

Graduate School

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# Graduate School

UMD offers the *master of fine arts* in art (emphasis in graphic design); *master of arts* in communication sciences and disorders, counseling psychology (emphases in community counseling, college counseling, and school counseling), and English; *master of science* in applied and computational mathematics, biology, chemistry, computer science, geology, and physics; *master of business administration*; *master of liberal studies*; *master of music*; and *master of social work*.

All-University M.S./Ph.D. programs in toxicology and water resources science are offered jointly with the Twin Cities campus. In addition, several graduate programs operate at UMD under the aegis of graduate programs on the Twin Cities campus. Cooperative programs offered at both the master's and doctoral levels include biochemistry, microbiology, pharmacology, and physiology.

## Admission

Any student with a U.S. bachelor's degree or a comparable foreign degree from a recognized college or university may apply to the Graduate School dean for admission. Applicants with the necessary background for their chosen major field, an excellent scholastic record from an approved college or university, and appropriate professional qualifications may be admitted for graduate work on recommendation of the graduate faculty in the proposed major field and approval of the Graduate School dean. The Graduate School operational standard for admission is an undergraduate grade point average (GPA) of 3.00. Individual programs may require a higher GPA. Applicants should consult the program to which they are applying for more specific information about admission standards.

University of Minnesota undergraduates who have no more than 7 semester credits or two courses to complete for the bachelor's degree (including both distribution and total credit requirements), if they are admitted, may register in the Graduate School to begin a graduate program while simultaneously completing their baccalaureate work. Before registering in the Graduate School, students must have the minimum number of credits required for their undergraduate degree.

Graduate School faculty and staff encourage applications from persons of color or other groups that have been underrepresented in the student body.

## Application Fee

For *each* program, the Graduate School application fee is \$50 for U.S. applicants and \$55 for foreign applicants. This fee is subject to change. The most detailed and up-to-date information about the fee is included in the instructions that accompany the Graduate School Application for Admission.

## Transcripts

Two copies of official transcripts of all previous academic study must be submitted. Also, during the program of study, students often need a complete set of official credentials covering previous college and university training. Applicants, therefore, are urged to request three sets of official credentials when preparing their application for admission: one to be submitted with the application, one for permanent filing in the Graduate School office, and the other for personal use.

## International Applicants

International applicants must submit complete credentials. Details on the types of transcripts required are given in the Graduate School Application for Admission instructions.

## GMAT

Business administration applicants must take the Graduate Management Admission Test (GMAT) and request that an official report of the results be sent to the Graduate School from the Educational Testing Service as part of the admission application. Because this test is given at limited times and places during the year, applicants are advised to register early for the examination. For more information, contact the Educational Testing Service, Box 6000, Princeton, NJ 08541-6000. Under certain circumstances, alternatives to the GMAT can be used; contact the business administration program for more information.

## GRE

Students who submit undergraduate narrative transcripts or transcripts containing pass-no credit (S-N), credit, or other ungraded notations for a substantial number of courses taken during the junior and senior years, or whose transcripts do not show a substantial number of letter grades during these years, must submit the results of the Graduate Record Examination (GRE) General Test and, if available, a Subject Test appropriate to the proposed major in the Graduate School.

The GRE General Test is required of all applicants for programs in applied and computational mathematics, biology, computer science, counseling psychology, English, and geology. International applicants who are applying for assistantships from any science program not listed here are also strongly urged to submit general test scores in support of their application. Arrangements to take these tests can be made through the Educational Testing Service, Box 6000, Princeton, NJ 08541-6000 USA.

## TOEFL

The operational standard for admission to the Graduate School is a score of at least 550 on the Test of English as a Foreign Language (TOEFL) (or 213 on a computer-based test taken after June 1998). Individual programs may have higher requirements. This examination is required of all international applicants whose native language is not English and who have not lived in the United States for at least one year while completing at least 18 semester credits. This requirement will not be waived. Test scores must be less than two years old. For more information, write to TOEFL, Box 899, Princeton, NJ 08541-6151 USA. If desired, the Michigan English Language Assessment Battery (MELAB) is an alternative to the TOEFL; a minimum score of 80 is required. Information about the MELAB is available by writing to the English Language Institute, Testing and Certification, 3020 North University Building, University of Michigan, Ann Arbor, MI 48109-1057 USA.

## Additional Information

The Graduate School and individual programs within it reserve the right to request additional information when they believe it is necessary.

## Application Procedure

Requests for application materials must be sent to the Graduate School, 431 Darland Administration Building, University of Minnesota Duluth, MN 55812. Requests should specify the applicant's proposed major field, degree objective, and desired date of entry. Requests can also be entered at <[www.d.umn.edu/grad/](http://www.d.umn.edu/grad/)> on the World Wide Web.

Applicants are encouraged to apply for admission well in advance of the term in which they wish to enter the Graduate School (but no more than one year in advance of the proposed entry date). The Graduate School application, complete with all required materials, must be submitted by the following deadlines.

<i>Fall semester</i>	<i>July 15</i>
<i>Spring semester</i>	<i>November 1</i>
<i>Summer session</i>	<i>May 1</i>

Deadlines that occur on a holiday or weekend will be extended through the next regular workday. Many major fields have established deadlines earlier than those listed above and also require additional application and supporting materials. It is the applicant's responsibility to obtain information on those deadlines and requirements from the specific program descriptions in this catalog and from the director of graduate studies in the proposed major field.

## Professional Development

Applicants who wish to enroll in a field in the Graduate School but are not interested in a graduate degree may apply for admission for professional development courses. These applicants must complete the usual application materials and meet existing deadlines and admission standards. Because some major fields restrict admission to those planning on pursuing an advanced degree, applicants are advised to consult with the director of graduate studies in their proposed major field before completing application materials.

## Visiting Graduate Students

Students who have registered within the previous two years in a graduate degree program at another recognized U.S. graduate school and wish to enroll for a summer session or a single semester in the Graduate School of the University of Minnesota to earn credits to apply toward their degree program may be

admitted as visiting graduate students. Visiting graduate status may not be granted for more than one semester or one summer term. Students seeking visiting graduate status should request and complete the Visiting Application available from the UMD Graduate School office, 431 Darland Administration Building. This form must be approved by the Graduate School before registering for classes.

### Academic Staff

University of Minnesota staff holding academic appointments above the rank of instructor or research fellow are normally not permitted to complete a graduate degree at the University. Those who wish to register for courses and transfer them elsewhere may apply for admission for professional development courses.

### Readmission, Change of Major or Degree Objective

Admitted students who have not registered in the Graduate School at least once a year must request readmission before registering for classes, submitting petitions, filing for graduation, scheduling examinations, or submitting a degree program/thesis. If readmitted, the student must also register for at least one credit in the Graduate School. Students admitted to the Graduate School who fail to register for classes within one year of their admission date are also required to reapply for admission. Students who have completed a degree or certification program and who wish to take additional work in the Graduate School must apply for readmission. Students currently enrolled who wish to change their major field or degree objective from that originally approved by the Graduate School must complete and submit a Change of Status form. Readmission or Change of Status forms may be obtained from the UMD Graduate School office, 431 Darland Administration Building. A minimum of six weeks before the desired date of enrollment is typically required to process these requests.

### Change of Campus

Students enrolled in the Graduate School on one campus who wish to complete their studies on another campus should complete and submit a Change of Status form.

## Registration

New graduate students must obtain directions for registration at the UMD Graduate School office. Graduate fees are listed in the General Information section of this catalog.

### Registration Requirements

The University requires that graduate students holding appointments as teaching or research assistants or administrative fellows must register for at least 6 A-F or S-N credits in the Graduate School each term that an appointment is held. This does not apply to summer terms. Exceptions to this can be done via petition to the program's director of graduate studies. To be exempt from FICA withholding, a graduate assistant must register for 3 or more credits. Audit registration by itself is not acceptable for maintaining an assistantship. Medical fellows must also register each term an appointment is held, including summer terms.

Students receiving other types of financial aid from the University or other agencies, international students with certain types of visas, and students wishing to use various University services and facilities may have to meet specific registration requirements of other agencies or University units. These students are responsible for securing information about such requirements from the appropriate offices. Active graduate students need not register for the sole purpose of taking final written or oral examinations for the master's degree or specialist certificate or for taking the preliminary written or oral examinations for the doctorate.

Master's degree candidates are not required to register for any specific number of semesters.

### Types of Registration

The two kinds of registration used by graduate students at UMD are:

*For Coursework*—The maximum number of credits for which a graduate student may register in a single semester during the academic year is 18; in a single summer session, 11. Exceptions are granted by the Graduate School office only under unusual circumstances.

*Thesis Credit*—Regardless of their initial dates of entry to the Graduate School, all students enrolled in a Plan A master's program must register for at least 10 master's thesis credits (8777), and all students enrolled in a doctoral program must register for at least 24 doctoral

thesis credits (8888). Doctoral thesis credits can only be taken after the semester in which the preliminary examination is passed.

### Doctoral Pre-Thesis Credits (8666)

These credits are available for doctoral students who have not yet passed their preliminary oral examination but who need to be registered in the Graduate School to meet requirements of agencies or departments outside the Graduate School (e.g., loan agencies). Doctoral pre-thesis credits are not graded. *Note: Registration for doctoral pre-thesis credits cannot be used to meet any Graduate School degree requirements.*

### Registration Holds

Registration holds may be placed on student records when students fail to file official degree programs and/or thesis proposals or when they accumulate an excessive number of incompletes. Students who fail to meet Graduate School or major field standards for scholarly achievement may also have a hold placed on their registration.

### International Students

International students are normally required to maintain registration in the Graduate School to satisfy the rules of the Immigration and Naturalization Service (INS). Students should, therefore, plan their programs carefully to meet this requirement. The Graduate School is required to notify the INS office when an international student fails to maintain registration.

### Official Transcripts

Official transcripts of Graduate School students are available at UMD's Campus Center Information Desk except for students who registered in the Graduate School summer session II, 1972 or earlier. Official records of these students are maintained in the Office of the Registrar, University of Minnesota, 200 Fraser Hall, 106 Pleasant Street S.E., Minneapolis, MN 55455.

### Changes in Registration

All registration changes require an adviser's signature. During fall and spring semesters, Friday of the second week of the semester is the last day to add a course or change sections of a course, change grading option (including to or from auditor status), or cancel a course without a W (indicating withdrawal) appearing on the transcript. During the summer term, the deadline for such changes is the fifth day of instruction.

Students may cancel courses through Friday of the eighth week of the semester; canceling courses after the eighth week requires the approval of the adviser, instructor, and UMD Graduate School office. During the summer term, students may cancel a course through the last day of instruction with the adviser's signature.

Students cannot change their registration after the last day of instruction of a semester or register for previous semesters.

### Rate Structure

Students registering for 1 through 5 credits (part time) do so on a per-credit basis. Students registering for 6 through 14 credits do so on a flat-rate basis. Registration for credits beyond 14 credits is on a per-credit basis.

Students from North Dakota, South Dakota, Wisconsin, and Manitoba may wish to take advantage of tuition reciprocity. Because tuition procedures differ, contact the UMD Office of Admissions for specific information.

## Transfer of Credits

Master's degree students are required by the Graduate School to complete at least 60 percent of the course credits (excluding thesis credits if any) for their official degree programs as registered Graduate School students. With the approval of the adviser and director of graduate studies of the major field (and the director of graduate studies in the minor field if the courses are to be applied to a designated minor) and the Graduate School, the transfer of up to 40 percent of the degree coursework from other recognized graduate schools, or from adult special and University College status at the University of Minnesota, in any desired combination, is permitted. Individual graduate programs may, at their option, specify a lower percentage of coursework for transfer.

The work to be transferred must be postbaccalaureate graduate level that was taken for graduate credit and taught by faculty authorized to teach graduate courses. University College courses must bear the special UC transcript entry verifying that they were completed for graduate credit. Credits transferred from other institutions must appear on official graduate school transcripts of the institutions. Credit for courses completed through independent (correspondence) study, completed through extension or special categories at other institutions, or taken before the awarding of the baccalaureate, cannot be transferred.

Any transfer course which will be used to satisfy degree requirements must be included on the proposed degree program. If the course has been completed by the time the degree program is approved, the transfer process is automatic. If the transfer course has not been completed by the time the degree program is approved, the course is not automatically transferred. To complete this transfer an appropriate petition must be submitted and approved. More information regarding this process can be obtained from the UMD Graduate School office, 431 Darland Administration Building.

In the case of a transfer from a non-U.S. institution, credits must have been earned in a program comparable to a graduate degree program at a regionally accredited U.S. institution.

## Financial Aid

Fellowships and scholarships are available through the Graduate School. For more information, contact the director of graduate studies in the particular program or the UMD Graduate School office.

Assistantships (teaching and research) are normally granted through the individual departments and information can be obtained by writing to the director of graduate studies for the particular program. Graduate assistants on a 25 percent or greater appointment will receive free health and medical insurance coverage.

Some residence counseling positions may be available. For information, write to the Housing Office, 149 Lake Superior Hall, University of Minnesota Duluth, MN 55812.

Inquiries regarding loan funds, living accommodations, employment, and placement should be addressed to the Vice Chancellor for Academic Support and Student Life, 297 Darland Administration Building, University of Minnesota Duluth, MN 55812.

## Two Degrees

Students may have a maximum of 8 semester credits in common between two Plan A master's degrees, two Plan B master's degrees, or a Plan A and Plan B master's degree.

## Master's Degree Requirements

The master's degree is offered under two plans: Plan A (involving a thesis) and Plan B (involving additional coursework and/or special projects in place of a thesis). Plan B is the only plan available at Duluth for majors in art, business administration, communication sciences and disorders, counseling psychology, English, liberal studies, music, and social work. Applied and computational mathematics, biology, chemistry, computer science, geology, and physics majors may select either Plan A or Plan B.

### Time Requirement

The maximum time allowed by the Graduate School for completion of the master's degree is seven years. The seven-year period begins with the oldest work included on the official degree program, including any transfer work applied. The graduate faculty in a specific program may set more stringent time requirements.

### Grading System

The Graduate School uses two grading systems, A-B-C-D-F (with pluses and minuses) and S-N. Except in courses in which grading has been restricted to one system or the other, students have the option of choosing the system under which they will be graded. Students must declare a grading system choice as part of their initial registration. Changes in grading options must be made by the end of the second week of class (end of the first week during summer sessions). For information about courses in which grading is restricted, students should consult the department offering the course. Instructors must explain to students the achievement level necessary to earn an S grade for a course.

Course instructors may, at their discretion, set a time limit for removal of incomplete grades. In general, it is recommended that incomplete grades be removed within one calendar year. A student with an excessive number of incompletes may be denied further registration until some of them have been removed.

The Graduate School discourages retaking courses to improve grades. Permission of the course instructor and the major adviser is required to do so. If a course is retaken, all registrations for it remain on the student's record.

## Minimum Grade Requirements

The minimum GPA required by the Graduate School for courses included on the official program for any master's degree is 2.80 (on a 4.00 scale). 5xxx and 8xxx courses with grades of A, B, C (including C-), and S may be applied to a Graduate School degree program. Under some circumstances and with approval of the student's major field, 4xxx, 6xxx, and 7xxx courses may also be applied to a Graduate School degree. Grades of A, B, C, and S are acceptable, but grades of S are not calculated in the GPA. At least two thirds of the course credits taken in the Graduate School (excluding thesis credits) and included in any degree program must be taken A-F.

Individual major fields may set higher grade requirements, and students should be familiar with special requirements in their major field.

## Transfer of Plan

A student transfers from one plan for the master's degree to the other by submitting to the Graduate School a revised program form signed by the adviser, director of graduate studies for the major, and director of graduate studies for the minor if a minor is declared.

## Plan A: Master's Degree With Thesis

*Major and Related Field(s) or Minor*—Students must complete an approved program of coursework consisting of at least 14 semester credits in the major field, at least 6 semester credits in one or more related fields outside the major, and at least 10 thesis credits (8777).

Students who wish to complete a designated minor (certified on the transcript; related fields option is not) must complete at least 6 semester credits in a single field. A designated minor must be approved by the director of graduate studies in the minor field.

In cases where the student takes coursework beyond the minimum requirements, both the adviser and the Graduate School may demand comparable standards of performance for all work taken.

Admission to the Graduate School requires the specification of a major field. Any proposal for a subsequent change in major necessitates a formal request to the Graduate School.

*Official Degree Program*—After completing 10 credits and ordinarily not later than the second semester of registration (the second year for longer programs), students must file an official degree program with the Graduate School. This requirement may vary with the

program. The program form is available in the UMD Graduate School office. Students list all coursework, completed and proposed, that will be offered to fulfill degree requirements, including transfer work. If a foreign language is required, it is specified. If the degree is being completed under Plan A, students should also include the proposed thesis title. The members of a student's final examining committee (who are the thesis reviewers for Plan A) are appointed by the Graduate School dean on recommendation of the faculty in the major field at the time the student's official degree program is approved. A degree program approved by the Graduate School must be on file before reviewers report, examination, or graduation forms can be released to the student.

*Program Changes*—Once approved, the program must be followed to meet graduation requirements. Alterations in the program, including committee changes, must be requested in advance by means of a Graduate School petition form.

*Language Requirement*—See the appropriate major field under Program Statements below to determine the language requirement, if any, for that field. The Graduate School monitors the fulfillment of the language requirement when a major field specifies one. Information about how the student must demonstrate proficiency and the conditions under which proficiency will be recorded on the official transcript is available from the UMD Graduate School office.

*Master's Thesis*—The thesis title is submitted for approval as part of the information provided on the student's official degree program form available from the UMD Graduate School office. The thesis title must be approved by the adviser. The thesis must be on a topic related to the major, be written in acceptable English, demonstrate the student's ability to work independently, and display the student's power of independent thought both in perceiving problems and in making satisfactory progress toward their solution. Familiarity with the bibliography of the special field and correct citation of authorities are expected.

Three unbound copies of the thesis must be provided and a \$10 fee paid. Two copies are for the University library in Minneapolis, and one is for the Duluth campus library. The student's adviser(s) must sign all three unbound copies of the thesis to confirm that they are complete and satisfactory in all respects and that all revisions required by the final examining committee have been made.

The copies must be on 20-pound linen stock of 75 percent rag content. The original and two copies must contain all illustrative material. If photographs are included, all three copies must contain original photographs (i.e., no photocopies). Ample margins should be left for binding purposes. The body of the thesis should be double spaced, but footnotes may be single spaced. Photocopy methods of reproduction will be accepted (except photographs), provided that 20-pound rag content bond is used and adequate contrast and clarity is provided.

*Thesis Registration*—Students are required to file the title of their thesis with the Graduate School before taking their oral examinations. They may obtain forms for this purpose in the UMD Graduate School office.

The thesis is examined by a committee of not less than three members, appointed by the Graduate School dean upon recommendation of the adviser and the director of graduate studies. The examining committee will include at least two representatives of the major field and one representative of the related or minor field. This committee must be unanimous in certifying that the thesis is ready for defense, and a record of this action must be filed in the UMD Graduate School office on the appropriate form before the candidate may be admitted to the final written or oral examination.

The thesis may include materials that students have published while University of Minnesota graduate students, provided the research was carried out under the direction of the graduate faculty and approved by the adviser for incorporation into the thesis. The adviser should notify the Graduate School in writing of the intent to publish part of the thesis materials, but Graduate School approval is not required.

If the thesis is accepted, the candidate should immediately begin to have it prepared in its final form and should submit the Application for Degree before the first working day of the month the candidate plans to graduate. Application for Degree forms must be obtained from the UMD Graduate School office. Two unbound copies of the thesis, including the original, must be submitted to the UMD Graduate School office by the last working day of the month of proposed graduation.

*Final Examinations*—Candidates for the master's degree, Plan A, must pass a final oral examination; a final written examination may also be required at the discretion of the graduate

faculty in the major field. If both a written and an oral examination are specified, the written examination must precede the oral examination.

The final examination covers the major and minor or related fields and may include other related work. This examination is coordinated by the chair of the student's examining committee. A majority vote of the committee, all members present and voting, is required for a pass. Results are reported to the Graduate School on a Final Examination Report that is issued to the student when the form certifying the thesis is ready for defense is submitted. In case of failure, unanimous consent of the examining committee is required to retake the examination, providing the reexamination is conducted by the original committee.

*Reports*—Forms are provided for signed reports concerning the thesis and the final written or oral examinations. All reports must be filed in the UMD Graduate School office by the published deadline.

### **Plan B: Master's Degree Without Thesis**

The requirements for this plan follow Plan A in matters of admission and language requirements. Unless otherwise specified by the program, a Plan B student must pass either a final written examination or a final oral examination, or both, at the discretion of the graduate faculty in the major field. Plan B differs from Plan A in substituting for the thesis a heavier course requirement and/or special projects. For professional purposes, the master's degree program under Plan B is less a test of research interest and more adapted to individuals who will profit by a broader range of knowledge in their fields. Whether taken for professional or personal purposes, the requirements for Plan B are meant to test interests and intellectual abilities for a different purpose, but not on a different level, from that of Plan A.

Under Plan B, students must complete an approved program of coursework consisting of at least 30 semester credits. At least 14 of these credits must be in the major field, at least 5 credits must be in one or more related fields outside the major, and the remaining credits may be in either the major or related fields. Normally a majority of the program credits are in the major field. These are minimum credit requirements; some major fields require additional work.

After completing 10 credits and ordinarily not later than the second semester of registration (the second year for longer programs), students must file an official degree program with the Graduate School. This requirement may vary with the program. The program form is available in the UMD Graduate School office. Students list all coursework, completed and proposed, that will be offered to fulfill degree requirements, including transfer work. If a foreign language is required, it is specified. The members of a student's final examining committee are appointed by the Graduate School dean on recommendation of the faculty in the major field at the time the student's official degree program is approved. A degree program approved by the Graduate School must be on file before reviewers report, examination, or graduation forms can be released to the student.

Students who wish to complete a designated minor (certified on the transcript; related fields option is not) must complete at least 6 semester credits in a single field. A designated minor must be approved by the director of graduate studies in the minor field.

If Plan B projects are required, these should take a combined minimum of 120 hours of effort on the part of the student. This requirement may be satisfied through papers written in conjunction with regular courses, papers written in specially designed courses, presentation of a studio show (art), or other appropriate methods. Students should consult individual programs concerning the project's requirement. If one Plan B project is required, it must be in the major; additional projects may be in related field(s).

In cases where the student takes coursework beyond the minimum requirements, both the adviser and the Graduate School may demand comparable standards of performance for all work taken and, in evaluating and approving the minimum program submitted, will reject the minimum degree program if the GPA for the total number of courses taken falls below 2.80 and may terminate candidacy.

Under this plan, the candidate is examined by a committee of not less than three members, two from the major field and one from a related field or minor, appointed by the Graduate School dean upon recommendation of the adviser and the director of graduate studies. The adviser is expected to contact the UMD Graduate School office before the student's final examination for the degree to obtain an Examination Report Form for use by the

student's committee. The student makes available to the examining committee for its review the projects prepared to fulfill the required 120 hours of effort, within an adequate period of time to allow for evaluation before the examination(s). A majority vote of the committee, all members present and voting, is required to pass. The vote is reported to the Graduate School on a form the student must obtain from the UMD Graduate School office before taking the examination. In case of failure, unanimous consent of the examining committee is required to retake the master's final examination, providing the reexamination is conducted by the original committee.

## Termination of Graduate Student Status

When performance is unsatisfactory in terms of grades or normal progress standards, as established and promulgated by the graduate faculty in the major field, graduate student status may be terminated. All guidelines stated in this catalog represent minimal requirements, and each program is free to set more specific terms by which progress will be measured for purposes of continuation. Notice of termination will be in writing.

## Attendance at Commencement

Subject to satisfying participation requirements, attendance at commencement is voluntary. However, all candidates are individually recognized at the ceremony and must inform the Graduate School whether or not they will attend. The policy governing commencement ceremony participation is attached to the Application for Degree.

## Sexual Harassment

See Policies and Procedures for information on sexual harassment.

## Program Statements

A synopsis of information concerning each major and minor field follows. Further details are available from the directors of graduate studies. Courses in each area are listed in Course Descriptions under the appropriate department headings.

General information concerning graduate work on the Duluth campus may be obtained from the Graduate School office. The University of Minnesota *Graduate School Catalog* may be requested by writing to the Graduate School, University of Minnesota, 316 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455. The zip code of the recipient is required for mailing catalogs.

## Degree Programs

### Applied and Computational Mathematics

#### M.S.

##### *Plan A and Plan B*

Associate Professor John R. Greene  
Director of Graduate Studies

This program is for those wishing to pursue careers that use applied mathematics and statistics in science, industry, business, and teaching, and for those wishing to go on for Ph.D. degrees in mathematics or statistics. It emphasizes the use of modern modeling techniques and computational methods, with areas of concentration available in continuous and probability/statistics and discrete mathematics. The faculty is drawn largely from the Department of Mathematics and Statistics, but includes members from the Departments of Computer Science, Electrical and Computer Engineering, and Chemical Engineering.

#### Admission Requirements

Applicants should have completed an undergraduate degree in mathematics or statistics. However, a student with a degree in another major, and with a substantial background in mathematics or statistics (e.g., computer science or engineering), may also qualify; students lacking certain prerequisites may make up deficiencies concurrently with graduate work.

GRE General Test scores are required. Students whose native language is not English must submit their TOEFL scores.

#### Degree Requirements

The M.S. is offered under both Plan A (with thesis) and Plan B (without thesis). All students must complete at least 33 credits, of which at least 17 must be from approved mathematics or statistics courses or seminars (including a

graduate seminar and two of the three core courses) and 6 must be from a minor or related field (statistics is a related field). Plan A also requires 10 thesis credits; Plan B requires a 2-credit project and an additional 8 credits from approved graduate-level mathematics, statistics, or related-field courses. There is an 8-credit limit on 4xxx credits that may be applied to the degree.

**Language Requirements**—None.

**Final Exam**—The final exams are written and oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires 6 credits in approved Math or Stat courses.

### Art—Graphic Design

#### M.F.A.

##### *Plan B*

Associate Professor Robyn Roslak  
Director of Graduate Studies

Graphic design is the manipulation of type and image for communication. Traditionally, this has meant design for the print medium, but the same skill and understanding go into design for video, computer-based presentations, and an ever-widening range of applications. The Department of Art strongly believes that, even though many graphic design M.F.A. graduates choose to practice rather than teach, the M.F.A. is a primary prerequisite for teaching at the university level, and M.F.A. programs therefore have a responsibility to prepare students for academic as well as aesthetic rigor. Consequently, although the M.F.A. is largely a studio degree, the program includes a strong analytical and intellectual component.

The department also believes that such rigor is ultimately the best approach for training graphic design practitioners as well. The field is rapidly changing, and only by being versed in the traditional capacities of the area, the skills and knowledge of related fields, and the skills of critical thought can future designers hope to lead rather than merely react to changes.

#### Admission Requirements

Applicants should have an interest in art-making and the cultural and historical importance of art, and have a B.A., B.S., or B.F.A. in art. Individuals with undergraduate degrees in other disciplines who have completed a substantial number of art courses also may be considered for admission. Deficiencies in undergraduate preparation may be made up concurrently with graduate work.

Applicants must have a minimum undergraduate GPA of 3.00. Those whose native language is not English must have a TOEFL score of at least 213 or a MELAB score of 80. The GRE is not required.

A portfolio of at least 20 slides of design work (or work submitted on videotape or disk), a letter of intent, a sample of the applicant's writing (written in or translated into English), and three letters of recommendation are required as part of the application.

### Degree Requirements

The M.F.A. program requires at least two years in residence and 60 credits. The program may be completed on a part-time basis by first taking all requirements other than the Art 8901—Graduate Seminar/Art 8980—Graduate Studio series and Art 8990—M.F.A. Creative Thesis. The 8901/8980 series must be taken within a two-year period. A final project and minimum 15-page supporting paper are required. Although a gallery exhibition is typical, the project may take forms such as a book, video, Web site, or interactive project.

**Language Requirements**—None.

**Final Exam**—An oral exam based on the project and supporting paper is required.

**Minor Requirements for Students Majoring in Other Fields**—Not applicable.

## Biochemistry

See Cooperative Programs.

## Biology

### M.S.

#### *Plan A and Plan B*

Associate Professor David J. Schimpf  
Director of Graduate Studies

The program offers study toward the M.S. under either Plan A or Plan B. Plan A students must select an area of concentration from among botany, cellular and physiological biology, environmental biology, or zoology.

### Admission Requirements

Introductory biology and at least 16 additional semester credits of approved coursework in biology; a sequence in inorganic chemistry; a sequence in organic chemistry; differential and integral calculus; and a sequence in general or introductory physics (or approved alternative courses in physical or analytical sciences).

Students with deficiencies may be admitted with the provision that equivalent coursework or approved substitutions be completed during the first year of graduate study.

As part of their application materials, applicants must also submit recent GRE General Test scores.

Prior coursework and/or GRE scores are used to ascertain proficiency in the areas of general biology, genetics, cell biology, and ecology. Such proficiency is considered in the admission decision.

### Degree Requirements

Plan A students must complete at least 14 course credits in the major, including at least 10 credits in courses approved for the selected area of concentration and Biol 8099—The Biological Practitioner; at least 6 credits of approved coursework in one or more related fields or a minor; and at least 10 thesis credits. Plan B students must complete Biol 8099—The Biological Practitioner, at least 13 other course credits in the major, at least 6 credits of approved coursework in one or more related fields or a minor, and at least 10 credits of other approved coursework. Plan A requires a thesis; Plan B requires one to three Plan B projects.

**Language Requirements**—None.

**Final Exam**—Students must present a department seminar and pass a final oral exam.

**Minor Requirements for Students Majoring in Other Fields**—Any course that may be used as credit for the major may be used as credit toward the minor.

## Business Administration

### M.B.A.

#### *Plan B, Coursework Only*

Professor Thomas B. Duff  
Director of Graduate Studies

The M.B.A. program is designed and offered to meet the needs of residents of northeastern Minnesota and northwestern Wisconsin who are currently employed full time, pursuing professional managerial careers, and seeking general management education at the graduate level part-time. To meet the needs of these practitioners, the M.B.A. core courses and electives are offered in the evening, with most courses meeting one evening per week. Full-time enrollment is possible, however, and a relatively small number of domestic and international students enroll full time.

## Admission Requirements

Applicants must have a bachelor's degree from an accredited college or university; completed prerequisite or foundation courses in accounting, economics, finance, production/operations, marketing, organizational management, and human resource management *or* be able to demonstrate knowledge and proficiency in each of these areas; and have an acceptable score on the GMAT or GRE, passed the Certified Professional Accountant (CPA) examination, or completed a graduate degree from an accredited college or university. In addition, international students must have an acceptable score on the TOEFL.

The bachelor's degree may be in any field; however, students who have had little or no undergraduate or other education in business administration must complete prerequisite or foundation courses in the areas identified above. These courses must be completed before admission to the M.B.A. program and no graduate credit or credit toward M.B.A. program requirements is granted for prerequisite courses.

## Degree Requirements

The M.B.A. requires 32 credits. All students must complete six core and three support area courses, which provide exposure to financial reporting, analysis, and markets; the domestic and global environments of business and organizations; the creation and distribution of goods and services; and human behavior in organizations. Also required is a capstone strategic management course and at least 2 credits of cross-functional experience selected from special topics, workshops, projects, or field study. Students then choose one of two options for completing an additional 6 credits of elective coursework: coursework only or field research (Plan B).

**Language Requirements**—None.

**Final Exam**—For Plan B, students meet with their faculty committee for a final review of their completed project. For coursework only, no final exam is required.

**Minor Requirements for Students Majoring in Other Fields**—Not applicable.

# Chemistry

## M.S.

### *Plan A and Plan B*

Professor Donald P. Poe  
Director of Graduate Studies

The M.S. program offers a broad-based education in chemistry that is well-suited to students going on to Ph.D. programs, careers in industry, or professional schools. Both Plan A (with thesis) and Plan B (without thesis) are available. For Plan A, emphases include analytical, biological, inorganic, organic, and physical chemistry. The faculty include members from the Department of Chemistry in the College of Science and Engineering and from the Department of Biochemistry and Molecular Biology in the School of Medicine.

## Admission Requirements

Applicants must have completed an undergraduate chemistry major, including a junior-senior level course in inorganic chemistry, one year of physical chemistry, mathematics through calculus, and one year of college physics, preferably taught using calculus. Students lacking some of these prerequisites may make up deficiencies concurrently with graduate work.

## Degree Requirements

All students must complete 30 credits, including at least 14 credits in the major (including four core courses) and 6 credits in a related field or minor. Plan A students must also register for 10 thesis credits; Plan B students must complete an additional 10 course credits and prepare three papers. Attendance and presentation at the chemistry seminar are required. Individual programs are designed to best serve the interests of the student. 4xxx courses must be approved by the director of graduate studies.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires at least 6 credits in chemistry courses. Individual programs must be approved by the director of graduate studies in chemistry.

## Communication Sciences and Disorders

### M.A.

#### Plan B

Associate Professor Faith C. Loven  
Director of Graduate Studies

The graduate program in communication sciences and disorders effectively combines academic and clinical endeavors to prepare students to become speech-language pathologists. The program places a major emphasis on the development of clinical skills, although students have the opportunity to engage in a wide variety of academic and research activities as well. The curriculum, which is based on five semesters of study, is accredited by the Council of Academic Accreditation (CAA) and is accredited in speech-language pathology by the American Speech-Language Hearing Association (ASHA).

### Admission Requirements

Applicants must have a bachelor's degree in communication sciences and disorders. Three letters of recommendation evaluating the applicant's scholarship and clinical skill are required. At least two letters should be from academic faculty familiar with the applicant. A personal statement of the applicant's short- and long-term goals is also required.

### Degree Requirements

The M.S. is offered under Plan B only. At least 42 credits are required, including 30 credits of required CSD courses, 2 credits of Plan B project (CSD 8099), 4 credits of internship, and at least 6 credits of approved courses from related fields. All Plan B projects must be pre-approved by the student's examining committee, which also must give final approval.

**Language Requirements**—None.

**Final Exam**—The final exams are written and oral.

**Minor Requirements for Students Majoring in Other Fields**—Not applicable.

## Computer Science

### M.S.

#### Plan A and Plan B

Professor Carolyn J. Crouch  
Director of Graduate Studies

Computer science is a discipline that involves understanding the design of computers and computational processes. The discipline ranges from the theoretical study of algorithms to the design and implementation of software at the systems and applications levels.

The M.S. is a two-year program that provides the necessary foundational studies for graduates planning to pursue either a Ph.D. in computer science or a career as a computer scientist in business or industry.

### Admission Requirements

The program is for students with undergraduate degrees in computer science or computer engineering. These students should be able to enroll immediately in 8xxx computer science courses. Students with other backgrounds may be considered if they have completed the following courses or their equivalents: CS 1511-1521—Computer Science I-II; CS 2511—Software Development; CS 2521—Computer Organization; CS 4511—Automata, Computability, and Algorithms; CS 4521—Advanced Data Structures and Algorithms; CS 5621—Architecture; and CS 5631—Operating Systems. The appropriate math prerequisites, namely Math 1296-1297—Calculus I-II, and Statistics 3611—Probability and Statistics, are also required. Students who fail to meet these requirements may be admitted provisionally and must complete specified courses before proceeding with their graduate work. The GRE General Test is required; the TOEFL is also required of international students.

### Degree Requirements

The M.S. is offered under Plan A (thesis) and Plan B (non-thesis). At least 33 credits are required, including 16 credits from 8xxx courses in computer science, 1 credit of CS 8993—Seminar, and 6 credits from a specified set of courses outside of computer science (minor or related field). Plan A also requires 10 thesis credits; Plan B requires at least 10 credits in additional computer science courses, 5xxx or above. All courses are chosen in consultation with the student's adviser, subject to approval by the director of graduate studies.

**Language Requirements**—None.

**Final Exam**—Students present a departmental colloquium, followed by an oral exam.

**Minor Requirements for Students Majoring in Other Fields**—At least 6 credits in computer science is required for a master's minor.

## Master of Education (M.Ed.)

For information about the master of education (M.Ed.) degree program, see College of Education and Human Service Professions in the Colleges and Schools section of this catalog, or write to the program director, 125 Bohannon Hall.

## Counseling Psychology

### M.A.

#### Plan B

Associate Professor Jane Hovland  
Director of Graduate Studies

The M.A. in counseling psychology is based on a developmental philosophy that encourages academic learning and personal growth. The overall emphasis is on the promotion of healthy psychological functioning and the prevention of psychological disturbances. A core curriculum provides theoretical frameworks and practice in counseling skills from which students can develop their unique strategies and pursue specialty training.

Three emphases for specialty training are offered: community counseling, college counseling, and school counseling. The community and school counseling emphases are accredited by the Council for Accreditation of Counseling and Related Educational Programs (CACREP); the college counseling emphasis will be included in the next accreditation review. Students select an emphasis during their second semester.

Community counseling students may elect coursework that provides a foundation for pursuing licensure as a psychological practitioner in the State of Minnesota or as a licensed professional counselor in many other states. The college counseling emphasis offers preparation for student support and development in colleges and universities. The school counseling emphasis allows for specialization in grades K-8 or 5-12. Experiential requirements for Minnesota professional school counselor licensure can be met through completion of a supervised one-year school counseling residency after

completing this program or through holding a valid Minnesota teaching license and having one year of teaching experience at the level of licensure desired.

### Admission Requirements

A minimum undergraduate GPA of 3.00 and 6 semester credits in psychology or education, including an undergraduate inferential statistics course, are required. Applicants must submit scores from the GRE General Test with minimum scores of 350 on the verbal and quantitative sections; scores of 500 on both sections are preferred. A written statement providing evidence of social service or teaching experience and three recommendation forms are required. Applications should be submitted by March 15 for consideration for admission the following fall semester. Applications submitted after March 15 are considered only if space is available.

### Degree Requirements

The M.A. requires 50 credits, including 31 counseling core credits, 13 professional emphasis credits, and 6 credits in a minor or related field. Counseling core credits include a 4-credit Plan B research paper (Psy 5061, 5062—Research Problems I, II) with an oral exam; professional emphasis credits include a semester practicum (2 credits) and a nine-month internship (23 hours per week, 6 credits). Core credits must include Psy 5051, 5052, 5061, 5062, 5121, 5501, 5502, 5601, 5603, 5611, 5651. Professional emphasis credits are as follows: community counseling—Psy 5125, 8001, 8101, 8197, 8297; college counseling—Psy 8003, 8101, 8397, 8497, 3-credit elective; school counseling—Psy 5201, 8005, 8101, 8597 or 8797, 8697 or 8897. A comprehensive examination is required after completing one year of full-time study.

Students pursuing licensure in Minnesota as psychological practitioners or professional school counselors must complete specified courses, which can be completed as major or related field requirements. Students should consult with the program for current specified courses, as requirements are determined by state agencies and may change.

Students must also complete a national counselor exam, such as the National Counselor Examination for Licensure and Certification (NCE), before graduation.

**Language Requirements**—None.

**Final Exam**—A final oral exam on the Plan B paper is required. Students must also take a national counselor exam.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires 8 credits of psychology and is structured to include a research component, counseling orientation, and an elective. Interested students should contact the director of graduate studies in counseling psychology.

## English

### M.A. Plan B

Associate Professor Carol Bock  
Director of Graduate Studies

The M.A. program offers courses in English, Irish, and American literature, creative writing, linguistics, composition and rhetorical theory, and English education. Students work closely with faculty in developing their own program of study through coursework, independent readings, and related research projects. The program has two master's emphases: a literary studies emphasis for concentrated study of literature and preparation for the Ph.D. in English, and an interdisciplinary English studies emphasis for those who wish to teach English at the community-college level.

### Admission Requirements

Students applying to either of these programs must submit GRE General Test scores, two writing samples such as course papers, and three letters of recommendation. International applicants must submit TOEFL scores of at least 600. Entering students should have completed 30 credits in English (these may include credits in literature, language, and advanced composition), including 28 upper division credits.

Applicants must have completed or complete as graduate students upper division courses in Chaucer, Shakespeare, Milton, and the English language or English linguistics. Certain course prerequisites may be taken concurrently with graduate work and may be applied toward degree requirements.

### Degree Requirements

#### Literary Studies Emphasis (Plan B)

Requires at least 30 credits, including at least 24 credits in the major, 6-8 credits in a related field, and three Plan B projects.

#### English Studies Emphasis (Plan B)

Requires at least 31 credits, including at least 25 credits in the major, distributed in literature, linguistics, and composition/rhetoric; 6-8 credits in a related field; and three Plan B projects.

**Language Requirements**—The literary studies emphasis requires a reading knowledge of Latin, Greek, French, German, Italian, Spanish, Russian, or another approved language.

The English studies emphasis requires certification in a foreign language or completion of 6 course credits beyond the 31 required credits. Certification is gained by demonstrating a reading knowledge of a foreign language appropriate to the candidate's area of study and approved by the English graduate committee. Candidates whose professional objectives are best served by completing the additional 6 credits select courses from literature and literary analysis, linguistics, composition/rhetoric, or courses closely related to the field of concentration.

**Final Exam**—The final exams are written and oral.

Students must submit Plan B papers (normally three) or projects totaling 120 hours of effort before taking the exam. The projects normally are completed in connection with courses in English or in a related field. A completed project must be approved by a graduate faculty member.

**Minor Requirements for Students Majoring in Other Fields**—At least 8 credits in English, composition, and/or linguistics is required for a master's minor.

## Geology

### M.S. Plan A and Plan B

Professor James Grant  
Director of Graduate Studies

The M.S. program in geology encompasses areas of interest in hard-rock geology (igneous, metamorphic, and sedimentary petrology; economic geology; and Precambrian geology), Quaternary geology, hydrogeology, geoarchaeology, and physical and chemical limnology. Several of these areas are strengthened by collaboration with the Large Lakes Observatory, the Natural Resources Research Institute, and the Geoarchaeology Laboratory.

## Admission Requirements

Applicants must have completed an undergraduate major in geology, geophysics, or related earth science with one year each of college mathematics (including calculus), chemistry, and physics. A full-time geological field course of at least five weeks is also required, as are GRE General Test scores.

## Degree Requirements

The M.S. is offered under Plan A (thesis) and Plan B (non-thesis). Courses are selected with approval of the student's adviser and the director of graduate studies; also, no more than 25 percent of the courses may be at the 4xxx level except by their approval. For both plans, a written candidacy exam during the second semester of residency is required.

Plan A requires 30 credits, including 14 course credits in the major, 6 course credits in a minor or related field (which may be taken within geology if they are in an area different from the student's principal area), and 10 thesis credits. All courses must be at the 4xxx or 5xxx level. Plan B requires 30 credits in approved courses, including three Plan B papers.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires at least 6 credits and is decided in consultation with the student's adviser and the director of graduate studies in geology.

## Master of Industrial Safety (M.I.S.)

For information about the master of industrial safety (M.I.S.) degree program, see College of Science and Engineering in the Colleges and Schools section of this catalog, or write to the program director, 229 Voss-Kovach Hall.

## Interdisciplinary Archaeological Studies

See Cooperative Programs.

## Liberal Studies

### M.L.S.

#### Plan B

Professor James Fetzler  
Director of Graduate Studies

The interdisciplinary M.L.S. is a community outreach program that provides citizens with the opportunity to return to higher education to broaden their intellectual horizons without having to focus on specific professional goals. Students choose to write one to three papers exploring in depth an interdisciplinary topic.

### Admission Requirement

Applicants must have a bachelor's degree from a recognized college or university.

The application should include a thoughtfully composed letter stating, in narrative form, reasons for wishing to pursue the M.L.S. and describing education and career experiences. This letter should be addressed to the director of graduate studies in the UMD Graduate School office.

### Degree Requirements

The M.L.S. is offered under Plan B only. Students must complete at least 4 credits of IS 8001—Introduction to Liberal Studies, 4 credits of IS 8501—Seminar: Ethics and the Human Condition, 9 additional credits in humanities/classics or interdisciplinary studies courses, and 15 elective credits from any disciplines. One to three Plan B papers are required.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—Not applicable.

## Linguistics

### Freestanding Minor

Professor Michael D. Linn

Linguistics, offered interdepartmentally and through the Department of Interdisciplinary Programs, may be elected by graduate students as a related field, or with approval of the director of graduate studies of the major, as a designated minor.

### Degree Requirements

The minor in linguistics requires at least 12 credits selected from Engl 5811—Introduction to Modern English (4 credits), Engl 5821—History of the English Language

(4 credits), Ling 5802—Applied Linguistics (4 credits), Ling 5852—Practicum in Teaching Linguistics (3 credits), and Ling 8500—Graduate Seminar (3 credits).

## Microbiology

See Cooperative Programs.

## Music

### M.M. With Emphasis in Music Education

#### Plan B

Professor Judith Kritzmire  
Director of Graduate Studies

The M.M. program offers the practicing music teacher an opportunity to acquire advanced understanding and skills in music education theory and practice. Through required and elective courses in music, education, and music education, a course of study is designed to meet the interests and objectives of the student.

#### Admission Requirements

Applicants must have an undergraduate degree in music and have applied to the University of Minnesota Graduate School. In addition, the following must be submitted for review by the Music Graduate Committee: 1) Department of Music Graduate Study Application; 2) sample of professional writing (a three- to five-page paper addressing current issues in music education); 3) two letters of reference from professional colleagues and/or supervisors describing the candidate's potential for success in the graduate music program; and 4) an entrance performance audition on the major instrument or a videotape of classroom teaching or conducting.

Applicants may request additional information at 218/726-8208 or from the director of graduate studies, at [jkritzmi@d.umn.edu](mailto:jkritzmi@d.umn.edu).

#### Degree Requirements

The M.M. (Plan B) requires 30 credits, including 14 credits in music education and education (including Mu 8222—Music Bibliography and Research [3 cr] and Mu 8601—Foundations of Music Education [3 cr]); 8 credits in music—literature, performance, ensembles, history, and theory; 6 credits for the Plan B paper; and 2 elective credits.

**Language Requirements**—None.

**Final Exam**—A final oral exam on the Plan B paper is required.

**Minor Requirements for Students Majoring in Other Fields**—Not applicable.

## Pharmacology

See Cooperative Programs.

## Physics

### M.S.

#### Plan A and Plan B

Associate Professor Bo R. Casserberg  
Director of Graduate Studies

The M.S. program provides a grounding in the fundamentals of physics, combined with significant research involvement. The primary areas of research are computational physics, quantum theory and relativity, experimental work in condensed-matter physics, and observational and theoretical work in physical limnology.

#### Admission Requirement

An undergraduate degree in physics or the equivalent is required.

#### Degree Requirements

The M.S. is offered under both Plan A and Plan B. All students take 14 credits in a common core of courses (including Phys 5501, 5511, 5521, and 5522 and 2 credits in 5090) and 6 credits in a minor or related fields. Plan A also requires 10 thesis credits; Plan B requires one or more projects requiring at least 120 hours work total, preparation of a written report for each project, and 10 additional course credits in physics. These courses may include 4xxx courses, if appropriate and if approved for graduate credit; for distinctly interdisciplinary programs, the courses may be outside physics. In all cases, the overall plan of study and selection of elective courses must form a coherent program and be approved by the director of graduate studies.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires 6 credits, of which no more than 1 credit can be from Phys 5090.

## Physiology

See Cooperative Programs.

## Social Work

### M.S.W.

#### Plan B

Professor Joyce Kramer  
Director of Graduate Studies

The M.S.W. program offers a concentration in advanced generalist practice. The curriculum prepares students to practice at the direct service, program, and community levels of intervention. Graduates undertake a variety of professional social work functions, including counselor, community organizer, case manager, educator, and administrator. The curriculum has a special focus on services to American Indians and their communities. The M.S.W. program is accredited by the Council on Social Work Education.

### Admission Requirements

- 1) A bachelor's degree from a regionally accredited college or university. The bachelor's degree should include a solid background in the liberal arts, as evidenced on the transcript by courses in the arts, humanities, and behavioral and social sciences. Applicants should be knowledgeable about diverse cultures, social problems, social conditions, and the social, psychological, and biological determinants of human behavior. Applicants with undergraduate degree majors in social work or a related field or discipline are given preference over applicants with other majors.
- 2) Completion of at least 18 semester credits in two or more social science disciplines, such as sociology, psychology, economics, anthropology, or political science.
- 3) Strong academic preparation as demonstrated by undergraduate GPA.
- 4) Demonstrated interest in becoming a social worker. Preference is given to applicants with professional experience in human service settings, particularly when this experience involves working with underrepresented and protected classes.

**Enrollment Prerequisites**—Admitted applicants must complete a college-level biology course with content on human anatomical and physiological development and a college-level statistics course. The biology course must be completed before registering for the first semester in the M.S.W. program, and the

statistics course must be completed before registering for the first research course. Interested persons can apply and be admitted before completing the enrollment prerequisites.

**Advanced Standing**—Applicants with a bachelor of social work degree from a program accredited by the Council on Social Work Education may apply for admission to the advanced standing program. All other applicants are ineligible for this program.

### Degree Requirements

A total of 51 graduate credits is required (34 credits for students admitted with advanced standing), with a minimum of 41 credits in social work courses (28 credits for advanced standing students) and at least 2 credits from a related discipline. The 51-credit program requires two field placements in human service agencies; the advanced standing program requires one field placement. A minimum GPA of 3.00 for courses included on the degree program is required. A Plan B project is also required. A level of personal and professional competence considered satisfactory for entrance into the profession of social work, as indicated by course and field placement evaluations, is required. Students graduating from a B.S.W. program accredited by the Council on Social Work Education are eligible for the advanced standing program.

**Language Requirements**—None.

**Final Exam**—The final exam is oral, except for students who are over 250 miles from Duluth. They may complete an oral or written exam using distance technology.

**Minor Requirements for Students Majoring in Other Fields**—Not applicable.

## Toxicology

### M.S.

#### Plan A and Plan B

### Ph.D.

Professor Kendall Wallace  
Associate Director of Graduate Studies

This University-wide program provides comprehensive training in the broad scope of toxicology. Toxicology, the science of poisons, is devoted to identifying and quantifying potential noxious agents in our environment. Although most chemical agents at sufficiently large doses may be toxic, not all present a significant risk to human health or to environmental organisms or ecosystems.

Accordingly, the essence of the science of toxicology is defining the fine line which distinguishes a risk from a residue. To accomplish this requires scientific expertise in such areas as analytical and environmental chemistry, biology, and mathematics. Advanced courses and research are also available in such subdisciplines as human health risk assessment; epidemiology; environmental chemistry and engineering; ecotoxicology; food additives and nutritional toxicology; biochemical and physiological mechanisms; histopathology; diagnostic and analytical toxicology; drug metabolism; chemical carcinogenesis; behavioral toxicology; and the toxicity of noxious agents to various organ systems (e.g., nervous, heart, liver, kidneys).

### Admission Requirements

Applicants must have a bachelor's degree or its foreign equivalent from a recognized college or university. At least a full year each of biology, organic chemistry, and physics as well as mathematics through calculus is expected. GRE General Test scores are required; international students must also submit TOEFL scores.

### M.S.

*Plan A and Plan B*

### Degree Requirements

The M.S. is offered under Plan A and Plan B. Plan A requires 22 course credits and 10 thesis credits; Plan B requires 30 course credits. A core curriculum of 8 credits in toxicology (Txcl 8012, 8013, and 8100) is required for both plans. Additional courses are arranged on an individual basis.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D.

### Degree Requirements

The Ph.D. requires core courses in physiology (4 credits), biochemistry (6 credits), statistics (2 credits), and toxicology (10 credits). Students must also complete 12 credits in a minor or supporting program and 24 thesis credits. Because the program spans the Duluth and Twin Cities campuses, the required courses differ on each campus.

Additional advanced courses in toxicology or related fields may be specified by the adviser. Students must complete and defend an original research project.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—A minor is available at the doctoral level and requires 12 credits: 8 credits of core courses and 4 credits of advanced toxicology courses.

## Water Resources Science

### M.S.

*Plan A and Plan B*

### Ph.D.

Associate Professor Howard Mooers  
Associate Director of Graduate Studies

This interdisciplinary program produces scientists with strong technical skills in disciplines relevant to water resources science and promotes a broad understanding of 1) the hydrologic cycle and associated ecosystems, 2) the interconnectedness of the sciences involved in managing aquatic resources, and 3) the interplay between the biophysical sciences and social sciences in developing and implementing public policies related to water.

The program involves the Twin Cities campus Departments of Anthropology; Applied Economics; Biosystems and Agricultural Engineering; Civil Engineering; Ecology, Evolution, and Behavior; Entomology; Environmental and Occupational Health; Fisheries and Wildlife; Forest Resources; Geography; Horticultural Science; Geology and Geophysics; Landscape Architecture; Plant Biology; and Soil, Water, and Climate; and the Humphrey Institute of Public Affairs. It also involves the Duluth campus Departments of Biology, Chemical Engineering, Chemistry, Economics, Geography, and Physics.

### Admission Requirements

Applicants must have a B.S. in a physical or biological science or engineering with a 3.00 minimum GPA, and normally will have taken at least two courses each in calculus, chemistry, and physics and one course in biological sciences. Students who do not have a master's degree in a related subject are admitted to the M.S. program first even if their long-term goal is a Ph.D. The GRE General Test is recommended for all applicants.

**M.S.****Plan A and Plan B****Degree Requirements**

Students may choose Plan A, which requires a thesis, or Plan B, which requires additional coursework and a major project. Both plans incorporate courses offered on the Twin Cities and Duluth campuses.

Students must complete five courses in four core areas (hydrology; environmental/water chemistry; limnology; water resources policy, law, and administration) and at least three electives (in emphasis areas such as aquatic biology, hydrologic science, watershed management, and water quality engineering). One elective must be from an approved list of technical courses dealing with water quality science/management; two electives must be in the student's focus area within aquatic science. Related field credits should be in courses outside of aquatic science.

If a student has had none of the core courses in previous studies, at least 28 course credits (plus 10 thesis credits) is required for Plan A and at least 30 credits is required for Plan B (up to 3 credits of independent study may be used for the Plan B project). If a student has met some core course requirements, the minimum number of credits for Plan A may be reduced proportionately, but never to less than the Graduate School minimum of 20 course credits.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires 10 credits, including WRS 5101 (3 credits), WRS 8100 (1 credit), a core course from one of the program's emphasis areas, and an elective within that field of specialization. In aquatic biology and limnology, the core course is EEB 4601; in hydrological science, watershed management, and water engineering, the core course is in hydrology.

**Ph.D.**

Coursework is tailored to student interests, and many areas of specialization are possible. Core courses are offered on both the Twin Cities and Duluth campuses or are available in both regions through interactive video.

**Degree Requirements**

Students complete coursework equivalent to that of an M.S. in water resources science, with additional coursework in an area of specialization. There are no specific credit requirements in the major, but Ph.D. programs normally include at least 40 course credits beyond the B.S. level, including relevant coursework taken for a master's degree and a required minimum of 12 credits in a minor or supporting program.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—Doctoral students must complete 14 credits, including WRS 5101 (3 credits), WRS 8100 (1 credit), a core course from one of the program's emphasis areas, and two electives within one field of specialization. In aquatic biology and limnology, the core course is EEB 4601; in hydrological science, watershed management, and water engineering, the core course is in hydrology.

**Cooperative Programs****Biochemistry****M.S.****Plan A****Ph.D.**

Professor Lester R. Drewes, ldrewes@d.umn.edu  
Associate Director of Graduate Studies

UMD Department of Biochemistry and Molecular Biology faculty participate fully in the University's biochemistry, molecular biology and biophysics graduate program <[www.d.umn.edu/medweb/biochem/](http://www.d.umn.edu/medweb/biochem/)>. Students are subject to the same entrance and degree requirements as all other University biochemistry graduate students. All requirements for the M.S. can be completed on the Duluth campus. Up to two semesters of coursework on the Twin Cities campus may be required for Ph.D. students, depending on their needs and interests. Postdoctoral students are welcome and find favorable opportunities for continued research. Teaching and research assistantships are available to some students through the department as a form of financial aid.

## Interdisciplinary Archaeological Studies

### M.A. and M.S.

#### *Plan A and Plan B*

Regents' Professor George R. Rapp, Jr.  
Associate Director of Graduate Studies

This program is offered cooperatively with the graduate program in interdisciplinary archaeological studies on the Twin Cities campus. Students combine archaeology with a related field such as geology, ecology, geography, ethnobotany, or ancient history. UMD faculty supervise interdisciplinary archaeology students; the Archaeometry Laboratory is the program's UMD home department.

## Microbiology

### M.S.

#### *Plan A*

### Ph.D.

This program is associated with the graduate program in microbiology on the Twin Cities campus. Preparative coursework is offered primarily on the Twin Cities campus and can be completed in one year. Thesis research is conducted in molecular genetics, bacteriology, virology, mycology, or immunology.

## Pharmacology

### M.S.

#### *Plan A*

### Ph.D.

Professor Jean F. Regal  
Associate Director of Graduate Studies

This program is associated with the graduate program in pharmacology on the Twin Cities campus. All requirements for the M.S. can be completed on the Duluth campus. Up to two semesters of coursework on the Twin Cities campus may be required for Ph.D. students. Courses and research provide opportunities for training in biochemical and physiological pharmacology, immunopharmacology, and toxicology. All students complete coursework in biochemistry, physiology, and statistics as well as the major courses in pharmacology. In general, applicants should be well grounded in

chemical and biological sciences and mathematics. Applicants must submit GRE General Test scores. Financial aid in the form of research assistantships is available through the department. When applying, students should specify that they are applying for the M.S. or Ph.D. program at UMD. Applications and information may be obtained from the Associate Director of Graduate Studies, Department of Pharmacology, University of Minnesota Duluth, MN 55812.

## Physiology

### M.S.

#### *Plan A*

### Ph.D.

Associate Professor Edwin W. Haller  
Associate Director of Graduate Studies

This program is part of the cellular and integrative physiology graduate program on the Twin Cities campus. Students may complete their M.S. studies on the Duluth campus. Students may enter and complete their doctoral studies on the Duluth campus with graduate faculty in the Department of Medical and Molecular Physiology; however, doctoral degree requirements require at least two semesters on the Twin Cities campus or at an internationally recognized institution that strengthens students' training program. Students can pursue studies in muscle, cardiovascular, respiratory, cellular, and endocrine physiology as well as membrane transport, neuroscience, and temperature regulation. For more information, see <[www.d.umn.edu/medweb/PhysGrad.html](http://www.d.umn.edu/medweb/PhysGrad.html)> on the Web.