



### **Twin Cities Campus**

## **Integrative Biology and Physiology M.S.**

*Integrative Biology and Physiology*

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Integrative Biology and Physiology, Jackson Hall 6-125, 321 Church Street S.E., Minneapolis, MN 55455 (612-625-5902; fax: 612-625-5149)

Email: [ibpdept@umn.edu](mailto:ibpdept@umn.edu)

Website: <http://physiology.med.umn.edu/graduate-program/>

- Program Type: Master's
- Requirements for this program are current for Fall 2016
- 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.

Note: Students enter the Twin Cities M.S. program in integrative biology and physiology only for exceptional reasons. Most Twin Cities graduate work is performed at the Ph.D. level. See the Integrative Biology and Physiology Ph.D. program for more information.

The graduate programs in the Twin Cities have a cardiovascular emphasis, although other areas of specialization are represented.

On the Duluth campus, students can enroll in coursework and participate in research in several basic areas.

The program includes faculty and corresponding research laboratories from the Department of Integrative Biology and Physiology and also the Departments of Medicine; Surgery; Neuroscience; Neurosurgery; Biochemistry, Molecular Biology, and Biophysics; Pharmacology; Physical Medicine and Rehabilitation; Kinesiology; and Animal Science.

### **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.

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**

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



**Plan B:** Plan B requires 14 major credits and 6 credits outside the major. The final exam is oral. A capstone project is required.

**Capstone Project:** The Plan B project focuses on some aspect of Physiology. Plan B students complete a project under the direction of a faculty member and present the work to their faculty committee in an oral exam.

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.

Duluth campus: All course requirements for the M.S. degree can be completed on the Duluth campus. Students are expected to fulfill all degree requirements over a period of two to three calendar years. The program includes at least 20 credits in physiology and 6 credits in a minor or related field of study. Incoming students are encouraged to undertake at least two laboratory rotations in faculty research laboratories of their choice. Fulfillment of degree requirements also includes the presentation and defense of a thesis (Plan A). The final written examination and oral defense of the thesis takes place with participation of faculty from both campuses.

Twin Cities campus: Plan A or B degrees are awarded only in exceptional circumstances. A Plan A M.S. degree requires 14 credits in physiology and 6 credits outside of physiology. The degree is based on laboratory research off or on campus, and requires a written thesis or written project and an oral presentation of the work for the final exam. The M.S. degree is Plan A, unless there are special circumstances requiring a Plan B. For Plan B, the final exam is oral.



### **Twin Cities Campus**

## **Integrative Biology and Physiology Minor**

*Integrative Biology and Physiology*

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Integrative Biology and Physiology, Jackson Hall 6-125, 321 Church Street S.E., Minneapolis, MN 55455 (612-625-5902; fax: 612-301-1543)

Email: [ibpdept@umn.edu](mailto:ibpdept@umn.edu)

Website: <http://physiology.med.umn.edu/graduate-program/>

- Program Type: Graduate minor related to major
- Requirements for this program are current for Fall 2016
- 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.

Physiology may be defined as the application of mathematics, physics, and chemistry to the study of structure and function in living systems. As such, physiology is a "hybrid" field in which expertise from many other disciplines is ordinarily required and combined. The program emphasizes a quantitative approach to understanding the functions of cells, organs, and systems in living animals.

The graduate program in the Twin Cities has a cardiovascular emphasis, although many other areas of specialization are represented.

The program includes faculty and corresponding research laboratories from the Department of Integrative Biology and Physiology and also the Departments of Medicine; Surgery; Neuroscience; Neurosurgery; Biochemistry, Molecular Biology, and Biophysics; Pharmacology; Physical Medicine and Rehabilitation; Kinesiology; and Animal Science.

### **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:

For the minor, a background in mathematics, physics, chemistry, and biology acceptable to the graduate faculty is required.

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.

A minimum of 6 graduate credits in physiology is required (with approval by the director of graduate studies) for the master's minor. Ph.D. students seeking a doctoral minor are expected to take PHSL 5101 or the equivalent, plus additional courses for a total of 12 credits. Approval is required by the director of graduate studies.

### **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**



Doctoral



### **Twin Cities Campus**

## **Integrative Biology and Physiology Ph.D.**

*Integrative Biology and Physiology*

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Integrative Biology and Physiology, Jackson Hall 6-125, 321 Church Street SE, Minneapolis, MN 55455 (612-625-5902; fax: 612-301-1543)

Email: [ibpdept@umn.edu](mailto:ibpdept@umn.edu)

Website: <http://z.umn.edu/ibpgradprog>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- Length of program in credits: 60
- 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.

Physiology may be defined as the application of mathematics, physics, and chemistry to the study of structure and function in living systems. As such, physiology is a "hybrid" field in which expertise from many other disciplines is ordinarily required and combined.

The program emphasizes a quantitative approach to understanding the functions of cells, organs, and systems in living animals. PhD students take a core concentration that provides a broad background in the physiology of membranes, cells, transport, and organ systems. Individualized programs are structured to build on the student's strengths and to fill in gaps that would otherwise be an impediment to specific problem solving. Teaching experience is also available to all students.

The graduate program in the Twin Cities has a cardiovascular emphasis, although many other areas of specialization are represented.

Students can enter the PhD program from the Twin Cities or Duluth campus. Highly qualified individuals with solid quantitative backgrounds are encouraged to apply. In the Twin Cities, prospective students also include people with previous medical training who are already at the University of Minnesota or are considering the University of Minnesota Medical School for residency or fellowship training.

Entering PhD students are expected to take a series of laboratory rotations to familiarize themselves with active areas of research within the degree program. The program includes faculty and corresponding research laboratories from the Department of Integrative Biology and Physiology and also the Departments of Medicine; Surgery; Neuroscience; Neurosurgery; Biochemistry, Molecular Biology, and Biophysics; Pharmacology; Physical Medicine and Rehabilitation; Kinesiology; and Animal Science.

### **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 3.50.

Other requirements to be completed before admission:

An undergraduate degree with at least one year (three quarters or two semesters) of calculus, one year of physics, one year of biology, and two years of chemistry is required. For the minor, a background in mathematics, physics, chemistry and biology acceptable to the graduate faculty is required.

#### **Special Application Requirements:**

For the Ph.D., applicants must take either the General Test of the GRE or the Medical College Admission Test. In addition, all applicants need three letters of recommendation. Admission to the program begins in the Fall semester.

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.

12 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 3.00 is required for students to remain in good standing.

At least 4 semesters must be completed before filing a Degree Program Form.

The PhD program requires courses in cellular physiology and medical physiology. Coursework is tailored to the student's interests with input from the director of graduate studies and the student's advisor. During the first year, students rotate through three laboratories, attend weekly seminars, choose an advisor, and begin a research project. A preliminary written exam in physiology is given after the first year and examines the ability of the student to apply concepts learned in core courses. By the end of the second year, students have completed their coursework including a grant-writing class, and selected a laboratory for their thesis research. A preliminary oral exam is given at the end of the second year and tests the student's ability to apply principles of both physiology and the minor or supporting program to a proposed research-based thesis. A minimum of 12 credits must be completed in the minor field or supporting program.

### Required Coursework

Take all of the coursework from the following list. Take 2 to 8 credits of PHSL 8294 (Lab Rotation), and 2 to 8 credits of PHSL 5096 (Seminar). Take PHSL 8232 (Journal Club) in conjunction with PHSL 5101.

[ANSC 5700](#) - Cell Physiology (4.0 cr)

[PHSL 8294](#) - Research in Physiology (1.0 - 18.0 cr)

[PHSL 5096](#) - Integrative Biology and Physiology Research Advances (1.0 cr)

[PHSL 5101](#) - Human Physiology (5.0 cr)

[PHSL 8232](#) - Critical Reading of Journal Articles in Physiology (2.0 cr)

[BIOC 8401](#) - Ethics, Public Policy, and Careers in Molecular and Cellular Biology (1.0 cr)

[PHSL 8242](#) - Professional Skills Development For Biomedical Scientists (1.0 cr)

[PHSL 5701](#) - Physiology Laboratory (1.0 - 2.0 cr)

### Molecular Biology/Genetics Options

Take at least 3 credits of molecular biology/genetics coursework, chosen in consultation with the advisor.

[BIOL 4003](#) - Genetics (3.0 cr)

or [BIOL 4004](#) - Cell Biology (3.0 cr)

or [BIOC 4331](#) - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)

or [BIOC 4332](#) - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)

or [BIOC 6021](#) - Biochemistry (3.0 cr)

### Biostatistics Options

Take at least 3 credits of biostatistics coursework, chosen in consultation with the advisor.

[STAT 5021](#) - Statistical Analysis (4.0 cr)

or [PUBH 6450](#) - Biostatistics I (4.0 cr)

or [PUBH 6451](#) - Biostatistics II (4.0 cr)

### Outside Coursework



Take at least 12 credits of coursework outside the major, in consultation with the advisor.

[BMEN 5001](#) - Advanced Biomaterials (3.0 cr)

or [BMEN 5041](#) - Tissue Engineering (3.0 cr)

or [BMEN 5101](#) - Advanced Bioelectricity and Instrumentation (3.0 cr)

or [BMEN 5351](#) - Cell Engineering (3.0 cr)

or [CMB 8344](#) - Mechanisms of Hormone Action (2.0 cr)

or [GCD 4134](#) - Endocrinology (3.0 cr)

or [NSC 5540](#) - Survey of Biomedical Neuroscience (2.0 cr)

or [PHSL 4021](#) - Advanced Physiology and Bioengineering: Bionic Human (3.0 cr)

or [PHSL 5095](#) - Problems in Physiology (1.0 - 5.0 cr)

or [PHSL 5197](#) - Stress Physiology (1.0 cr)

or [PHSL 5444](#) - Muscle (3.0 cr)

or [PHSL 5510](#) - Advanced Cardiac Physiology and Anatomy (2.0 - 3.0 cr)

or [PHSL 5525](#) - Anatomy and Physiology of the Pelvis and Urinary System (1.0 - 2.0 cr)

or [PHSL 8222](#) - Central Regulation of Autonomic Function (3.0 cr)

#### **Thesis Credits**

Take 24 credits of doctoral thesis credits.

[PHSL 8888](#) - Thesis Credit: Doctoral (1.0 - 24.0 cr)



### **Twin Cities Campus**

## **Medical Physics M.S.**

*Radiation Oncology Administration, Radiology*

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

University of Minnesota Medical School, Department of Radiation Oncology, Mayo Mail Code 494, 420 Delaware Street S.E., Minneapolis, MN 55455 (phone: 612-626-6154; fax: 612-626-7060)

Email: [gerbi001@umn.edu](mailto:gerbi001@umn.edu)

Website: <http://www.med.umn.edu/trad/GraduateProgram/home.html>

- Program Type: Master's
- Requirements for this program are current for Fall 2016
- Length of program in credits: 30
- This program does not require summer semesters for timely completion.
- no
- 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 program is made up of faculty members with primary appointments in departments that include radiation oncology, radiology, physics, engineering, computer science, physiology, dentistry, and biochemistry. In addition to providing clinical experience in areas such as radiation oncology, radiation safety and quality assurance, the program is active in research and provides graduate level training in medical physics. The goal of the program is to prepare students (1) for further education, teaching, and research in medical physics, (2) to qualify to enter a medical physics residency program in radiation oncology or diagnostic radiology, and (3) to provide the mathematical and technical knowledge needed to succeed in the increasingly complex field of medical physics.

### **Accreditation**

This program is accredited by Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP)

### **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 2.80.

A degree in physics or engineering or other physical science. Equivalent of an undergraduate physics minor-at least 2 semesters of calculus based physics and at least 3 upper level physics courses.

Other requirements to be completed before admission:

All students should have some familiarity with physical chemistry, intermediate physics, intermediate mathematics, biostatistics, computer programming, biology, physiology, and biochemistry. This may be demonstrated by coursework completed at the undergraduate level or as part of the graduate program; by reading or practical experience; or by informal competency examinations.

#### **Special Application Requirements:**

Three letters of recommendation are required. The General Test of the GRE is required. The computer based GRE exam is provided year -round by the Educational Testing Service. A list of test sites can be found at: <http://www.ets.org/gre>. Our institution code is R6874 with no department code. If the GRE was taken more than two years prior to application, the applicant will need to retake the examination. We have no absolute GRE cutoff score, but the score is taken into consideration among many individual factors in the evaluation of each application. Applicants are considered for admission in both semesters.

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

**Plan B:** Plan B requires 30 major credits and 0 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.

A minimum GPA of 2.8 is required for students to remain in good standing.

The M.S. is offered under one plan. Plan B students complete a project under the direction of a faculty member/advisor, submit a written document to their oral exam committee, and defend their work in front of the committee.

### Required Courses M.S.

- [MPHY 5170](#) - Basic Radiological Physics (3.0 cr)
- [PHYS 5401](#) - Physiological Physics (4.0 cr)
- [MPHY 5138](#) - Research Seminar (1.0 - 5.0 cr)
- [MPHY 5173](#) - Medical and Health Physics of Radiation Therapy (3.0 cr)
- [PHYS 5402](#) - Radiological Physics (4.0 cr)
- [PHAR 5201](#) - Applied Health Sciences Terminology (2.0 cr)
- [MPHY 5171](#) - Medical and Health Physics of Imaging I (3.0 cr)
- [MPHY 5172](#) - Radiation Biology (3.0 cr)
- [MPHY 5174](#) - Medical and Health Physics of Imaging II (3.0 cr)
- [MPHY 5139](#) - Seminar and Journal Club (1.0 cr)

### Medical Physics Electives

Other electives as advised.

- [MPHY 5177](#) - Radiation Therapy Physics Lab: Radiation Physics Basics (3.0 cr)
- or [MPHY 8149](#) - Advanced Topics in Radiation Therapy Physics (2.0 cr)
- or [MPHY 8148](#) - Advanced Digital Imaging Science (3.0 cr)
- or [MPHY 8147](#) - Advanced Physics of Magnetic Resonance Imaging (MRI) (3.0 cr)

### ADDITIONAL REQUIREMENTS (NOT FOR CREDIT)

In the fall semester of their first year, students must take the University ethics training: Responsible Conduct of Research (RCR), Parts 1 (a 3-hour session offered about 4 times/year) and 2.



### **Twin Cities Campus**

## **Medical Physics Ph.D.**

*Radiation Oncology Administration, Radiology*

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Therapeutic Radiology, Dept of MMC 494 Mayo 8494A 420 Delaware St SE Minneapolis, MN 55455

Email: [gerbi001@umn.edu](mailto:gerbi001@umn.edu)

Website: <http://www.med.umn.edu/trad/GraduateProgram/home.html>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- Length of program in credits: 48
- This program does not require summer semesters for timely completion.
- no
- 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 program is made up of faculty members with primary appointments in departments that include radiation oncology, radiology, physics, engineering, computer science, physiology, dentistry, and biochemistry. In addition to providing clinical experience in areas such as radiation oncology, radiation oncology, radiation safety and quality assurance, the program is active in research and provides graduate level training in medical physics. The goal of the program is to prepare students (1) for further education, teaching, and research in medical physics, (2) to qualify to enter a medical physics residency program in radiation oncology or diagnostic radiology, and (3) to provide the mathematical and technical knowledge needed to succeed in the increasingly complex field of medical physics.

### **Accreditation**

This program is accredited by Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP)

### **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.

A degree in physics or engineering or other physical science. Equivalent of an undergraduate physics minor-at least 2 semesters of calculus based physics and at least 3 upper level physics courses.

Other requirements to be completed before admission:

All students should have some familiarity with physical chemistry, intermediate physics, intermediate mathematics, biostatistics, computer programming, biology, physiology, and biochemistry. This may be demonstrated by coursework completed at the undergraduate level or as part of the graduate program; by reading or practical experience; or by informal competency examinations.

#### **Special Application Requirements:**

Three letters of recommendation are required. The General Test of the GRE is required. The computer based GRE exam is provided year -round by the Educational Testing Service. A list of test sites can be found at: <http://www.ets.org/gre>. Our institution code is R6874 with no department code. If the GRE was taken more than two years prior to application, the applicant will need to retake the examination. We have no absolute GRE cutoff score, but the score is taken into consideration among many individual factors in the evaluation of each application. Applicants are considered for admission in both semesters.

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

48 credits are required in the major.

0 credits are required outside the major.

24 thesis credits are required.

This program may not 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.

Ph.D. students take preliminary written exams at the end of the first year of study or as soon as possible after completing the core course sequence in topics in physics for medicine and biology. An oral preliminary exam focuses on the plan for thesis research and the student's grasp of related information and is taken by the fall of the third year of full-time registration or its equivalent. Additionally, 24 thesis credits are required.

### Required Courses

- [MPHY 5170](#) - Basic Radiological Physics (3.0 cr)
- [PHYS 5401](#) - Physiological Physics (4.0 cr)
- [MPHY 5138](#) - Research Seminar (1.0 - 5.0 cr)
- [MPHY 5173](#) - Medical and Health Physics of Radiation Therapy (3.0 cr)
- [PHYS 5402](#) - Radiological Physics (4.0 cr)
- [PHAR 5201](#) - Applied Health Sciences Terminology (2.0 cr)
- [MPHY 5171](#) - Medical and Health Physics of Imaging I (3.0 cr)
- [MPHY 5172](#) - Radiation Biology (3.0 cr)
- [MPHY 5174](#) - Medical and Health Physics of Imaging II (3.0 cr)
- [MPHY 5177](#) - Radiation Therapy Physics Lab: Radiation Physics Basics (3.0 cr)
- [MPHY 8149](#) - Advanced Topics in Radiation Therapy Physics (2.0 cr)
- [MPHY 5139](#) - Seminar and Journal Club (1.0 cr)

### Medical Physics Electives

Electives will be based on focus of program objectives with advisor.

- [MPHY 8148](#) - Advanced Digital Imaging Science (3.0 cr)
- or [MPHY 8147](#) - Advanced Physics of Magnetic Resonance Imaging (MRI) (3.0 cr)
- or Other electives as advised.

### ADDITIONAL REQUIREMENTS (NOT FOR CREDIT)

In the fall semester of their first year, students must take the University ethics training: Responsible Conduct of Research (RCR), Parts 1 (a 3-hour session offered about 4 times/year) and 2.



### **Twin Cities Campus**

## **Microbiology, Immunology, and Cancer Biology M.S.**

Medical School - Adm

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Microbiology and Immunology, 689 23rd Avenue SE, Minneapolis, MN 55455, 612-624-5947

Email: [micab@umn.edu](mailto:micab@umn.edu)

Website: <http://micab.umn.edu>

- Program Type: Master's
- Requirements for this program are current for Fall 2016
- 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.

Note: Students are not admitted directly into the master's program; it is available only by special arrangement with the program.

Students prepare for careers in biomedical research and teaching by completing broad training in molecular biology or biological sciences, and focused specialization in one of three concentrations (microbiology, immunology, or cancer biology). The program offers exceptional research opportunities for graduate training in autoimmunity, biotechnology, cancer biology and therapy, environmental microbiology, genetic engineering of microorganisms, lymphocyte activation and development, microbial pathogenesis, molecular genetics of disease, tumor immunology, vaccine development, and vascular biology and inflammation.

### **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 3.50.

Applicants must have a bachelor's degree (B.S. preferred).

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: 96
  - Paper Based - Total Score: 600
- IELTS
  - Total Score: 7
- MELAB
  - Final score: 85

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 12 to 18 major credits, 6 credits outside the major, and 10 thesis credits. The final exam is written and 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.

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.

Students are not admitted directly into the master's program; it is available only by special arrangement with the program. Students complete 14 MICA course credits, 6 credits in the minor or related field, and 10 thesis credits. Students must write and defend a thesis based on original research.



### **Twin Cities Campus**

## **Microbiology, Immunology, and Cancer Biology Minor**

Medical School - Adm

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Microbiology and Immunology, 690 23rd Avenue SE, Minneapolis, MN 55455, 612-624-5947

Email: [micab@umn.edu](mailto:micab@umn.edu)

Website: <http://micab.umn.edu>

- Program Type: Graduate minor related to major
- Requirements for this program are current for Fall 2016
- Length of program in credits (Masters): 8
- Length of program in credits (Doctorate): 12
- This program does not require summer semesters for timely completion.
- No

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.

Students prepare for careers in biomedical research and teaching by completing broad training in molecular biology or biological sciences, and focused specialization in one of three concentrations (microbiology, immunology, or cancer biology). The program offers exceptional research opportunities for graduate training in autoimmunity, biotechnology, cancer biology and therapy, environmental microbiology, genetic engineering of microorganisms, lymphocyte activation and development, microbial pathogenesis, molecular genetics of disease, tumor immunology, vaccine development, and vascular biology and inflammation.

### **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 3.50.

Applicants must have a bachelor's degree (B.S. preferred).

Other requirements to be completed before admission:

Required courses include calculus, general chemistry, organic chemistry, and physics. A minimum of two upper-level biology courses, which may include biochemistry, genetics, cell biology, molecular biology, microbiology, or immunology, etc. are also required.

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: 96

Key to [test abbreviations](#)(GRE, TOEFL).

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.

Students enrolled in a University master's or doctoral program are eligible for the MICaB minor. Requirements for the master's- and doctoral-level MICaB minor include: completion of 8 MICaB credits from 2 of the following 4-credit courses: MICA 8002, MICA 8003, MICA 8004; and the approval of the MICaB director of graduate studies. Doctoral students must also complete at least 4, but no more



than 10, additional MICAB credits in consultation with the MICaB director of graduate studies.

**MICaB minor requirements**

Minimum requirement of 12-18 credits to include: two or three of the following MICa 8002, 8003 or 8004; and other MICa 8000-level 2, 3 or 4 credit courses to total 12-18 credits (excluding MICa 8012).

**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

**Course Group 0**

Doctoral



### **Twin Cities Campus**

## **Microbiology, Immunology, and Cancer Biology Ph.D.**

Medical School - Adm

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Microbiology, Immunology and Cancer Biology PhD Program, 689 23rd Avenue SE, Room 1-109, University of Minnesota, Minneapolis, MN 55455

612-624-5947

Email: [micab@umn.edu](mailto:micab@umn.edu)

Website: <http://micab.umn.edu>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- 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.

Students prepare for careers in biomedical research and teaching by completing broad training in molecular biology or biological sciences, and focused specialization in one of three concentrations (microbiology, immunology, or cancer biology). The program offers exceptional research opportunities for graduate training in autoimmunity, biotechnology, cancer biology and therapy, environmental microbiology, genetic engineering of microorganisms, lymphocyte activation and development, microbial pathogenesis, molecular genetics of disease, tumor immunology, vaccine development, and vascular biology and inflammation.

### **Accreditation**

This program is accredited by NA

### **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 3.50.

Applicants must have a bachelor's degree (BS preferred).

Other requirements to be completed before admission:

Required courses include calculus, general chemistry, organic chemistry, and physics. A minimum of two upper-level biology courses, which may include biochemistry, genetics, cell biology, molecular biology, microbiology, or immunology, etc., are also required.

Research experience is required. Relevant undergraduate experience includes honors thesis work, paid or volunteer work in a research laboratory and summer internships. It does not include laboratory courses that accompany science courses such as biology. Postbaccalaureate research experience is preferred but not required.

#### **Special Application Requirements:**

The program evaluates applications based on four equally weighted criteria: academics (GPA and GRE scores), letters (3) of recommendation, a personal statement, and research experience. The average GPA and GRE scores of accepted applicants are typically 3.50 and 80th percentile, respectively (no GRE Subject Test is required). Letters of recommendation from research advisers or mentors are preferred as these individuals can comment knowledgeably on the student's potential in biomedical research. Applicants' personal statements should describe their research in general and their specific contribution to it, their rationale for seeking a doctoral degree, and any information they wish to share regarding their backgrounds and interest in the MICaB Program. Finally, applicants should provide specific details of their research experiences (project titles, mentors, dates, locations, etc.), along with a list of relevant abstracts, publications, etc.

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: 96
  - Paper Based - Total Score: 600
- IELTS
  - Total Score: 7
- MELAB
  - Final score: 85

The preferred English language test is Test of English as Foreign Language

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

11 to 12 credits are required in the major.  
12 to 13 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 3.00 is required for students to remain in good standing.

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

Beginning study in the fall, students spend their first year on major coursework, identifying an advisor by doing laboratory rotations, selecting a focus area, and initiating their thesis research project. In the fall semester of their second year, all students take MICA 8012, which highlights the integrated nature of the three foci and helps prepare the students for their written and oral qualifying examinations (taken in the spring semester of the second year). Students also take courses that support studies in their focus area during their first two years.

In addition to coursework and research, students have opportunities to participate in laboratory meetings, journal clubs, and student research seminars, and to assist in laboratory courses. Most students complete the PhD in five years.

### Required Coursework

Take 8 credits from the following list. Take MICA 8094 during the fall and spring semesters of the first year for a total of 2 credits. While students are required to take only one of the three core courses (MICA 8002, 8003, and 8004), they are encouraged to take all three.

- MICA 5000 - Practicum: Teaching (0.0 cr)
- MICA 8002 - Structure, Function, and Genetics of Bacteria and Viruses (4.0 cr)
- MICA 8003 - Immunity and Immunopathology (4.0 cr)
- MICA 8004 - Cellular and Cancer Biology (4.0 cr)
- MICA 8012 - Writing and Reviewing a Research Proposal (2.0 cr)
- MICA 8094 - Research in Microbiology, Immunology, and Cancer Biology (1.0 cr)
- MICA 8910 - Seminar: Faculty Research Topics (0.0 cr)
- MICA 8920 - Seminar: Student Research Topics (0.0 cr)

### Focus Area and Elective Coursework

Take one 3-credit, 5xxx-level or higher focus area science course in the first and second years. Select a focus area course from the following list, or another course related to the area of interest. MICA 8002, 8003 or 8004 can be used as a focus area course, if not taken as a required course. Elective courses also can be chosen from this list or selected in consultation with the advisor. No more than one 4xxx-level course can be applied towards credit requirements.

Take 16 or more credit(s) from the following:

- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 5352 - Biotechnology and Bioengineering for Biochemists (3.0 cr)



- [BIOC 5361](#) - Microbial Genomics and Bioinformatics (3.0 cr)
- [BIOC 5960](#) - Special Topics in Biochemistry (3.0 cr)
- [BIOC 8001](#) - Biochemistry: Structure, Catalysis, and Metabolism (3.0 cr)
- [BIOC 8002](#) - Molecular Biology and Regulation of Biological Processes (3.0 cr)
- [BIOC 8216](#) - Signal Transduction and Gene Expression (3.0 cr)
- [BTHX 5610](#) - Research & Publication Seminar (1.0 cr)
- [CHEM 8412](#) - Chemical Biology of Enzymes (4.0 cr)
- [CHEN 8754](#) - Systems Analysis of Biological Processes (3.0 cr)
- [CHEN 8995](#) - Special Topics (1.0 - 4.0 cr)
- [CSCI 5481](#) - Computational Techniques for Genomics (3.0 cr)
- [CSCI 5980](#) - Special Topics in Computer Science (1.0 - 3.0 cr)
- [ESCI 4801](#) - Geomicrobiology (3.0 cr)
- [GCD 5005](#) - Computer Programming for Cell Biology (3.0 cr)
- [GCD 6103](#) - Human Histology (3.0 - 8.0 cr)
- [GCD 8008](#) - Mammalian Gene Transfer and Expression (2.0 cr)
- [GCD 8073](#) - Advanced Human Genetics (3.0 cr)
- [GCD 8131](#) - Advanced Molecular Genetics and Genomics (3.0 cr)
- [GCD 8151](#) - Cell Structure and Function (3.0 cr)
- [GCD 8161](#) - Advanced Developmental Biology (3.0 cr)
- [GCD 8920](#) - Special Topics (2.0 cr)
- [GEOG 8260](#) - Seminar: Physical Geography (2.0 cr)
- [GRAD 5102](#) - Preparation for University Teaching for Nonnative English Speakers (2.0 cr)
- [GRAD 8101](#) - Teaching in Higher Education (3.0 cr)
- [GRAD 8200](#) - Teaching and Learning Topics in Higher Education (1.0 cr)
- [HINF 5502](#) - Programming Essentials Python 3 (1.0 cr)
- [LAAS 5311](#) - Soil Chemistry and Mineralogy (3.0 cr)
- [MICA 8009](#) - Biochemical Aspects of Normal and Abnormal Cell Growth and Cell Death (2.0 cr)
- [MICA 8010](#) - Microbial Pathogenesis (3.0 cr)
- [MICA 8011](#) - Current Topics in Immunology (3.0 cr)
- [MICA 8013](#) - Translational Cancer Research (2.0 cr)
- [MICA 8014](#) - Small RNA Biology (2.0 cr)
- [MICA 8371](#) - Mucosal Immunobiology (3.0 cr)
- [PHCL 5111](#) - Pharmacogenomics (3.0 cr)
- [PHSL 8242](#) - Professional Skills Development For Biomedical Scientists (1.0 cr)
- [PUBH 6182](#) - Emerging Infectious Disease: Current Issues, Policies, and Controversies (3.0 cr)
- [PUBH 6341](#) - Epidemiologic Methods I (3.0 cr)
- [PUBH 6450](#) - Biostatistics I (4.0 cr)
- [PUBH 7445](#) - Statistics for Human Genetics and Molecular Biology (3.0 cr)
- [SCB 8181](#) - Stem Cell Biology (3.0 cr)
- [VMED 5180](#) - Ecology of Infectious Disease (3.0 cr)

#### Thesis Credits

Take at least 24 doctoral thesis credits.

[MICA 8888](#) - Thesis Credit: Doctoral (1.0 - 24.0 cr)



**Twin Cities Campus**

## Neuroscience M.S.

Neuroscience

Medical School

Link to a [list of faculty](#) for this program.

**Contact Information:**

Department of Neuroscience, 6-145 Jackson Hall, 321 Church Street S.E., Minneapolis, MN 55455 (612-626-6474; fax: 612-626-6460)

Email: [neurosci@umn.edu](mailto:neurosci@umn.edu)

Website: <http://www.neuroscience.umn.edu>

- Program Type: Master's
- Requirements for this program are current for Fall 2016
- Length of program in credits: 48
- 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.

Neuroscience is an interdisciplinary field of inquiry. The objects of this inquiry, the brain and nervous system, are sufficiently complex and unique among biological systems to require experimental and analytical approaches that cross the traditional boundaries of molecular and cell biology, behavioral biology, biochemistry, genetics, pharmacology, physiology, and psychology. In some instances, neuroscientific inquiry may also encompass computer science, information processing, engineering, physics, and mathematics.

### 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

**Plan A:** Plan A requires 26 major credits, 12 credits outside the major, and 10 thesis credits. 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 4 semesters must be completed before filing a Degree Program Form.

The course requirements for a master's degree are the same as those for a Ph.D. degree. See the Program Requirements of the Neuroscience Ph.D.



**Twin Cities Campus**

## Neuroscience Minor

Neuroscience

Medical School

Link to a [list of faculty](#) for this program.

**Contact Information:**

Department of Neuroscience, 6-145 Jackson Hall, 321 Church Street S.E., Minneapolis, MN 55455 (612-626-6474; fax: 612-626-6460)

Email: [neurosci@umn.edu](mailto:neurosci@umn.edu)

Website: <http://www.neuroscience.umn.edu>

- Program Type: Graduate minor related to major
- Requirements for this program are current for Fall 2016
- Length of program in credits (Doctorate): 16
- 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.

Neuroscience is an interdisciplinary field of inquiry. The objects of this inquiry, the brain and nervous system, are sufficiently complex and unique among biological systems to require experimental and analytical approaches that cross the traditional boundaries of molecular and cell biology, behavioral biology, biochemistry, genetics, pharmacology, physiology, and psychology. In some instances, neuroscientific inquiry may also encompass computer science, information processing, engineering, physics, and mathematics.

### 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.

A doctoral minor program is developed in consultation with the director of graduate studies for neuroscience. Students are required to take one of the following core courses.

Function/Structure: NSC 5561 - Systems Neuroscience (4 cr) or

Cellular/Molecular: NSC 5461 - Cellular and Molecular Neuroscience (4 cr)

In addition, students are required to take elective neuroscience courses for a total minimum of 12 credits (including the core courses).



### *Twin Cities Campus*

## Neuroscience Ph.D.

Neuroscience

### Medical School

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Neuroscience, 6-145 Jackson Hall, 321 Church Street SE, Minneapolis, MN 55455 (612-626-6474; fax: 612-626-6460)

Email: [neurosci@umn.edu](mailto:neurosci@umn.edu)

Website: <http://www.neuroscience.umn.edu>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- Length of program in credits: 51
- This program requires 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.

Neuroscience is an interdisciplinary field of inquiry. The objects of this inquiry, the brain and nervous system, are sufficiently complex and unique among biological systems to require experimental and analytical approaches that cross the traditional boundaries of molecular and cell biology, behavioral biology, biochemistry, genetics, pharmacology, physiology, and psychology. In some instances, neuroscientific inquiry may also encompass computer science, information processing, engineering, physics, and mathematics.

## Program Delivery

This program is available:

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

## Prerequisites for Admission

#### **Special Application Requirements:**

Applicants are required to take the GRE General Test. Students whose native language is not English are required to take the TOEFL and obtain a minimum score of 625 (paper) or 107 (Internet); or obtain 6.5 on the IELTS examination. There are no minimum GPA or GRE score requirements to apply.

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: 107
  - Paper Based - Total Score: 625
- IELTS
  - Total Score: 6.5

The preferred English language test is Test of English as Foreign Language

Key to [test abbreviations](#)(GRE, TOEFL, IELTS).

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

## Program Requirements

21 credits are required in the major.

6 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 3.00 is required for students to remain in good standing.

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

The neuroscience PhD curriculum begins in the summer session with the intensive laboratory course in cellular and molecular neurobiology (NSC 5551), held at the Itasca Biological Station and Laboratories.

The core curriculum continues on the Twin Cities campus with NSC 5461, 5561, 5661, and 8211. While taking these courses, students explore research opportunities in the faculty's laboratories and thereby select a thesis advisor.

Students will also participate in journal clubs (NSC 8320) to discuss work in the field of Neuroscience. Elective courses totaling 6 credits are required and selected in consultation with the advisor.

Students with sufficient background and previous course experience may apply for a waiver of specific requirements. A student, if they so choose, must take at least 12 elective credits to receive a minor (typical minors include cell biology, physiology, statistics, and psychology). Students are also expected to participate in teaching neuroscience and to attend the weekly colloquiums, as well as neuroscience seminars and sessions devoted to professional development. Students are strongly encouraged to attend seminars in other areas and departments that may interest them.

#### **Summer - First Year**

NSC 5551: Cell & Molecular Neurobiology Lab at Itasca (4 cr)

#### **Fall - First Year**

NSC 5461: Cellular & Molecular Neuroscience (4 cr)

NSC 5561: Systems Neuroscience (4 cr)

NSC 8321: Career Skills and Understanding Responsibilities as a Neuroscientist (0.5 cr)

#### **Spring - First Year**

NSC 5661: Behavioral Neuroscience (3 cr)

NSC 8211: Developmental Neurobiology (3 cr)

NSC 8320: Neuroscience Seminar Series Journal Club (Section 2) (1 cr)

NSC 8321: Career Skills and Understanding Responsibilities as a Neuroscientist (0.5 cr)

#### **Fall - Second Year**

NSC 8321: Career Skills and Understanding Responsibilities as a Neuroscientist (0.5 cr)

#### **Spring - Second Year**

NSC 8320: Neuroscience Seminar Series Journal Club (Section 2) (1 cr)

#### **Electives**

During the course of PhD studies, take at least 6 credits of electives. Electives are chosen in consultation with the advisor.



### **Twin Cities Campus**

## **Orthoptics Post-baccalaureate Certificate**

Ophthalmology

Medical School

Link to a [list of faculty](#) for this program.

### **Contact Information:**

Minnesota Lions Children's Eye Clinic  
(University of Minnesota Physicians and University of Minnesota Amplatz Children's Hospital)  
701 25th Ave S. Ste 300  
Minneapolis, MN 55454  
612-365-8365  
612-365-8351 (Fax)  
Email: [kmerrill@umphysicians.umn.edu](mailto:kmerrill@umphysicians.umn.edu)

- Program Type: Post-baccalaureate credit certificate/licensure/endorsement
- Requirements for this program are current for Fall 2016
- Length of program in credits: 14
- This program requires summer semesters for timely completion.
- Degree: Orthoptics PostBaccalaureate Certificate

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 Orthoptic Certificate program is a vital part of the ophthalmic health care profession. This is a specialized profession, the focus of which is the evaluation and treatment of disorders of vision, eye movements, and eye alignment in children and adults. The study of orthoptics follows a logical sequence of studies vital to the understanding of the visual system. The didactic education is integrated with practical clinical experience. Orthoptists work with ophthalmologists, eye physicians and surgeons, as part of the medical team. They are employed in a variety of settings, including university and teaching hospitals, children's hospitals, and solo or multi-specialty group medical practices. An orthoptist sees a variety of patients of all ages, although due to the nature of their visual disorders, the majority of the patients are young children; some individuals with multiple health concerns are also evaluated as they commonly have ocular/binocular problems. After completing an Orthoptic Certificate, a student earns national certification as an orthoptist through written and practical examinations administered by the American Orthoptic Council.

This program requires two semesters and a summer term of coursework.

### **Accreditation**

This program is accredited by American Association of Certified Orthoptists

### **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 2.00.

### **Required prerequisites**

#### **Course Group 0**

Other requirements to be completed before admission:

Requirements for entry into the Orthoptics Certificate Program include the following:

1. Completion of baccalaureate degree with GPA at least 2.0.
2. Successful completion of one year in a hospital/clinic-based ophthalmic technician training program (e.g., Regions Hospital)

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.

A minimum GPA of 2.8 is required for students to remain in good standing.

The 2.8 GPA requirement complies with University of Minnesota policy.

### Orthoptics Required Courses

[OPH 5501](#) - Orthoptics I (4.0 cr)

[OPH 5601](#) - Orthoptics II (5.0 cr)

[OPH 5701](#) - Orthoptics III (5.0 cr)

### Required Core

### Orthoptic Certificate



### *Twin Cities Campus*

## Otolaryngology Ph.D. Otol.

Otolaryngology

Medical School

Link to a [list of faculty](#) for this program.

### **Contact Information:**

Department of Otolaryngology, MMC 396, 420 Delaware Street SE, Minneapolis, MN 55455 (612-625-3200; fax: 612-625-2101)

Website: <http://www.ent.umn.edu>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- Length of program in credits: 55
- This program does not require summer semesters for timely completion.
- Degree: Doctor of Philosophy in Otolaryngology

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 program prepares students in both clinical and experimental aspects of otolaryngology. The Ph.D.Otol. degree requires a publishable thesis. Rotations at University of Minnesota Medical Center-Fairview, Minneapolis Veterans Administration Medical Center, Regions Hospital, Minneapolis Children's Hospital, and Hennepin County Medical Center provide a wide range of opportunity for clinical education and surgical experience.

Opportunities for independent research are provided in the laboratories of audiology, auditory electrophysiology, auditory neurophysiology, biochemistry, cancer biology, cell biology and genetics, electron microscopy, electrophysiology, histochemistry, morphometry, psychoacoustics, temporal bone pathology, tumor immunology, skin-flap physiology, laryngeal physiology, mandibular bone physiology, microvascular tissue transfer, and vestibular physiology. Graduates of the program have careers in teaching, research, and professional practice.

### **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:

Requires a bachelor's or master's degree, preferably in an area related to otolaryngology or, for those pursuing the degree in conjunction with a residency in otolaryngology, an MD degree.

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

### **Program Requirements**

19 credits are required in the major.

12 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 3.00 is required for students to remain in good standing.

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

The number of credits varies depending on preparation and the research undertaken. Most students take a total of about 55 credits. A minimum of 12 credits in the minor or supporting program, plus 24 doctoral thesis credits, are required. An advisory committee, including the student, the advisor, and the director of graduate studies, determines coursework in the major. At least one seminar is



selected from seminars such as OTOL 8247, 8248, 8249, and 8250. Understanding and application of basic statistics and experimental methodology are expected. Statistics coursework is usually necessary. Choice of statistics courses is made with the guidance of the director of graduate studies.

All students are expected to publish a research paper in a peer-reviewed journal. Students concurrently in an otolaryngology residency usually take five to six years to complete research, course, and dissertation requirements.



**Twin Cities Campus**

**Pharmacology M.S.**

Pharmacology

Medical School

Link to a [list of faculty](#) for this program.

**Contact Information:**

Department of Pharmacology, 6-120 Jackson Hall, 321 Church Street S.E., Minneapolis MN 55455 (612-625-9997; fax: 612-625-8408)

Email: [phclgrad@umn.edu](mailto:phclgrad@umn.edu)

Website: <http://www.pharmacology.med.umn.edu/graduate.html>

- Program Type: Master's
- Requirements for this program are current for Fall 2016
- Length of program in credits: 30 to 36
- 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.

Pharmacology is the study of the interactions of chemicals with biological systems. Courses and research training in biochemistry, biophysics, genetics, and molecular biology provide a solid foundation for performing original research in pharmacology, neuropharmacology, and cancer chemotherapy.

**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 3.50.

A four-year B.A. or B.S. degree (or its equivalent) in a basic science program is generally required.

Other requirements to be completed before admission:

Candidates for admission are evaluated on the basis of undergraduate record, GRE score, previous research experience, and letters of recommendation.

**Special Application Requirements:**

Applicants must submit scores from the General Test of the GRE; three letters of recommendation from persons familiar with their scholarship and research potential; a complete set of official transcripts; and a clearly written statement of career interests, goals, and objectives.

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: 100
  - Paper Based - Total Score: 600
- IELTS
  - Total Score: 7.5

The preferred English language test is Test of English as Foreign Language

Key to [test abbreviations](#)(GRE, TOEFL, IELTS).

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 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 oral. A capstone project is required.

**Capstone Project:** A research project approved by the advisor and Director of Graduate Studies.

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.

Students are required to maintain a GPA of 3.00. Students who fail to maintain this standard must petition the Director of Graduate Studies for permission to remain in the program.



**Twin Cities Campus**

## Pharmacology Minor

Pharmacology

Medical School

Link to a [list of faculty](#) for this program.

**Contact Information:**

Department of Pharmacology, 6-120 Jackson Hall, 321 Church Street S.E., Minneapolis MN 55455 (612-625-9997; fax: 612-625-8408)

Email: [phclgrad@umn.edu](mailto:phclgrad@umn.edu)

Website: <http://www.pharmacology.med.umn.edu/graduate.html>

- Program Type: Graduate minor related to major
- Requirements for this program are current for Fall 2016
- Length of program in credits (Masters): 9
- 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.

Pharmacology is the study of the interactions of chemicals with biological systems. Courses and research training in biochemistry, biophysics, genetics, and molecular biology provide a solid foundation for performing original research in pharmacology, neuropharmacology, and cancer chemotherapy.

### 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 toward program requirements is permitted under certain conditions with adviser approval.

A master's minor requires a minimum of 9 credits in pharmacology approved by the director of graduate studies. A doctoral minor requires a minimum of 12 credits in pharmacology approved by the director of graduate studies. There are no special requirements (e.g., specific courses, written examination).



**Twin Cities Campus**

## Pharmacology Ph.D.

Pharmacology

Medical School

Link to a [list of faculty](#) for this program.

**Contact Information:**

Department of Pharmacology, 6-120 Jackson Hall, 321 Church Street S.E., Minneapolis MN 55455 (612-625-9997; fax: 612-625-8408)

Email: [phclgrad@umn.edu](mailto:phclgrad@umn.edu)

Website: <http://www.pharmacology.med.umn.edu/graduate.html>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- Length of program in credits: 48
- This program requires 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.

Pharmacology is the study of the interactions of chemicals with biological systems. Courses and research training in biochemistry, biophysics, genetics, and molecular biology provide a solid foundation for performing original research in pharmacology, neuropharmacology, and cancer chemotherapy.

## 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 3.50.

A four-year B.A. or B.S. degree (or its equivalent) in a basic science program is generally required.

Other requirements to be completed before admission:

Candidates for admission are evaluated on the basis of undergraduate record, GRE score, previous research experience, and letters of recommendation.

**Special Application Requirements:**

Applicants must submit scores from the General Test of the GRE; three letters of recommendation from persons familiar with their scholarship and research potential; a complete set of official transcripts; and a clearly written statement of career interests, goals, and objectives.

Applicants must submit scores from the General Test of the GRE, with scores above the 80th percentile in all categories preferred.

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: 100
  - Paper Based - Total Score: 600
- IELTS
  - Total Score: 7.5

The preferred English language test is Test of English as Foreign Language

Key to [test abbreviations](#)(GRE, TOEFL, IELTS).

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.

0 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 3.00 is required for students to remain in good standing.

Students are required to maintain a GPA of 3.00. Students who fail to maintain this standard must petition the Director of Graduate Studies for permission to remain in the program.

For more detailed information, contact the Director of Graduate Studies in Pharmacology.

**Joint- or Dual-degree Coursework:** Joint Degree Program in Law, Health and the Life Sciences. Student may take a total of 12 credits in common among the academic programs.



### **Twin Cities Campus**

## **Physical Therapy D.P.T.**

Rehabilitation Medicine Administration

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Program in Physical Therapy, MMC 388, 420 Delaware Street SE, Minneapolis, MN 55455, (612-624-2662; fax: 612-625-4274)

Email: [goebe005@umn.edu](mailto:goebe005@umn.edu)

Website: <http://physther.umn.edu>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- Length of program in credits: 141
- This program requires summer semesters for timely completion.
- Courses in this Program are taught on campus for the first 7 semesters, with numerous off-site clinic visits scheduled throughout semester 2-7. The remaining 2 semesters of the Program consist of 4 full-time clinical internships. These internships occur off-campus in physical therapy clinics.
- Degree: Doctor of Physical Therapy

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 physical therapy program, a division within the Department of Physical Medicine and Rehabilitation, offers a professional doctoral degree in physical therapy (D.P.T.). Physical therapy is a healthcare discipline involved with the study and rehabilitation of movement impairments such as muscular weakness, impaired coordination, joint stiffness, and pain, which can lead to functional problems affecting self care, employment, ambulation, etc. Graduates are prepared to promote proper health care and quality of living by maximizing human movement following disease or injury or by preventing its loss. The program requires three years of year-round, full-time graduate study. Academic coursework and research activity are completed during the first seven semesters. The final two semesters are devoted to clinical internships.

### **Accreditation**

This program is accredited by Commission on Accreditation in Physical Therapy Education (CAPTE) (APTA).

### **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.

The University of Minnesota program in physical therapy has no required or preferred undergraduate major. Any baccalaureate degree or equivalent from an accredited institution is accepted.

Other requirements to be completed before admission:

To be eligible for admission, the student must complete a baccalaureate degree, or its foreign equivalent, from an accredited institution by June 1st of the year of admission, including the required prerequisite courses or their equivalents.

Applicant must complete at least 100 hours of volunteer or work experience in a physical therapy setting. Exposure to multiple and varied areas of practice in physical therapy and additional health care exposure are considered an important preparation. The GRE General exam only is required. TOEFL is required for international students. Two letters of recommendation.

#### **Special Application Requirements:**

Below is a list of required prerequisite coursework to be taken before entering the program. Courses must be taken A-F, unless receiving Advanced Placement (AP) credit. A minimum grade of C is required in all prerequisite coursework. It is recommended that these courses be taken within the previous five years. Courses may be taken at any accredited college. Students are expected to be skillful with computer applications for word processing and creating spreadsheets.

- General biology, with on-site lab
- A second biology course of the student's choice, with on-site lab



- Human anatomy (lab strongly recommended)
- Human physiology
- General chemistry or inorganic chemistry - minimum two courses, with on-site lab
- General physics, which includes mechanics and electricity - minimum two courses, with on-site lab
- General psychology
- Abnormal psychology
- Statistics - ANOVA and regression analysis content strongly recommended
- Introductory calculus (pre-calculus not acceptable; Intro to Calculus or Short Calculus acceptable)
- Medical terminology

For all AP courses on the transcript, a score must be entered. This will be the score issued by the College Board. Students must also forward an unofficial copy of the College Board Report to the admissions coordinator to keep on file.

If distance learning courses are taken from an accredited college or university for college credit, there is no limit to the number that may be taken through distance education. Labs must be taken on-site.

All prerequisite courses and an undergraduate degree must be completed before the student enrolls in the professional program. Students may apply with two remaining prerequisites in progress. Past students have found that biochemistry, and human/animal biology classes have been helpful preparation for the D.P.T. curriculum.

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
  - Paper Based - Total Score: 550
- IELTS
  - Total Score: 6.5

The preferred English language test is Test of English as Foreign Language

Key to [test abbreviations](#) (GRE, TOEFL, IELTS).

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

## Program Requirements

141 credits are required in the major.

This program may not be completed with a minor.

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

A minimum GPA of 2.8 is required for students to remain in good standing.

At least 6 semesters must be completed before filing a Degree Program Form.

The program requires 141 major field credits, of which 101 are core academic credits and 40 are clinical internship credits. Nine credits of research are included in the core academic credits and a scientific poster presentation and written exam based on this research culminates the project. No minor or related field is required. Students must maintain a cumulative GPA of 2.80 while in the program.

### Year 1 summer

[PT 6058](#) - Anatomy for Physical Therapy (6.0 cr)

### Year 1 Fall

- [PT 6002](#) - Ethics in Public Health: Research and Policy (1.0 cr)
- [PT 6231](#) - Clinical Biomechanics (5.0 cr)
- [PT 6280](#) - Clinical Assessment (4.0 cr)
- [PT 6213](#) - Clerkship I (2.0 cr)
- [PT 6281](#) - Scientific Foundations I: Theory of Therapeutic Exercise (3.0 cr)



PT 6340 - Human Growth and Development (3.0 cr)  
PT 8131 - Research Seminar I (1.0 cr)

**Year 1 Spring**

NSCI 6112 - Medical Neuroscience for Professional Students (5.0 cr)  
PT 8132 - Research Seminar II (1.0 cr)  
PT 6310 - Physiology for Physical Rehabilitation (5.0 cr)  
PT 6214 - Clerkship II (2.0 cr)  
PT 6221 - Therapeutic Procedures (4.0 cr)

**Year 2 Summer**

PT 6813 - Cardiopulmonary Physical Therapy (3.0 cr)  
PT 6250 - Acute Care in Physical Therapy (2.0 cr)  
PT 6251 - Integument (2.0 cr)  
PT 6252 - Pathophysiology (3.0 cr)  
PHAR 6800 - Rehabilitation Pharmacotherapy (2.0 cr)  
PT 8193: Research Problems in Physical Therapy 2 crs.

**Year 2 Fall**

PT 6283 - Musculoskeletal I (7.0 cr)  
PT 6293 - Essentials of Rehabilitation Research (4.0 cr)  
PT 6215 - Clerkship III (1.0 cr)  
PT 8193: Research Problems in Physical Therapy 2 crs.

**Year 2 Spring**

PT 6282 - Scientific Foundations II: Neuromotor Control (3.0 cr)  
PT 6287 - Neurorehabilitation (8.0 cr)  
PT 6284 - Musculoskeletal Rehabilitation II (4.0 cr)  
PT 6216 - Clerkship IV (1.0 cr)  
PT 8193: Research Problems in Physical Therapy 2 crs.

**Year 3 Summer**

PT 6288 - Pediatric Rehabilitation (8.0 cr)  
PT 6290 - Administration (4.0 cr)  
PT 8193: Research Problems in Physical Therapy 1 crs.

**Year 3 Fall**

PT 6295 - Clinical Internship I (10.0 cr)  
PT 6296 - Clinical Internship II (10.0 cr)

**Year 3 Spring**

PT 6297 - Clinical Internship III (10.0 cr)  
PT 6298 - Clinical Internship IV (10.0 cr)



### **Twin Cities Campus**

## **Rehabilitation Science M.S.**

*Rehabilitation Medicine Administration*

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Physical Medicine and Rehabilitation, MMC 388, 420 Delaware Street SE, Minneapolis, MN, 55455 (612-625-3966; fax: 612-625-4274)

Email: [adamc002@umn.edu](mailto:adamc002@umn.edu)

Website: <http://www.rehabscience.umn.edu>

- Program Type: Master's
- Requirements for this program are current for Fall 2016
- Length of program in credits: 30 to 33
- 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.

Note: The rehabilitation science program prefers PhD applicants over MS applicants. The MS often applies to students who are in need of a trial program to determine whether or not the PhD is a good fit. In addition, the MS is used for students who initially begin the PhD, but find that the PhD is not the best fit and subsequently switch to the MS.

The graduate program in rehabilitation science is a post-professional program designed to train rehabilitation scientists and academicians. The program includes occupational and physical therapists and students with other backgrounds interested in rehabilitation research. The program's philosophy provides students with 1) a strong foundation in research methodology, 2) a concentrated educational experience specifically tailored toward a student's specific research question in rehabilitation science, and 3) a working knowledge of the importance of a collaborative, interdisciplinary approach to the scientific process.

### **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.

Minimum US equivalent bachelor's degree.

Other requirements to be completed before admission:

Applicants must hold a US-equivalent bachelor's degree or graduate degree in a discipline related to rehabilitation such as biomedical engineering, medicine, occupational therapy, physical therapy, or speech/audiology. International students must hold a comparable foreign degree from an accredited program. Depending on the educational background of the applicant, admission may be contingent upon completion of selected prerequisite coursework.

#### **Special Application Requirements:**

In addition to the University's application (including personal statement and fee), applicants must submit the following materials: GRE General Test scores (scores in the 60th percentile or higher are preferred); official transcripts; three letters of reference; and TOEFL score for international students. Student must also have an agreed-upon faculty adviser at the time of applying. Compatibility of research interests is a major determinant in the student/adviser relationship.

GRE score is mandatory. Scores in the 50th percentile or higher are preferred.

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

- GRE
  - General Test - Verbal Reasoning: 154
  - General Test - Quantitative Reasoning: 155
  - General Test - Analytical Writing: 4



International applicants must submit score(s) from one of the following tests:

- TOEFL
  - Internet Based - Total Score: 88
  - Internet Based - Listening Score: 21
  - Internet Based - Writing Score: 23
  - Internet Based - Reading Score: 21
  - Internet Based - Speaking Score: 23
- IELTS
  - Total Score: 6.5

The preferred English language test is Test of English as Foreign Language

Key to [test abbreviations](#)(GRE, TOEFL, IELTS).

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, 9 credits outside the major, and 10 thesis credits. The final exam is written and oral.

**Plan B:** Plan B requires 14 major credits and 16 credits outside the major. The final exam is written and oral. A capstone project is required.

**Capstone Project:** The Plan B project is determined in consultation with the advisor.

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

### Plan A Requirements

Take at least 14 RSC credits to meet the major field requirement; 3 statistics credits and 6 credits of electives for the outside credit requirement; and 10 master's thesis credits.

Take 14 or more credit(s) from the following:

- RSC 5058 - Anatomy for Rehabilitation Science (6.0 cr)
- RSC 5101 - Mathematical Tools for Research Applications in Health, Rehab, and Human Movement Sciences (1.0 cr)
- RSC 5106 - Rehab Science: Past, Present, and Future (1.0 cr)
- RSC 5103 - Seminal Milestones in the Biology of Aging (0.0 - 1.0 cr)
- RSC 5135 - Advanced Biomechanics I: Kinematics (3.0 cr)
- RSC 5200 - Introduction to Transcranial Magnetic Stimulation (3.0 cr)
- RSC 5206 - Academic Ethos (1.0 cr)
- RSC 5231 - Clinical Biomechanics (2.0 - 5.0 cr)
- RSC 5235 - Advanced Biomechanics II: Kinetics (3.0 cr)
- RSC 5281 - Scientific Foundations: Exercise Theory (3.0 cr)
- RSC 5294 - Independent Study in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 5306 - Scientific and Professional Presentation (1.0 cr)
- RSC 5310 - Physiology for Physical Rehabilitation (1.0 - 5.0 cr)
- RSC 5814 - Age, Exercise, and Rehabilitation (2.0 cr)
- RSC 5841 - Applied Data Acquisition and Processing (4.0 cr)
- RSC 5901 - Scholarly Inquiry in Health Sciences (4.0 cr)
- RSC 8021 - Application of Proteomics to Aging (0.0 - 1.0 cr)
- RSC 8022 - Fostering a Career in Aging Research (1.0 cr)
- RSC 8106 - Critical Analysis of Scientific Literature (1.0 - 2.0 cr)
- RSC 8130 - Current Literature Seminar (1.0 - 3.0 cr)
- RSC 8135 - Advanced Kinesiology (3.0 cr)
- RSC 8170 - Special Topics in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8185 - Problems in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8188 - Teaching Practicum (1.0 - 5.0 cr)
- RSC 8192 - Research Design in Rehabilitation Science (4.0 cr)
- RSC 8206 - Grant Writing (2.0 cr)



- RSC 8235 - Human Kinetics (3.0 cr)
- RSC 8282 - Problems in Human Movement (4.0 cr)
- RSC 8306 - Peer Review and Publication (2.0 cr)
- Statistics Requirement**  
Take at least 3 credits of statistics from the following list, or chosen in consultation with the adviser.
  - PUBH 6450 - Biostatistics I (4.0 cr)
  - PUBH 6451 - Biostatistics II (4.0 cr)
  - EPSY 8251 - Statistical Methods in Education I (3.0 cr)
  - EPSY 8252 - Statistical Methods in Education II (3.0 cr)
- Electives**  
Take 6 elective RSC and/or non-RSC credits, selected in consultation with the advisor.
  - RSC 5xxx
  - RSC 8xxx
- Thesis Credits**  
Take at least 10 master's thesis credits.
  - RSC 8777 - Thesis Credits: Master's (1.0 - 18.0 cr)

### Plan B Requirements

Take at least 14 RSC credits to meet the major field requirement; and 3 statistics credits and 13 credits of electives for the outside credit requirement

Take 14 or more credit(s) from the following:

- RSC 5058 - Anatomy for Rehabilitation Science (6.0 cr)
- RSC 5101 - Mathematical Tools for Research Applications in Health, Rehab, and Human Movement Sciences (1.0 cr)
- RSC 5106 - Rehab Science: Past, Present, and Future (1.0 cr)
- RSC 5103 - Seminal Milestones in the Biology of Aging (0.0 - 1.0 cr)
- RSC 5135 - Advanced Biomechanics I: Kinematics (3.0 cr)
- RSC 5200 - Introduction to Transcranial Magnetic Stimulation (3.0 cr)
- RSC 5206 - Academic Ethos (1.0 cr)
- RSC 5231 - Clinical Biomechanics (2.0 - 5.0 cr)
- RSC 5235 - Advanced Biomechanics II: Kinetics (3.0 cr)
- RSC 5281 - Scientific Foundations: Exercise Theory (3.0 cr)
- RSC 5294 - Independent Study in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 5306 - Scientific and Professional Presentation (1.0 cr)
- RSC 5310 - Physiology for Physical Rehabilitation (1.0 - 5.0 cr)
- RSC 5814 - Age, Exercise, and Rehabilitation (2.0 cr)
- RSC 5841 - Applied Data Acquisition and Processing (4.0 cr)
- RSC 5901 - Scholarly Inquiry in Health Sciences (4.0 cr)
- RSC 8021 - Application of Proteomics to Aging (0.0 - 1.0 cr)
- RSC 8022 - Fostering a Career in Aging Research (1.0 cr)
- RSC 8106 - Critical Analysis of Scientific Literature (1.0 - 2.0 cr)
- RSC 8130 - Current Literature Seminar (1.0 - 3.0 cr)
- RSC 8135 - Advanced Kinesiology (3.0 cr)
- RSC 8170 - Special Topics in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8185 - Problems in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8188 - Teaching Practicum (1.0 - 5.0 cr)
- RSC 8192 - Research Design in Rehabilitation Science (4.0 cr)
- RSC 8206 - Grant Writing (2.0 cr)
- RSC 8235 - Human Kinetics (3.0 cr)
- RSC 8282 - Problems in Human Movement (4.0 cr)
- RSC 8306 - Peer Review and Publication (2.0 cr)
- Statistics Requirement**  
Take at least 3 credits of statistics from the following list, or chosen in consultation with the advisor.
  - PUBH 6450 - Biostatistics I (4.0 cr)
  - PUBH 6451 - Biostatistics II (4.0 cr)
  - EPSY 8251 - Statistical Methods in Education I (3.0 cr)
  - EPSY 8252 - Statistical Methods in Education II (3.0 cr)
- Electives**  
Take 13 elective RSC and/or non-RSC credits, selected in consultation with the advisor.
  - RSC 5xxx
  - RSC 8xxx



### ***Twin Cities Campus***

## **Rehabilitation Science Minor**

*Rehabilitation Medicine Administration*

### **Medical School**

Link to a [list of faculty](#) for this program.

#### **Contact Information:**

Department of Physical Medicine and Rehabilitation, MMC 388, 420 Delaware Street SE, Minneapolis, MN, 55455 (612-625-3966; fax: 612-625-4274)

Email: [adamc002@umn.edu](mailto:adamc002@umn.edu)

Website: <http://www.rehabscience.umn.edu>

- Program Type: Graduate minor related to major
- Requirements for this program are current for Fall 2016
- 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 rehabilitation science is a post-professional program designed to train rehabilitation scientists and academicians. The program includes occupational and physical therapists and students with other backgrounds interested in rehabilitation research. The program's philosophy provides students with 1) a strong foundation in research methodology, 2) a concentrated educational experience specifically tailored toward a student's specific research question in rehabilitation science, and 3) a working knowledge of the importance of a collaborative, interdisciplinary approach to the scientific process.

### **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.

Minimum US equivalent bachelor's degree.

Other requirements to be completed before admission:

Applicants must hold a bachelor's degree or graduate degree in a discipline related to rehabilitation such as biomedical engineering, medicine, occupational therapy, physical therapy, or speech/audiology. International students must hold a comparable foreign degree from an accredited program. Depending on the educational background of the applicant, admission may be contingent upon completion of selected prerequisite coursework.

#### **Special Application Requirements:**

The student must inform the director of graduate studies (DGS) in writing of his or her intent to pursue the minor. A rehabilitation science faculty admissions committee determines student admission for the minor. To be admitted, a student must be an active graduate student pursuing an equivalent graduate degree in another field. The student must be in good academic standing within his or her major program. The student must have a mutually agreed-upon graduate faculty member in rehabilitation science serve as a reviewer on the student's dissertation committee and serve as the minor field examiner on the final exam committee.

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.

### Doctoral

#### Ph.D. Minor

Take at least 12 credits, selected in consultation with the Rehabilitation Sciences director of graduate studies. RSC courses must be taken on the A-F grading basis.

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

- RSC 5106 - Rehab Science: Past, Present, and Future (1.0 cr)
- RSC 5206 - Academic Ethos (1.0 cr)
- RSC 5135 - Advanced Biomechanics I: Kinematics (3.0 cr)
- RSC 5294 - Independent Study in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 5306 - Scientific and Professional Presentation (1.0 cr)
- RSC 5814 - Age, Exercise, and Rehabilitation (2.0 cr)
- RSC 5841 - Applied Data Acquisition and Processing (4.0 cr)
- RSC 8106 - Critical Analysis of Scientific Literature (1.0 - 2.0 cr)
- RSC 8206 - Grant Writing (2.0 cr)
- RSC 8306 - Peer Review and Publication (2.0 cr)
- RSC 8130 - Current Literature Seminar (1.0 - 3.0 cr)
- RSC 8135 - Advanced Kinesiology (3.0 cr)
- RSC 8170 - Special Topics in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8185 - Problems in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8192 - Research Design in Rehabilitation Science (4.0 cr)
- RSC 8282 - Problems in Human Movement (4.0 cr)

### Masters

#### Master's Minor

Take at least 6 credits, selected in consultation with the Rehabilitation Sciences director of graduate studies. RSC courses must be taken on the A-F grading basis.

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

- RSC 5106 - Rehab Science: Past, Present, and Future (1.0 cr)
- RSC 5206 - Academic Ethos (1.0 cr)
- RSC 5135 - Advanced Biomechanics I: Kinematics (3.0 cr)
- RSC 5294 - Independent Study in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 5306 - Scientific and Professional Presentation (1.0 cr)
- RSC 5814 - Age, Exercise, and Rehabilitation (2.0 cr)
- RSC 5841 - Applied Data Acquisition and Processing (4.0 cr)
- RSC 8106 - Critical Analysis of Scientific Literature (1.0 - 2.0 cr)
- RSC 8206 - Grant Writing (2.0 cr)
- RSC 8306 - Peer Review and Publication (2.0 cr)
- RSC 8130 - Current Literature Seminar (1.0 - 3.0 cr)
- RSC 8135 - Advanced Kinesiology (3.0 cr)
- RSC 8170 - Special Topics in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8185 - Problems in Rehabilitation Science (1.0 - 3.0 cr)
- RSC 8192 - Research Design in Rehabilitation Science (4.0 cr)
- RSC 8282 - Problems in Human Movement (4.0 cr)



**Twin Cities Campus**

**Rehabilitation Science Ph.D.**

*Rehabilitation Medicine Administration*

**Medical School**

Link to a [list of faculty](#) for this program.

**Contact Information:**

Rehabilitation Science Program, 420 Delaware Street SE - MMC 388, Minneapolis, MN, 55455 (phone: 612-625-3966; fax: 612-625-4274)

Email: [adamc002@umn.edu](mailto:adamc002@umn.edu)

Website: <http://www.physicalrehab.umn.edu/rehabilitation-science>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2016
- Length of program in credits: 60
- 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 rehabilitation science is a post-professional program designed to train rehabilitation scientists and academicians to meet the growing demand for experts in physical and occupational therapy and related fields. The program includes occupational and physical therapists and students with other backgrounds interested in rehabilitation research. The program's philosophy provides students with 1) a strong foundation in research methodology, 2) a concentrated educational experience tailored toward a student's specific research question in rehabilitation science, and 3) a working knowledge of the importance of a collaborative, interdisciplinary approach to the scientific process.

**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.

Bachelor's degree or US equivalent in a related discipline is minimal requirement.

Professional, graduate, or master's degree preferred but not required.

Other requirements to be completed before admission:

Applicants must hold a bachelor's or graduate degree, or accredited US equivalent, in a discipline related to rehabilitation; for example, biomedical engineering, kinesiology, medicine, occupational therapy, physical therapy, public health, or speech/audiology. Depending on the educational background of the applicant, admission may be contingent upon completion of selected prerequisite coursework.

**Special Application Requirements:**

In addition to completing and submitting the University's online application (which includes submission of a personal statement, diversity statement, and upload of CV/resume), applicants must submit the following materials: report of GRE General Test scores (scores in the 50th percentile or higher are preferred); transcripts from all institutions attended; three letters of recommendation; and TOEFL and/or IELTS scores for international students. Student must also have an agreed-upon faculty adviser at the time of application. Compatibility of research interest is a major determinant in the student/adviser relationship. For further information regarding these requirements, contact Program Administrator, Rich Adamczak, via email at [adamc002@umn.edu](mailto:adamc002@umn.edu).

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

- GRE
  - General Test - Verbal Reasoning: 153
  - General Test - Quantitative Reasoning: 155
  - General Test - Analytical Writing: 4

International applicants must submit score(s) from one of the following tests:

- TOEFL



- Internet Based - Total Score: 88
- Internet Based - Listening Score: 21
- Internet Based - Writing Score: 21
- Internet Based - Reading Score: 21
- Internet Based - Speaking Score: 23
- IELTS
  - Total Score: 6.5

The preferred English language test is Test of English as Foreign Language

Key to [test abbreviations](#)(GRE, TOEFL, IELTS).

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

## Program Requirements

16 credits are required in the major.

20 credits are required outside 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 1 semesters must be completed before filing a Degree Program Form.

### Core Courses

All students must complete the core courses.

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

- RSC 5106 - Rehab Science: Past, Present, and Future (1.0 cr)
- RSC 5206 - Academic Ethos (1.0 cr)
- RSC 5306 - Scientific and Professional Presentation (1.0 cr)
- RSC 8106 - Critical Analysis of Scientific Literature (1.0 - 2.0 cr)
- RSC 8206 - Grant Writing (2.0 cr)
- RSC 8306 - Peer Review and Publication (2.0 cr)

### Additional RSC Courses

Take at least 10 credits from the following courses, upon consultation with advisor:

RSC 5xxx  
RSC 8xxx

### Statistics Requirement

Take at least 8 credits of statistics from the following options, or choose 8 statistics credits in consultation with advisor:

#### Public Health Statistics Series

PUBH 6450 - Biostatistics I (4.0 cr)  
PUBH 6451 - Biostatistics II (4.0 cr)

#### or Educational Psychology Statistics Series

EPSY 8261 - Statistical Methods in Education I (3.0 cr)  
EPSY 8262 - Statistical Methods in Education II (3.0 cr)

### Elective Courses

Take at least 12 credits in consultation with advisor. Electives can include a combination of RSC coursework and courses from other disciplines.

**Joint- or Dual-degree Coursework:**DPT/PhDStudent may take a total of 18 credits in common among the academic programs.



### ***Twin Cities Campus***

## **Stem Cell Biology M.S.**

*Stem Cell Institute*

**Medical School**

Link to a [list of faculty](#) for this program.

### **Contact Information:**

Department of Stem Cell Biology Institute, 2001 6th Street S.E., Mail Code 2873, Minneapolis, MN 55455-3007 (612-625-0602; fax: 612-624-2436)

Email: [ander607@umn.edu](mailto:ander607@umn.edu)

Website: [http://www.stemcell.umn.edu/graduate\\_programs/master\\_of\\_science/home.htm](http://www.stemcell.umn.edu/graduate_programs/master_of_science/home.htm)

- Program Type: Master's
- Requirements for this program are current for Fall 2016
- 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 Stem Cell Biology master's program is a multidisciplinary program that prepares graduates for a career in research, teaching, or industry within the field of stem cell biology. It offers training in stem cell biology, a rapidly growing interdisciplinary field that rests on foundations provided by molecular, cellular, and developmental biology. Students will take lecture, lab, and seminar courses in these various disciplines, in addition to stem cell biology. They will interact with members of the Stem Cell Institute through participation in research seminars and journal clubs.

Students who elect Plan A will spend a full calendar year, including summer, conducting research in the laboratory of a stem cell graduate program faculty member. This research will form the basis of the master's thesis.

Students who elect Plan B will conduct research of primary literature that will result in a written paper and seminar on a topic in Stem Cell Biology agreed upon in advance by the student and faculty adviser. Part-time students choosing Plan B are expected to take one to two courses per semester and to finish the master's degree within 3 years. Students will not be expected to take courses in the summer.

### **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 3.20.

A bachelor's degree or foreign equivalent in biological science or a related field.

### **Special Application Requirements:**

Applicants must upload to the Apply Yourself on-line application website: 1) a personal statement (500 words or less) outlining research interests and long- and short-term goals (NOTE: students applying to Plan A should include information about previous research experience); 2) a curriculum vitae or resume; 3) the names of three individuals whom the student has asked to write letters of recommendation; and 4) unofficial transcripts.

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: 94
  - Internet Based - Listening Score: 22
  - Internet Based - Writing Score: 24
  - Internet Based - Reading Score: 22
  - Internet Based - Speaking Score: 26



- Paper Based - Total Score: 580
- IELTS
  - Total Score: 7
  - Listening Score: 6.2
  - Reading Score: 6.2
  - Writing Score: 6.2
  - Speaking Score: 6.2
- MELAB

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 to 16 major credits, 4 to 6 credits outside the major, and 10 thesis credits. The final exam is oral.

**Plan B:** Plan B requires 14 to 16 major credits and 14 to 16 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 2.80 is required for students to remain in good standing.

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

Students must demonstrate familiarity with the tools of research and scholarship in their major field, the ability to work independently, and the ability to present the results of their investigation effectively.

In addition to taking courses in two or three semesters, students can choose two paths for completing the degree. Students in Plan A will complete a master's thesis and take an oral exam. Students in Plan B will complete a course which will involve a major written paper and presentation.

### Required Courses

All students are required to take these courses.

#### Required Courses

- [SCB 5051](#) - Stem Cell Biology Practical Training Module (1.0 cr)
- [SCB 5054](#) - Stem Cell Institute Research Seminar and Journal Club (2.0 cr)
- [SCB 8181](#) - Stem Cell Biology (3.0 cr)

#### Required molecular biology course

At least one of these courses is required.

- [BIOC 8002](#) - Molecular Biology and Regulation of Biological Processes (3.0 cr)
- or [GCD 4034](#) - Molecular Genetics (3.0 cr)

#### Required courses - at least one of these three is required.

At least one of these courses is required.

- [GCD 8161](#) - Advanced Developmental Biology (3.0 cr)
- or [GCD 8008](#) - Mammalian Gene Transfer and Expression (2.0 cr)
- or Either 5xxx or 8xxx level Bioethics course, must be approved by SCB program before registration.

### Additional Courses for Plan A and Plan B

#### Plan A

Students must take 10 thesis credits - 5 in spring of year 1 and 5 in fall of year 2 is recommended.

[SCB 8777](#) - Thesis Credits: Master's (1.0 - 18.0 cr)

Students may choose elective credits from the following list or other courses in consultation with the program advisor.

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

- [BIOC 5213](#) - Selected Topics in Molecular Biology (3.0 cr)
- [BIOC 8401](#) - Ethics, Public Policy, and Careers in Molecular and Cellular Biology (1.0 cr)
- [BIOL 4004](#) - Cell Biology (3.0 cr)
- [BMEN 5041](#) - Tissue Engineering (3.0 cr)



- BMEN 5351 - Cell Engineering (3.0 cr)
- BMEN 5444 *(Inactive)*(3.0 cr)
- BTHX 5210 - Ethics of Human Subjects Research (3.0 cr)
- BTHX 5400 - Intro Ethics in Hlth Policy (3.0 cr)
- GCD 5036 - Molecular Cell Biology (3.0 cr)
- GCD 8008 - Mammalian Gene Transfer and Expression (2.0 cr)
- GCD 8131 - Advanced Molecular Genetics and Genomics (3.0 cr)
- GCD 8151 - Cell Structure and Function (3.0 cr)
- GCD 8161 - Advanced Developmental Biology (3.0 cr)
- MICA 8003 - Immunity and Immunopathology (4.0 cr)
- MICA 8004 - Cellular and Cancer Biology (4.0 cr)
- MILI 6235 - Pharmaceutical Industry: Business and Policy (2.0 cr)
- MILI 6726 - Medical Device Industry: Business and Public Policy (2.0 cr)
- MILI 6990 - The Health Care Marketplace (2.0 cr)
- MILI 6995 - Medical Industry Valuation Laboratory (2.0 cr)
- NSC 8211 - Developmental Neurobiology (3.0 cr)
- PHCL 5110 - Introduction to Pharmacology (3.0 cr)
- PHCL 5112 - A Graduate Toolkit I: An Introduction to the Scientific Research Lab (1.0 cr)
- PHSL 5510 - Advanced Cardiac Physiology and Anatomy (2.0 - 3.0 cr)
- PHSL 8242 - Professional Skills Development For Biomedical Scientists (1.0 cr)
- PSY 5063 - Introduction to Functional MRI (3.0 cr)

-OR-

#### Plan B

SCB 5900 is a required course for Plan B.

SCB 5900 - Master's Plan B Research Paper and Presentation (2.0 cr)

Students may choose elective credits from the following list or other courses in consultation with their advisor.

Take 14 or more credit(s) from the following:

- BIOC 5213 - Selected Topics in Molecular Biology (3.0 cr)
- BIOC 8401 - Ethics, Public Policy, and Careers in Molecular and Cellular Biology (1.0 cr)
- BIOL 4004 - Cell Biology (3.0 cr)
- BMEN 5041 - Tissue Engineering (3.0 cr)
- BMEN 5351 - Cell Engineering (3.0 cr)
- BMEN 5444 *(Inactive)*(3.0 cr)
- BTHX 5210 - Ethics of Human Subjects Research (3.0 cr)
- BTHX 5400 - Intro Ethics in Hlth Policy (3.0 cr)
- GCD 5036 - Molecular Cell Biology (3.0 cr)
- GCD 8008 - Mammalian Gene Transfer and Expression (2.0 cr)
- GCD 8131 - Advanced Molecular Genetics and Genomics (3.0 cr)
- GCD 8151 - Cell Structure and Function (3.0 cr)
- GCD 8161 - Advanced Developmental Biology (3.0 cr)
- MICA 8003 - Immunity and Immunopathology (4.0 cr)
- MICA 8004 - Cellular and Cancer Biology (4.0 cr)
- MILI 6235 - Pharmaceutical Industry: Business and Policy (2.0 cr)
- MILI 6726 - Medical Device Industry: Business and Public Policy (2.0 cr)
- MILI 6990 - The Health Care Marketplace (2.0 cr)
- MILI 6995 - Medical Industry Valuation Laboratory (2.0 cr)
- NSC 8211 - Developmental Neurobiology (3.0 cr)
- PHCL 5110 - Introduction to Pharmacology (3.0 cr)
- PHCL 5112 - A Graduate Toolkit I: An Introduction to the Scientific Research Lab (1.0 cr)
- PHSL 5510 - Advanced Cardiac Physiology and Anatomy (2.0 - 3.0 cr)
- PHSL 8242 - Professional Skills Development For Biomedical Scientists (1.0 cr)
- PSY 5063 - Introduction to Functional MRI (3.0 cr)



### **Twin Cities Campus**

## **Stem Cell Biology PhD Minor**

Stem Cell Institute

Medical School

Link to a [list of faculty](#) for this program.

### **Contact Information:**

Department of Stem Cell Biology Institute, 2001 6th Street SE, Mail Code 2873, Minneapolis, MN 55455-3007 (612-625-0602; fax: 612-624-2436)

Email: [ander607@umn.edu](mailto:ander607@umn.edu)

Website: <http://www.stemcell.umn.edu/graduate-programs/phd-level-minor>

- Program Type: Graduate minor related to major
- Requirements for this program are current for Fall 2016
- 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 degree program offers training in stem cell biology, a rapidly growing interdisciplinary field that rests on foundations provided by molecular, cellular, and developmental biology. Students will take lecture, lab, and seminar courses in these various disciplines, in addition to Stem Cell Biology. They will interact with members of the Stem Cell Institute through participation in research seminars and journal clubs, and will spend a full calendar year conducting stem cell research in the laboratory of a stem cell biology graduate program faculty member.

### **Program Delivery**

This program is available:

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

### **Prerequisites for Admission**

#### **Special Application Requirements:**

Applicants must be admitted to a Ph.D. program and obtain approval from the director of graduate studies in stem cell biology to enroll in the minor 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.

In addition to the major requirement appropriate to the student's specific program, the stem cell biology PhD minor will require 12 credits from designated courses with a minimum GPA 3.00.

The main research project must be done in the lab of a member of the stem cell biology graduate faculty.

### **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.

#### **Doctoral**

The PhD minor is available to students with an interest in stem cell biology who are in relevant PhD programs such as MCDB&G, MiCaB, pharmacology, microbiology, bio-engineering, or in a medical or veterinary medicine school program. It offers training in stem cell biology, which is a rapidly growing interdisciplinary field that rests on foundations provided by molecular, cellular, and developmental biology. Students will take lecture and seminar courses. They will interact with members of the Stem Cell Institute through participation in research seminar and journal clubs and conduct stem cell research in the laboratory of a stem cell biology



graduate program faculty member.

Requirements include 12 credits from designated courses--9 core credits and 3 credits from elective courses--and a research project in the lab of a Stem Cell Institute faculty member. Students may not use credits offered in their major field to satisfy minor requirements.

#### Required Courses

All students are required to take these courses.

[BIOC 8002](#) - Molecular Biology and Regulation of Biological Processes (3.0 cr)

[GCD 8161](#) - Advanced Developmental Biology (3.0 cr)

[SCB 8181](#) - Stem Cell Biology (3.0 cr)

#### PhD Minor Electives

Students may choose from following list of courses. If any are required as part of major requirements, they may not be used to fulfill minor requirements.

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

- [BIOC 8401](#) - Ethics, Public Policy, and Careers in Molecular and Cellular Biology (1.0 cr)
- [BMEN 5041](#) - Tissue Engineering (3.0 cr)
- [BMEN 5351](#) - Cell Engineering (3.0 cr)
- [BTHX 5400](#) - Intro Ethics in Hlth Policy (3.0 cr)
- [BTHX 8000](#) - Advanced Topics in Bioethics (1.0 - 4.0 cr)
- [GCD 8008](#) - Mammalian Gene Transfer and Expression (2.0 cr)
- [GCD 8131](#) - Advanced Molecular Genetics and Genomics (3.0 cr)
- [GCD 8151](#) - Cell Structure and Function (3.0 cr)
- [MICA 8003](#) - Immunity and Immunopathology (4.0 cr)
- [MICA 8004](#) - Cellular and Cancer Biology (4.0 cr)
- [NSC 8211](#) - Developmental Neurobiology (3.0 cr)
- [PHCL 5110](#) - Introduction to Pharmacology (3.0 cr)
- [PHSL 5510](#) - Advanced Cardiac Physiology and Anatomy (2.0 - 3.0 cr)
- [PHSL 8242](#) - Professional Skills Development For Biomedical Scientists (1.0 cr)
- [PSY 5063](#) - Introduction to Functional MRI (3.0 cr)