D.) students. Microbial ecology is an interdisciplinary research area concerned with the relationships between microorganisms and their natural environment. The microbial ecology minor offers core coursework in microbiology, microbial physiology, microbial genetics, microbial genomics, microbial ecology, ecology, and theoretical ecology. Additional courses and opportunities to interact with others interested in microbial ecology are also part of the minor. The microbial ecology/biotechnology seminar series allows students and faculty to interact with microbial ecologists from other universities. The curriculum encourages interdisciplinary interaction, communication, and synthesis.

Program Delivery
This program is available:
- via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission
Other requirements to be completed before admission:
To be admitted to the minor, a student must be admitted to a master's or doctoral degree-granting program within the Graduate School, should have broad training in the biological sciences, and must be accepted by the director of graduate studies of the microbial ecology minor program. All students are expected to have had the equivalent of introductory microbiology (MICB 3301) and general ecology, but may fulfill deficiencies in these areas by taking these courses while in the program.

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

Program Requirements
Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

The master's minor requires 6 graduate credits, all of which must be outside the student's major department and must include at least one laboratory course in microbiology (e.g., MICB 4215) and one ecology (EEB) course chosen from the list below. The remaining courses also are chosen from this list with the guidance and approval of the director of graduate studies.

The doctoral minor requires 12 graduate credits, 9 credits of which must come from the core courses listed below (contact the director of graduate studies for potential alternatives to these courses). The remaining credits must come from at least two courses chosen from this list, but may not be in the student's major.

Core courses:
EEB 5053 (4 cr)
MICB 4111 (3 cr)
MICB 4121 (3 cr)
MICA 8002 (4 cr)
Additional courses
CE 8541
CE 8542
CE 8551
EEB 4601
EEB 4609
PLPA 8102
PLPA 8103
SOIL 5515
SOIL 5611
Twin Cities Campus
Microbial Engineering M.S.
BioTechnology Institute
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
M.S. Program in Microbial Engineering, University of Minnesota, 1479 Gortner Avenue, Suite 140, Saint Paul, MN 55108 (612-624-6774; fax 612-625-5780)
Email: mice@umn.edu
Website: http://www.bti.umn.edu/MicE

- Program Type: Master's
- Requirements for this program are current for Fall 2018
- Length of program in credits: 30
- This program does not require summer semesters for timely completion.
- Degree: Master of Science

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

Microbial engineering allows students to pursue an interdisciplinary program that combines microbiology, biochemistry, molecular biology, bioinformatics, chemical engineering, and related sciences. Students perform brief rotations in faculty laboratories to choose an independent project, and tailor their coursework to support and complement their research. Projects can span modern basic microbiology, applied industrial engineering, as well as include computer science and informatics disciplines. After graduation, many students choose to continue on to a PhD program in a related discipline or work directly in biotechnology research and development. Supporting courses are chosen from fields including biochemistry, microbiology, food science, genetics and cell biology, and computer science. The program is coordinated by the BioTechnology Institute (BTI) and involves faculty from 10 departments and 5 institutes of the University.

Program Delivery
This program is available:
• via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission
The preferred undergraduate GPA for admittance to the program is 3.00.

Science or Engineering Discipline
N/A

Other requirements to be completed before admission:
Typically, applicants with a bachelor's degree in biological sciences, biochemistry, chemistry, or chemical engineering or related engineering disciplines apply. Recommended academic preparation includes one year each of calculus, organic chemistry, physics, microbiology, and a background in a field such as basic chemical engineering, biology, physical chemistry, or genetics. Background deficiencies can be made up during the first year of graduate work. Most students enter the program with a GPA of 3.00 or higher.

Special Application Requirements:
Three letters of recommendation, scores from the General Test of the GRE, the TOEFL score for international applicants, transcripts, Curriculum Vitae, and an autobiographical statement including occupational goals must be submitted to the director of graduate studies. Applications are accepted for fall semester only. To receive full consideration for financial aid, students must apply for fall semester admission by January 14.

Applicants must submit their test score(s) from the following:
• GRE

International applicants must submit score(s) from one of the following tests:
• TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
Key to test abbreviations (GRE, TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

Program Requirements

Plan A: Plan A requires 14 major credits, 6 credits outside the major, and 10 thesis credits. The final exam is oral.

Plan B: Plan B requires 24 major credits and 6 credits outside the major. The final exam is oral.

This program may not be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

MicE Requirements

All students are required to sign up for the following courses:

- MicE 5355 (1 Credit during winter break with special registration) and MicE 8990 (1 Credit per semester) Attendance is MANDATORY for two semesters. Two credits are needed for graduation.
- MICE 5355 - Advanced Fermentation and Biocatalysis Laboratory (1.0 cr)
- MICE 8990 - Biotechnology Seminar (1.0 - 3.0 cr)

Computer Proficiency Requirement

Students are required to show evidence of competence in using computers and a practical working knowledge of at least one computer language such as Pascal, Fortran, python, scripting, or statistical packages appropriate to their area of interest. Experience and competence may be obtained by passing a semester of basic computer use and programming courses, or submitting evidence that Equivalent courses of study have been completed elsewhere. (One course upper level required.)

- BIOL 5272 - Applied Biostatistics (4.0 cr)
  or CSCI 5421 - Advanced Algorithms and Data Structures (3.0 cr)

Plan Options

Plan A

Take at least 14 additional course credits, in consultation with the advisor, and 10 thesis credits (MICE 8777).

Thesis Credits

Take at least 10 master's thesis credits.

- MICE 8777 - Thesis Credits: Master's (1.0 - 18.0 cr)

RELATED ELECTIVES

A maximum of 9 credits of 4000-level coursework is allowed. Additional courses can be used with the approval of the director of graduate studies.

Take 14 or more credits from the following:

- BBE 4713 - Biological Process Engineering (3.0 cr)
- BBE 5713 - Biological Process Engineering (3.0 cr)
- BIOC 4125 - Laboratory in Molecular Biology and Biotechnology (3.0 cr)
- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
- BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
- BIOC 5309 - Biocatalysis and Biodegradation (3.0 cr)
- BIOC 5352 - Biotechnology and Bioengineering for Biochemists (3.0 cr)
- BIOC 5361 - Microbial Genomics and Bioinformatics (3.0 cr)
- BIOC 5527 - Introduction to Modern Structural Biology (4.0 cr)
- BIOC 5xxx
- BIOC 8084 - Research and Literature Reports (1.0 cr)
Plan A

Take 24 additional credits, in consultation with the advisor.

RELATED ELECTIVES

Take 24 or more credit(s) from the following:

- BBE 4713 - Biological Process Engineering (3.0 cr)
- BBE 5713 - Biological Process Engineering (3.0 cr)
- BIOC 4125 - Laboratory in Molecular Biology and Biotechnology (3.0 cr)
- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
- BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
- BIOC 5352 - Biotechnology and Bioengineering for Biochemists (3.0 cr)
- BIOC 5361 - Microbial Genomics and Bioinformatics (3.0 cr)
- BIOC 5527 - Introduction to Modern Structural Biology (4.0 cr)
- BIOC 5xxx
- BIOC 8084 - Research and Literature Reports (1.0 cr)
- BIOL 4003 - Genetics (3.0 cr)
- BIOL 4004 - Cell Biology (3.0 cr)
- CHEN 5751 - Biochemical Engineering (3.0 cr)
- CHEN 5xxx
- CHEN 8754 - Systems Analysis of Biological Processes (3.0 cr)
- CHEN 8xxx
- FSCN 4121 - Food Microbiology (3.0 cr)
- FSCN 4122 - Food Fermentations and Biotechnology (2.0 cr)
- FSCN 4332 - Food Processing Operations (3.0 cr)
- GCD 5036 - Molecular Cell Biology (3.0 cr)
- GCD 8131 - Advanced Molecular Genetics and Genomics (3.0 cr)
- GCD 8151 - Cellular Biochemistry and Cell Biology (2.0 - 4.0 cr)
- MICB 4131 - Immunology (3.0 cr)
- MICB 4151 - Molecular and Genetic Bases for Microbial Diseases (3.0 cr)
- MICB 4171 - Biology, Genetics, and Pathogenesis of Viruses (3.0 cr)
- MICB 4215 - Advanced Laboratory: Microbial Physiology and Diversity (3.0 cr)
- MICB 4235 - Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3.0 cr)
- MICE 5035 - Personal Microbiome Analysis (3.0 cr)
- MICE 5xxx
- MICE 8920 - Teaching Practicum (1.0 cr)
- MICE 8xxx
- PMB 8123 - Research Ethics in the Plant and Environmental Sciences (0.5 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)

-OR-

Plan B

Take 24 additional credits, in consultation with the advisor.

RELATED ELECTIVES

Take 24 or more credit(s) from the following:

- BBE 4713 - Biological Process Engineering (3.0 cr)
- BBE 5713 - Biological Process Engineering (3.0 cr)
- BIOC 4125 - Laboratory in Molecular Biology and Biotechnology (3.0 cr)
- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
- BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
- BIOC 5352 - Biotechnology and Bioengineering for Biochemists (3.0 cr)
- BIOC 5361 - Microbial Genomics and Bioinformatics (3.0 cr)
- BIOC 5527 - Introduction to Modern Structural Biology (4.0 cr)
- BIOC 5xxx
- BIOC 8084 - Research and Literature Reports (1.0 cr)
- BIOL 4003 - Genetics (3.0 cr)
- BIOL 4004 - Cell Biology (3.0 cr)
- CHEN 5751 - Biochemical Engineering (3.0 cr)
- CHEN 5xxx
- CHEN 8754 - Systems Analysis of Biological Processes (3.0 cr)
- CHEN 8xxx
- FSCN 4121 - Food Microbiology (3.0 cr)
- FSCN 4122 - Food Fermentations and Biotechnology (2.0 cr)
- FSCN 4332 - Food Processing Operations (3.0 cr)
- GCD 5036 - Molecular Cell Biology (3.0 cr)
- GCD 8131 - Advanced Molecular Genetics and Genomics (3.0 cr)
- GCD 8151 - Cellular Biochemistry and Cell Biology (2.0 - 4.0 cr)
- MICB 4131 - Immunology (3.0 cr)
- MICB 4151 - Molecular and Genetic Bases for Microbial Diseases (3.0 cr)
- MICB 4215 - Advanced Laboratory: Microbial Physiology and Diversity (3.0 cr)
- MICB 4235 - Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3.0 cr)
- MICE 5035 - Personal Microbiome Analysis (3.0 cr)
- MICE 5xxx
- MICE 8920 - Teaching Practicum (1.0 cr)
- PMB 8123 - Research Ethics in the Plant and Environmental Sciences (0.5 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)
Twin Cities Campus
Plant and Microbial Biology M.S.
Plant and Microbial Biology
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
Plant and Microbial Biology Graduate Program, 1479 Gortner Avenue, Suite 140, St. Paul, MN 55108 (612-625-4222; fax: 612-625-1738)
Email: pmb@umn.edu
Website: https://cbs.umn.edu/academics/departments/pmb/graduate-education

- Program Type: Master's
- Requirements for this program are current for Fall 2018
- Length of program in credits: 30
- This program does not require summer semesters for timely completion.
- Degree: Master of Science

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

Plant and microbial biology encompasses all aspects of plant and microbial life, from molecular biology to genomics to ecosystem science. Students study plants from the subcellular and molecular to the whole plant and community levels of biological organization. They also have opportunities for laboratory and field research at state, national, and international levels. Each student's program is planned to meet individual requirements within the framework of a multidisciplinary core of coursework.

Program Delivery
This program is available:
• via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission
The preferred undergraduate GPA for admittance to the program is 3.00.

Special Application Requirements:
Students are admitted to the M.S. program only under special arrangement with a faculty advisor. The deadline to apply is December 1. Refer to the Plant and Microbial Biology website for full details on application requirements and procedures: https://cbs.umn.edu/academics/departments/pmb/graduate-education.

Applicants must submit their test score(s) from the following:
• GRE

International applicants must submit score(s) from one of the following tests:
• TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
• IELTS
  - Total Score: 6.5
• MELAB
  - Final score: 80

Key to test abbreviations (GRE, TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

Program Requirements
Plan A: Plan A requires 14 major credits, 6 credits outside the major, and 10 thesis credits. The final exam is oral.
Plan B: Plan B requires 24 major credits and 6 credits outside the major. The final exam is oral.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

A minimum GPA of 3.00 is required for students to remain in good standing.

At least 1 semesters must be completed before filing a Degree Program Form.

The MS is offered under both Plan A (with thesis) and Plan B (without thesis). Plan A requires 20 course credits in the major and 10 thesis credits. Plan B requires 30 course credits in the major and one to three research papers, which may be written in conjunction with graduate courses. Significant field or laboratory experience and competence in statistics, to include hypothesis testing, regression, and correlation are required. Degree programs are planned by the student and an advisory committee of three faculty members to meet the student's interests and needs.

Core Coursework
All students take the following required courses, for a total of 6.5 credits. [Note: Take PMB 8900 three times (1 credit each time, for a total of 3 credits): section 001 (PMB colloquium), section 002 (Itasca orientation seminar), and section 003 (PMB graduate students seminar).]

- PMB 8081 - Integrative Plant Biology: Connecting Molecules to Ecosystems (3.0 cr)
- PMB 8123 - Research Ethics in the Plant and Environmental Sciences (0.5 cr)
- PMB 8900 - Seminar (1.0 - 2.0 cr)

Professional development requirement
Participate in at least one professional development activity. Options to fulfill this requirement include, but are not limited to: courses (e.g., GRAD 8101 Preparing Future Faculty, BIOL 8100 Improvisation for Scientists), workshops (e.g., career planning, research group management, teaching skills, leadership development), internships in industry.

Plan A and Plan B course options

Plan A
Take at least 13.5 credits of additional coursework, in consultation with the academic advisor and advisory committee, and with approval from the PMB Director of Graduate Studies (DGS), to complete the 20 course credits total (6.5 credits of required core coursework and 13.5 credits of electives/supporting courses) required for the Plan A master's degree. A maximum of two 4000-level courses is allowed.

Take 14 or more credit(s) from the following:
- PBS 8xxx
- PMB 4xxx
- PMB 5xxx
- AGRO 5xxx
- AGRO 8xxx
- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
- BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
- BIOC 5xxx
- BIOL 4003 - Genetics (3.0 cr)
- BIOL 4004 - Cell Biology (3.0 cr)
- PMB 4121 - Microbial Ecology and Applied Microbiology (3.0 cr)
- BIOL 5xxx
- BIOL 8100 - Improvisation for Scientists (1.0 cr)
- CSCI 5xxx
- EEB 5xxx
- EEB 8xxx
- FNRM 5xxx
- FNRM 8xxx
- GCD 5xxx
- GCD 8xxx
- GRAD 5xxx
- GRAD 8xxx
- HORT 5xxx
- HORT 8xxx
- MICB 4xxx
• PLPA 5xxx
• PLPA 8xxx
• STAT 5xxx
• STAT 8xxx

**Thesis Credits**

Take 10 master's thesis credits.

PMB 8777 - Thesis Credits: Master's (1.0 - 18.0 cr)

-OR-

**Plan B**

Take at least 23.5 credits of additional coursework, in consultation with the academic advisor and advisory committee, and with approval from the PMB Director of Graduate Studies (DGS), to complete the 30 course credits total (6.5 credits of required core coursework and 23.5 credits of electives/supporting courses) required for the Plan B master's degree. A maximum of two 4000-level courses is allowed.

Take 24 or more credit(s) from the following:

- PBS 8xxx
- PMB 4xxx
- PMB 5xxx
- AGRO 5xxx
- AGRO 8xxx
- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
- BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
- BIOC 5xxx
- BIOL 4003 - Genetics (3.0 cr)
- BIOL 4004 - Cell Biology (3.0 cr)
- PMB 4121 - Microbial Ecology and Applied Microbiology (3.0 cr)
- BIOL 5xxx
- BIOL 8100 - Improvisation for Scientists (1.0 cr)
- CSCI 5xxx
- EEB 5xxx
- EEB 8xxx
- FNRM 5xxx
- FNRM 8xxx
- GCD 5xxx
- GCD 8xxx
- GRAD 5xxx
- GRAD 8xxx
- HORT 5xxx
- HORT 8xxx
- MICB 4xxx
- PLPA 5xxx
- PLPA 8xxx
- STAT 5xxx
- STAT 8xxx
Plant and Microbial Biology Minor

Plant and Microbial Biology
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
Plant and Microbial Biology Graduate Program, 1479 Gortner Avenue, Suite 140, St. Paul, MN 55108 (612-625-4222)
Email: pmb@umn.edu
Website: https://cbs.umn.edu/academics/departments/pmb/graduate-education

• Program Type: Graduate minor related to major
• Requirements for this program are current for Fall 2018
• Length of program in credits (Masters): 6
• Length of program in credits (Doctorate): 12
• This program does not require summer semesters for timely completion.

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

Plant and microbial biology encompasses all aspects of plant and microbial life, from molecular biology to genomics to ecosystem science. Students study plants from the sub-cellular and molecular to the whole plant and community levels of biological organization. They also have opportunities for laboratory and field research at state, national, and international levels. Each student's program is planned to meet individual requirements within the framework of a multidisciplinary core of coursework.

Program Delivery
This program is available:
• via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission

Special Application Requirements:
Refer to the Plant and Microbial Biology website for full details on application requirements and procedures: https://cbs.umn.edu/academics/departments/pmb/graduate-education.

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

Program Requirements
Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

Program Sub-plans
Students are required to complete one of the following sub-plans.
Students may not complete the program with more than one sub-plan.

Masters-level Minor
Take at least 6 credits, chosen in consultation with the Plant and Microbial Biology director of graduate studies.

Doctoral-level Minor
Take at least 12 credits, chosen in consultation with the Plant and Microbial Biology director of graduate studies.
Twin Cities Campus
Plant and Microbial Biology Ph.D.
Plant and Microbial Biology
College of Biological Sciences

Link to a list of faculty for this program.

Contact Information:
Plant and Microbial Biology Sciences Graduate Program, 1479 Gortner Avenue, Suite 140, St. Paul, MN 55108 (612-625-4222; fax: 612-625-1738)
Email: pmb@umn.edu
Website: https://cbs.umn.edu/academics/departments/pmb/graduate-education

- Program Type: Doctorate
- Requirements for this program are current for Fall 2018
- Length of program in credits: 54
- This program does not require summer semesters for timely completion.
- Degree: Doctor of Philosophy

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

Plant and microbial biology encompasses all aspects of plant and microbial life, from molecular biology to genomics to ecosystem science. Students study plants from the subcellular and molecular to the whole plant and community levels of biological organization. They also have opportunities for laboratory and field research at state, national, and international levels. Each student's program is planned to meet individual requirements within the framework of a multidisciplinary core of coursework.

Program Delivery
This program is available:
- via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission
The preferred undergraduate GPA for admittance to the program is 3.00.

Special Application Requirements:
Students are admitted only in fall semester. The deadline to apply is December 1. Refer to the Plant and Microbial Biology website for full details on application requirements and procedures: https://cbs.umn.edu/academics/departments/pmb/graduate-education.

Applicants must submit their test score(s) from the following:
- GRE

International applicants must submit score(s) from one of the following tests:
- TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
- IELTS
  - Total Score: 6.5
- MELAB
  - Final score: 80

Key to test abbreviations (GRE, TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

Program Requirements
10 to 18 credits are required in the major.
12 to 20 credits are required outside the major.
24 thesis credits are required.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

A minimum GPA of 3.0 is required for students to remain in good standing.

At least 1 semesters must be completed before filing a Degree Program Form.

Course plans are discussed and agreed upon by the student and an advisory committee of at least four faculty members. Students are expected to teach at least one semester at 50-percent time.

**Required Core Coursework**

Complete the following required courses, for a total of 9.5 credits. [Note: Take PMB 8900 three times (1 credit each time, for a total of 3 credits): section 001 (PMB colloquium), section 002 (Itasca orientation seminar), and section 003 (PMB graduate students seminar). Take one credit of PMB 8994 in fall semester of the first year.]

- PMB 8081 - Integrative Plant Biology: Connecting Molecules to Ecosystems (3.0 cr)
- PMB 8123 - Research Ethics in the Plant and Environmental Sciences (0.5 cr)
- PMB 8900 - Seminar (1.0 - 2.0 cr)
- PMB 8901 - Preparation of Research Proposals (2.0 cr)
- PMB 8994 - Research (1.0 - 5.0 cr)

**Electives/Supporting Courses**

Take at least 20.5 credits of additional coursework, in consultation with the academic advisor and advisory committee, and with approval from the PMB director of graduate studies (DGS), to complete the 30 course credits total (9.5 credits of required core coursework and 20.5 credits of electives/supporting courses) required for the doctoral degree. A maximum of two 4000-level courses is allowed.

Take 21 or more credit(s) from the following:

- AGRO 5xxx
- AGRO 8xxx
- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
- BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
- BIOC 5xxx
- BIOL 4003 - Genetics (3.0 cr)
- BIOL 4004 - Cell Biology (3.0 cr)
- PMB 4121 - Microbial Ecology and Applied Microbiology (3.0 cr)
- BIOL 5xxx
- BIOL 8100 - Improvisation for Scientists (1.0 cr)
- CSCI 5xxx
- EEB 5xxx
- EEB 8xxx
- FNRM 5xxx
- FNRM 8xxx
- GCD 5xxx
- GCD 8xxx
- GRAD 5xxx
- GRAD 8xxx
- HORT 5xxx
- HORT 8xxx
- MICB 4xxx
- PLPA 5xxx
- PLPA 8xxx
- PMB 4xxx
- PMB 5xxx
- PMB 8xxx
- STAT 5xxx
- STAT 8xxx

**Professional development requirement**

Participate in at least one professional development activity. Options to fulfill this requirement include, but are not limited to: courses (e.g., GRAD 8101 Preparing Future Faculty, APSC 8124 Professional Skills for Plant Scientists, BIOL 8100 Improvisation for Scientists), workshops (e.g., career planning, research group management, teaching skills, writing skills, leadership development), internships in industry.
Required Doctoral Thesis Credits
Take at least 24 doctoral thesis credits.

PMB 8888 - Thesis Credit: Doctoral (1.0 - 24.0 cr)