Twin Cities Campus

Genetics, Cell Biology, and Development B.S.

Genetics, Cell Biology, and Development TCBS

College of Biological Sciences

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2021
- Required credits to graduate with this degree: 120
- Required credits within the major: 73 to 84
- Degree: Bachelor of Science

The program genetics, cell biology, and development (GCD) focuses 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 BS 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 Delivery

This program is available:

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

Admission Requirements

A GPA above 2.0 is preferred for the following:

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

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

General Requirements

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

Program Requirements

At least 18 upper division credits in the major must be taken at the University of Minnesota Twin Cities campus.

Foundational Courses

Nature of Life/Nature of Science and Research

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

Foundations of Biology

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

Quantitative Requirements

MATH 1241 - Calculus and Dynamical Systems in Biology [MATH] (4.0 cr)
or MATH 1271 - Calculus I [MATH] (4.0 cr)
or MATH 1371 - CSE Calculus I [MATH] (4.0 cr)
or MATH 1571H - Honors Calculus I [MATH] (4.0 cr)
Take 1 or more course(s) from the following:
•CSCI 1133 - Introduction to Computing and Programming Concepts (4.0 cr)

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•CSCI 1133H - Honors Introduction to Computing and Programming Concepts (4.0 cr)
•CSCI 3003 - Introduction to Computing in Biology (3.0 cr)
•MATH 1272 - Calculus II (4.0 cr)
•MATH 1572H - Honors Calculus II (4.0 cr)
•MATH 2241 - Mathematical Modeling of Biological Systems (3.0 cr)
•STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
•BIOL 3272 - Applied Biostatistics (4.0 cr)
or BIOL 3272H - Applied Biostatistics (4.0 cr)
or BIOL 5272 - Applied Biostatistics (4.0 cr)

Chemistry

Track 1: Preferred CBS Chemistry Sequence

CHEM 1081 - Chemistry for the Life Sciences I [PHYS] (3.0 cr)
CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
CHEM 1082 - Chemistry for the Life Sciences II (3.0 cr)
CHEM 1086 - Chemistry for the Life Sciences II Laboratory (1.0 cr)
CHEM 2081 - Chemistry for the Life Sciences III (3.0 cr)
CHEM 2085 - Chemistry for the Life Sciences III Laboratory (2.0 cr)

or **Track 2**

This track is allowable for students entering CBS with previous chemistry credit or for whom space is not available in the preferred track. Students should speak with a CBS academic advisor to determine eligibility for this track.

CHEM 1061 - Chemical Principles I [PHYS] (3.0 cr)
CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
CHEM 1062 - Chemical Principles II [PHYS] (3.0 cr)
CHEM 1066 - Chemical Principles II Laboratory [PHYS] (1.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
CHEM 2302 - Organic Chemistry II (3.0 cr)

or **Track 2 (Honors Option)**

This track is allowable for CBS honors students.

CHEM 1071H - Honors Chemistry I [PHYS] (3.0 cr)
CHEM 1075H - Honors Chemistry I Laboratory [PHYS] (1.0 cr)
CHEM 1072H - Honors Chemistry II [PHYS] (3.0 cr)
CHEM 1076H - Honors Chemistry II Laboratory [PHYS] (1.0 cr)
CHEM 2331H - Honors Elementary Organic Chemistry I (3.0 cr)
CHEM 2332H - Honors Elementary Organic Chemistry II (3.0 cr)

Physics

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

Molecular and Cellular Biology

BIOL 3015 - Molecular Biology (2.0 cr)
or BIOL 3025 - Molecular Biology and Society [TS] (3.0 cr)
BIOC 3022 - Biochemistry for Life Scientists (3.0 cr)
or BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
BIOL 4003 - Genetics (3.0 cr)
BIOL 4004 - Cell Biology (3.0 cr)
or GCD 4005W - Cell Biology-Writing Intensive [WI] (4.0 cr)

Ecology, Evolution, and Biodiversity

Courses cannot fulfill both the ecology, evolution, and biodiversity requirements and a major elective requirement.
Take 2 or more course(s) from the following:

Organismal Biology

Take 1 or more course(s) from the following:
•GCD 4161 - Developmental Biology (3.0 cr)
•MICB 3301 - Biology of Microorganisms (5.0 cr)
•PMB 3007W - Plant, Algal, and Fungal Diversity and Adaptation [WI] (4.0 cr)
•PMB 3002 - Plant Biology: Function (2.0 cr)
PMB 3005W - Plant Function Laboratory [WI] (2.0 cr)
•BIOL 3211 - Physiology of Humans and Other Animals (3.0 cr)
BIOL 2005 - Animal Diversity Laboratory (2.0 cr)

•**Ecology, Evolution, and Behavior**

Take 1 or more course(s) from the following:
- EEB 3807 - Ecology (4.0 cr)
- EEB 3811W - Animal Behavior in the Field [WI] (4.0 cr)
- EEB 3407 - Ecology (3.0 cr)
- EEB 3408W - Ecology [WI] (4.0 cr)
- EEB 3411 - Introduction to Animal Behavior (3.0 cr)
- EEB 3412W - Introduction to Animal Behavior, Writing Intensive [WI] (4.0 cr)
- EEB 3409 - Evolution (3.0 cr)
  or EEB 5409 - Evolution (3.0 cr)
- EEB 3534 - Biodiversity Science: The origins, maintenance, consequences, detection & assessment of biodiversity [ENV] (3.0 cr)
  or EEB 5534 - Biodiversity Sci: The origins, maintenance, consequences, detection and assessment of biodiversity [ENV] (3.0 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 4171 cannot count in more than one area. To count as an elective lab, directed research must be completed for a minimum of 3 credits; credits can be split over multiple terms using 4994, 4794W, or a combination of the two. Students may use a maximum of seven credits of directed research toward a CBS degree.

Take 15 or more credit(s) from the following:

Elective Labs

Take 1 or more course(s) from the following:
- BIOC 4025W - Laboratory in Biochemistry [WI] (2.0 cr)
- BIOC 4125 - Laboratory in Molecular Biology and Biotechnology (3.0 cr)
- GCD 3485 - Bioinformatic Analysis: Introduction to the Computational Characterization of Genes and Proteins (4.0 cr)
- GCD 3486 - Personal Genome Analysis (3.0 cr)
- GCD 4025 - Cell Biology, Development & Regeneration Laboratory (3.0 cr)
- GCD 4111 - Histology: Cell and Tissue Organization (4.0 cr)
- GCD 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- GCD 4994 - Directed Research (1.0 - 7.0 cr)
- GCD 5005 - Computer Programming for Biology (3.0 cr)
- GCD 5111 - Quantitative Fluorescence Microscopy (3.0 cr)
- MICB 4225W - Advanced Laboratory: Microbial Genetics [WI] (3.0 cr)
- MICB 4235 - Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3.0 cr)

- **Genetics**

Take 0 - 3 course(s) from the following:
- EEB 5042 - Quantitative Genetics (3.0 cr)
- GCD 3485 - Bioinformatic Analysis: Introduction to the Computational Characterization of Genes and Proteins (4.0 cr)
- GCD 3486 - Personal Genome Analysis (3.0 cr)
- GCD 4034 - Molecular Genetics and Genomics (3.0 cr)
- GCD 4143 - Human Genetics and Genomics (3.0 cr)
- GCD 4151 - Molecular Biology of Cancer (3.0 cr)
- GCD 4161 - Developmental Biology (3.0 cr)
- GCD 4171 - Stem Cells in Biology and Medicine (3.0 cr)
- MICB 4171 - Biology, Genetics, and Pathogenesis of Viruses (3.0 cr)

- **Cell Biology**

Take 0 - 3 course(s) from the following:
- GCD 4111 - Histology: Cell and Tissue Organization (4.0 cr)
- GCD 4171 - Stem Cells in Biology and Medicine (3.0 cr)
- GCD 5036 - Molecular Cell Biology (3.0 cr)
- MICB 4131 - Immunology (3.0 cr)
- NSCI 3101 - Neurobiology I: Molecules, Cells, and Systems (3.0 cr)
- PMB 4516W - Plant Cell Biology: Writing Intensive [WI] (3.0 cr)
  or PMB 5516 *{Inactive}*(3.0 cr)

- **Developmental Biology**

Take 0 - 3 course(s) from the following:
- GCD 4151 - Molecular Biology of Cancer (3.0 cr)
- GCD 4161 - Developmental Biology (3.0 cr)
- GCD 4171 - Stem Cells in Biology and Medicine (3.0 cr)
- NSCI 4101 - Development of the Nervous System: Cellular and Molecular Mechanisms (3.0 cr)

- **Additional Electives**

Take 0 - 4 credit(s) from the following:
- BIOC 4025W - Laboratory in Biochemistry [WI] (2.0 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 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)

•BIOC 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•BIOC 4993 - Directed Studies (1.0 - 7.0 cr)
•BIOC 4994 - Directed Research (1.0 - 7.0 cr)
•BIOC 5352 - Biotechnology and Bioengineering for Biochemists (3.0 cr)
•BIOL 3211 - Physiology of Humans and Other Animals (3.0 cr)
•BIOL 3272 - Applied Biostatistics (4.0 cr)
•BIOL 3503 - Biology of Aging (2.0 cr)
•BIOL 3600 - Directed Instruction (1.0 - 2.0 cr)
•BIOL 3696 - Internship: Professional Experience in Biological Sciences (1.0 - 3.0 cr)
•BIOL 3700 - Special Topics in Biology (1.0 - 3.0 cr)
•BIOL 4201 - Teaching in the Biology Laboratory (1.0 cr)
•BIOL 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
•BIOL 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•BIOL 4950 - Special Topics in Biology (1.0 - 4.0 cr)
•BIOL 4993 - Directed Studies (1.0 - 7.0 cr)
•BIOL 4994 - Directed Research (1.0 - 7.0 cr)
•BIOL 5409 *{Inactive}*(3.0 cr)
•BIOL 5950 - Special Topics (1.0 - 4.0 cr)
•EEB 3407 - Ecology (3.0 cr)
•EEB 3408W - Ecology [WI] (4.0 cr)
•EEB 3411 - Introduction to Animal Behavior (3.0 cr)
•EEB 3412W - Introduction to Animal Behavior, Writing Intensive [WI] (4.0 cr)
•EEB 3807 - Ecology (4.0 cr)
•EEB 3811W - Animal Behavior in the Field [WI] (4.0 cr)
•EEB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
•EEB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•EEB 4993 - Directed Studies (1.0 - 7.0 cr)
•EEB 4994 - Directed Research (1.0 - 6.0 cr)
•EEB 5042 - Quantitative Genetics (3.0 cr)
•EEB 5221 *{Inactive}*(3.0 cr)
•GCD 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
•GCD 4993 - Directed Studies (1.0 - 7.0 cr)
•MICB 3303 - Biology of Microorganisms (without laboratory) (3.0 cr)
•MICB 4131 - Immunology (3.0 cr)
•MICB 4151 - Molecular and Genetic Bases for Microbial Diseases (3.0 cr)
•MICB 4161W - Eukaryotic Microbiology [WI] (3.0 cr)
•MICB 4171 - Biology, Genetics, and Pathogenesis of Viruses (3.0 cr)
•MICB 4215 - Advanced Laboratory: Microbial Physiology and Diversity (3.0 cr)
•MICB 4225W - Advanced Laboratory: Microbial Genetics [WI] (3.0 cr)
•MICB 4235 - Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3.0 cr)
•MICB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
•MICB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•MICB 4993 - Directed Studies (1.0 - 7.0 cr)
•MICB 4994 - Directed Research (1.0 - 7.0 cr)
•MICE 5035 - Personal Microbiome Analysis (3.0 cr)
•NSCI 3001W - Neuroscience and Society [CIV, WI] (4.0 cr)
•NSCI 3101 - Neurobiology I: Molecules, Cells, and Systems (3.0 cr)
•NSCI 3102W - Neurobiology II: Perception and Behavior [WI] (3.0 cr)
•NSCI 4101 - Development of the Nervous System: Cellular and Molecular Mechanisms (3.0 cr)
•NSCI 4105 - Neurobiology Laboratory I (3.0 cr)
•NSCI 4150 - Advanced Topics in Neuroscience (3.0 cr)
•NSCI 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 6.0 cr)
•NSCI 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•NSCI 4993 - Directed Studies (1.0 - 7.0 cr)
•NSCI 4994 - Directed Research (1.0 - 6.0 cr)
•PHCL 4001 - Mechanisms of Drug Action (2.0 cr)
•PHCL 5111 - Pharmacogenomics (3.0 cr)
•PMB 3002 - Plant Biology: Function (2.0 cr)
•PMB 3005W - Plant Function Laboratory [WI] (2.0 cr)
•PMB 3007W - Plant, Algal, and Fungal Diversity and Adaptation [WI] (4.0 cr)
•PMB 4111 - Microbial Physiology and Diversity (3.0 cr)
•PMB 4121 - Microbial Ecology and Applied Microbiology (3.0 cr)
•PMB 4131 - Prokaryotic Genetics (3.0 cr)
•PMB 4412 - Plant Physiology and Development (3.0 cr)
•PMB 4516W - Plant Cell Biology: Writing Intensive [WI] (3.0 cr)
•PMB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)

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- PMB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- PMB 4993 - Directed Studies (1.0 - 7.0 cr)
- PMB 4994 - Directed Research (1.0 - 7.0 cr)
- PMB 5412 - Plant Physiology and Development (3.0 cr)
- PMB 5516 *{Inactive}*(3.0 cr)
- MICB 3301 - Biology of Microorganisms (5.0 cr)
  or MICB 3303 - Biology of Microorganisms (without laboratory) (3.0 cr)
- BIOC 5444 - Muscle (3.0 cr)
  or PHSL 5444 - Muscle (3.0 cr)
- EEB 3409 - Evolution (3.0 cr)
  or EEB 5409 - Evolution (3.0 cr)
- PMB 3212 - Fungi - A Kingdom of Their Own (3.0 cr)
  or PMB 5212 - Fungi - A Kingdom of Their Own (3.0 cr)
- Take 0 - 1 course(s) from the following:
  - GCC 3xxx
  - GCC 5xxx

Upper Division Writing Intensive within the Major

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

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

- BIOC 4025W - Laboratory in Biochemistry [WI] (2.0 cr)
- BIOC 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- BIOC 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- BIOL 4321W - Deconstructing Research: Writing about Biological Research for Non-scientists [WI] (2.0 cr)
- BIOL 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- BIOL 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- COP 4793W - Writing Intensive Directed Studies [WI] (1.0 - 7.0 cr)
- COP 4794W - Writing Intensive Directed Research [WI] (1.0 - 7.0 cr)
- EEB 3408W - Ecology [WI] (4.0 cr)
- EEB 3412W - Introduction to Animal Behavior, Writing Intensive [WI] (4.0 cr)
- EEB 3811W - Animal Behavior in the Field [WI] (4.0 cr)
- EEB 4330W - Animal Communication [WI] (3.0 cr)
- EEB 4609W - Ecosystem Ecology [ENV, WI] (3.0 cr)
- EEB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- EEB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- GCD 4005W - Cell Biology-Writing Intensive [WI] (4.0 cr)
- GCD 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- GCD 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- MICB 4161W - Eukaryotic Microbiology [WI] (3.0 cr)
- MICB 4225W - Advanced Laboratory: Microbial Genetics [WI] (3.0 cr)
- MICB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- MICB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- NSCI 3001W - Neuroscience and Society [CIV, WI] (4.0 cr)
- NSCI 3102W - Neurobiology II: Perception and Behavior [WI] (3.0 cr)
- NSCI 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 6.0 cr)
- NSCI 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- PMB 3005W - Plant Function Laboratory [WI] (2.0 cr)
- PMB 3007W - Plant, Algal, and Fungal Diversity and Adaptation [WI] (4.0 cr)
- PMB 4516W - Plant Cell Biology: Writing Intensive [WI] (3.0 cr)
- PMB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- PMB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)

Program Sub-plans

A sub-plan is not required for this program.

Integrated BS/MPH-Environmental Health

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

The MPH program in the Division of Environmental Health Sciences emphasizes the scientific, technological, policy, and management skills required to address environmental health concerns. These concerns include investigating health hazards in our environment, protecting worker health, and establishing the basis for public health policy. The Division of Environmental Health is committed to

graduating professionals with interdisciplinary training, which includes practicing innovative problem solving, and gaining experience with a diversity of approaches and applications.

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

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

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

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