

Clinical Translational Science

Statement of Mission and Goals

The mission of the Clinical and Translational Science Graduate Program is to prepare its students for careers in research, teaching, and service in the interdisciplinary medical sciences. The mission is carried out with emphasis on the following goals:

1. To provide a strong foundation in the complex and interrelated fields of clinical sciences, population-based studies, outcome studies, genetic studies, environmental sciences and molecular basis of human disease.
2. To foster in students an attitude of inquiry, collaboration and interdisciplinary approaches that leads naturally to the scientific method of investigation.
3. To train students in modern methods and in data analysis which is critical for clinical, translational, and population based research.
4. To mentor students to become highly qualified researchers, educators and research oriented practitioners so that they are available for future demands in clinical and translational research and education.
5. To engender in students a spirit of cooperation for the mutual benefit of all colleagues.

The Clinical and Translational Science doctoral program exists to prepare students for self-directed, life-long learning and careers as independent scientists in Clinical and Translational sciences with a specialization in either the Molecular and Pathological Basis of Human Disease or Bioinformatics and Human Population Genetics. The program provides a quality academic curriculum that emphasizes training, mentoring, and practical experience in research and in teaching.

Program goals

The Clinical and Translational Science Master's program exists to prepare students for life-long learning and careers in research and teaching. The program provides a quality academic curriculum that emphasizes education and research in the area of Clinical and Translational Sciences with emphasis on human disease.

Goal 1: Students will possess and be capable of applying knowledge and understanding of the Clinical and Translational Sciences as they encounter new or unfamiliar problems in broader contexts related to their field of study.

Goal 2: Students will demonstrate the ability to develop and apply ideas in a research context.

Goal 3: Students will possess communication skills necessary to relate the results and conclusions of their research clearly and convincingly.

Goal 4: Students will recognize and adhere to ethical principles, exhibit professional behavioral standards, and fulfill their professional responsibilities to their institution, the scientific community and society in general.

Master of Science

Admission Requirements

The application process occurs through the School of Graduate Studies. Information is available from the UND School of Graduate Studies website (<http://www.und.edu/dept/grad>) (<http://graduateschool.und.edu/>).

If further advice or help would be beneficial to an applicant's decision-making process, we encourage her or him to contact our Director of Graduate Education.

1. Completion of a four-year degree from an accredited university. We are particularly interested in students who have completed an undergraduate degree within the state of North Dakota.

2. Coursework: Admission into the graduate program offered through our department is dependent upon the applicant's demonstration of effective academic skills and appropriate undergraduate training.

Generally, the applicant will have completed successfully the following coursework:

- General Biology or Zoology (one year sequence)
- General Chemistry (one year sequence)
- Organic Chemistry
- College Algebra

Coursework in Physics, Molecular Biology, or Genetics is strongly recommended.

Preference for admission may be given to applicants who have completed coursework in at least one of the following areas: Biology, Cell Biology, Chemistry, Biochemistry, or Medical Laboratory Sciences.

Applicants must have a cumulative undergraduate GPA of at least 2.75 and a cumulative GPA of 3.00 in graduate level course work, if applicable. Since the Graduate School requires a 3.0 for admission, those individuals with GPA less than 3.0 would have to be admitted under provisional status.

1. Graduate Record Examination Scores: Applicants must submit Graduate Record Examination (General Test) scores. Preference for admission will be given to applicants whose test scores fall at or above the reported national averages or 50th percentiles.
2. Satisfy the School of Graduate Studies' English Language Proficiency requirements as published in the graduate catalog.
3. Admission to the Clinical and Translational Science Graduate Program can be made either through the MS degree program or by application directly to the PhD degree program. A MS degree is **not** required for admission into the PhD degree program.
4. Students who elect to begin the MS degree program and later decide they wish to pursue the PhD degree may choose to attempt to bypass the MS degree by taking the comprehensive examination. By passing it and meeting the other requirements, such as a GPA of 3.0 or higher in graduate level coursework, a student may be admitted to the PhD program without completing the MS program. Otherwise, a student admitted to the MS program must complete the degree as listed.

Degree Requirements

Students seeking the Master of Science degree through the Clinical and Translational Science Graduate program at the University of North Dakota must satisfy all general requirements set forth by the School of Graduate Studies as well as particular requirements set forth by the program.

1. Minimum of 38 semester hours of graduate credit.
2. Completion of the following graduate level courses (minimum 38 credits):

Foundational Coursework to be completed by all CTS graduate students:

BIMD 510	Basic Biomedical Statistics	2
BIMD 516	Responsible Conduct of Research	2
PATH 500	Biochemistry and Cell Biology	6
PATH 505	Seminar in Clinical and Translational Science	1
PATH 590	Readings	1-3
PATH 593	Research	1-6
PATH 998	Thesis	1-9

A minimum of 4 credits of elective coursework is required for all MS in CTS students. Available elective coursework will vary based on track.

For students in the Pathogenesis of Human Disease track, a minimum of 4 hours of elective courses selected from the following:

MBIO 509	Immunology	3
ANAT 517		3
PATH 590	Readings	1-3
PATH 591	Special Topics	1-4

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For students in the Bioinformatics and Human Population Genetics track, a minimum of 4 hours of elective courses selected from the following:		
MPH 532	Biostatistics 2 *	3
MPH 534	Bioinformatics	3
MPH 535	Health Care Data Mining	3
MPH 590	MPH Seminar	1
PATH 591	Special Topics (Human Population Genetics)	2
PATH 591	Special Topics (Scientific Writing)	1

* MPH 531 Biostatistics 1 must be completed as a pre-requisite for MPH 532 Biostatistics 2; MPH 531 Biostatistics 1 will not count toward the 4 hours of required elective coursework for this specialization, but can be substituted for the required foundational course BIMD 510 Basic Biomedical Statistics .

3. Other graduate level courses may be selected or substituted if approved by the graduate student's Faculty Advisory Committee. Elective courses chosen should be appropriate to the student's area of interest.

4. A thesis written on an independent research problem.

Doctor of Philosophy

Admission Requirements

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the PhD degree program. A MS degree is **not** required for admission into the PhD degree program.

4. Students who elect to begin the MS degree program and later decide they wish to pursue the PhD degree may choose to attempt to bypass the MS degree by taking the comprehensive examination. By passing it and meeting the other requirements, such as a GPA of 3.0 or higher in graduate level coursework, a student may be admitted to the PhD program without completing the MS program. Otherwise, a student admitted to the MS program must complete the degree as listed.

Degree Requirements

The graduation requirements for the Ph.D. degree in the Clinical and Translational Sciences Program consist of required and elective coursework and research leading to the preparation of a dissertation and scholarly tools.

1. Minimum of 90 semester hours of graduate credit.
2. Completion of the following graduate level courses (90 credits):

Foundational Coursework to be completed by all CTS graduate students:

BIMD 510	Basic Biomedical Statistics	2
BIMD 516	Responsible Conduct of Research	2
PATH 500	Biochemistry and Cell Biology	6
PATH 505	Seminar in Clinical and Translational Science	1
PATH 590	Readings	1-3
PATH 591	Special Topics	1-4
PATH 593	Research	1-6
PATH 999	Dissertation	1-15

For the Pathogenesis of Human Disease Specilization, the following are required core courses:

MBIO 509	Immunology	3
ANAT 517		3
PATH 575	Molecular and Pathological Basis of Human Disease	4
PATH 591	Special Topics	1-4

Students in the Pathogenesis of Human Disease Specilization are required to take a minimum of 4 hours of elective courses:

Examples:

- Breast Disease, 1 cr
- Urinary Disease, 1 cr
- Human Population Genetics, 2 cr
- Metals, 2 cr
- Other available, 1-4 cr

For the Bioinformatics and Human Population Genetics Specialization, the following are required core courses:

MPH 531	Biostatistics 1 *	3
MPH 532	Biostatistics 2	3
MPH 534	Bioinformatics	3
MPH 535	Health Care Data Mining	3

* MPH 531 Biostatistics 1 can be substitute for the required foundational course BIMD 510 Basic Biomedical Statistics.

Students in the Bioinformatics and Human Population Genetics Specialization are required to take a minimum of 5 hours of elective courses from the following:

PATH 591	Special Topics	1-4
MPH 533	Advanced Biostatistics	3
PATH 590	Readings	1-3
PATH 591	Special Topics	1-4

3. Other graduate level courses may be selected or substituted if approved by the graduate student's Faculty Advisory Committee. Elective courses chosen should be appropriate to the student's area of interest.

4. Scholarly Tools: All candidates for the PhD degree must demonstrate competence in the scholarly tools for study and research in the Clinical and Translational Science Graduate Program. Each department at UND is responsible for setting up its own "Scholarly Tool" requirements. These requirements must be completed before the student is permitted to take the comprehensive examination or becomes a candidate for the PhD degree. For the CTS program BIMD 510 Basic Biomedical Statistics meets the scholarly tool requirement.

5. Research and Dissertation: The PhD degree in Clinical and Translational Sciences requires completion of a dissertation based on the results of a research project completed by the graduate student under the guidance of a faculty advisor. The project must represent an original and independent investigation by the student. It is expected that the results of the research will be published in a refereed scientific journal before graduation or at least accepted for publication. The candidate must make a significant contribution to the advancement of knowledge in the field. The dissertation prepared by the candidate must be presented and defended before the Advisory Committee and the Clinical and Translational Sciences Graduate Faculty

Courses

PATH 490. Directed Studies. 1-4 Credits.

Students are given an opportunity to perform research on a project related to research of any of the faculty members in CTS program. Although activities are specific to the individual faculty member, initial training usually involves pipetting, the protein assay, PCR and data presentation. Repeatable to 12 credits. S/U grading. F,S.

PATH 500. Biochemistry and Cell Biology. 6 Credits.

Knowledge in biochemistry and cell biology form the core concepts that underlay all study and research endeavors in the clinical sciences. Since the basics in these two disciplines are paramount to a successful graduate studies program, the course is designed to emphasize proficiency in basic concepts. The course is highly didactic and makes no assumptions of previous educational experiences of the incoming graduate student. This is deemed essential for a course that forms the stem in a multi-disciplinary graduate program. Thus the course is focused on basic textbook-based foundational knowledge and problem solving skills. The course begins by relating basic general and organic chemistry to biochemical systems, followed by addressing actual biochemical, synthetic and degradation reactions, and expanding this to the macromolecular and cell biological components of the process. Thus the study is first presented with the biochemical and molecular aspects of cellular processes and then uses this to build a more comprehensive picture of how molecular structures come together to form structures visible by various forms of microscopy. F.

PATH 505. Seminar in Clinical and Translational Science. 1 Credit.

All students and faculty within the program will participate in longitudinal seminars discussing their research area and interrelationships with complimentary disciplines. This may be in form of discussions, "chalk talks" of current efforts, literature or topic review. This will give students and faculty interdisciplinary and collaborative exposure to broad areas of inquiry and foster creativity and collaboration. This course will be taken annually by all students in the CTS program. Repeatable to 11 credits. S/U grading. F,S.

PATH 575. Molecular and Pathological Basis of Human Disease. 4 Credits.

Pathogenesis of Human Disease is an advanced graduate course that is based on lectures and discussions with a strong element of self-study through the use of extensive reading materials as well as lecture videos. This course is intended to cover aspects of the fundamental molecular, cellular and pathological mechanisms underlying various human diseases while the courses offered in the various CTS 590 special topics course will focus on diseases of specific organ systems. By the end of this course the student will have demonstrated a significant knowledge base of the molecular and pathological basis of human disease that is applicable to clinical and translational research. The student will also have sufficient knowledge of pathology to be capable of teaching this material to medical, professional, and graduate students. This course is open to all graduate students in the School of Medicine and Health Sciences as well as graduate students in biological sciences enrolled at the University of North Dakota who meet the prerequisites. Prerequisites: MBI0 509, PATH 500, and ANAT 517. F.

PATH 590. Readings. 1-3 Credits.

The primary goal of this course is for students to learn critical thinking and data analysis of the literature in their field of research study. Course sections will range from general training to journal clubs with an advanced topic focus. 1-3 credits There are two modes of this course 1)CTS 590 Readings: Scientific Reading This course is designed to promote critical reading of the literature. The primary goal is to teach students the process by which scientists identify problems, formulate testable hypotheses, collect data through experiments, and eventually establish new models describing biological processes. 1 credit 2)CTS 590 Readings: Journal Club The goal of the journal club is to familiarize students with the most up-to-date scientific literature and to develop the tools necessary to be a life-long learner. Students led by a faculty facilitator will discuss experimental methods and observations and this will provide graduate students the opportunity to develop oral skills. The course will also facilitate scientific communication between various clinical disciplines. The prerequisite for this course is CTS590 Readings: Scientific Reading; or equivalent with permission from course director. Repeatable to 3 credits. S/U grading. F,S.

PATH 591. Special Topics. 1-4 Credits.

The course sections offered under Special Topics are designed to bring a wide range of advanced topic learning to students within the Clinical and Translational Science Program and are where the sub-program specialization courses will be focused. Most of these topics are advanced focus areas of pathology such as in breast or urologic disease, advanced topics in toxicology such as metals, or topics in bioinformatics such as human population genetics. Scientific writing is another special topic that is germane to all in the CTS program. Topic areas will be advertised the semester previous to being offered. Prerequisite: PATH 500 and PATH 575. Repeatable to 8 credits. F,S.

PATH 593. Research. 1-6 Credits.

Research experience is offered in the specialty fields of the faculty within the Clinical and Translational Science Program and involves an intensive research experience on a variety of unique research problems utilizing modern methods and tools. Credits arranged (generally 1-6 credits per semester). Repeatable. F,S,SS.

PATH 996. Continuing Enrollment. 1-12 Credits.

This course is designed to allow the student to continue working on their thesis or dissertation when all the Research Credits have been used up. Repeatable to 12 credits. S/U grading. F,S,SS.

PATH 998. Thesis. 1-9 Credits.

The course is to enable the student time to complete the thesis or dissertation in the event that that student has already used up all the required courses to the maximum extent before graduating. Repeatable to 9 credits. S/U grading. F,S,SS.

PATH 999. Dissertation. 1-15 Credits.

This required course is taken in the students last semester(s) as they prepare their doctoral dissertation. Progress will be overseen by the student's faculty advisor in the Clinical and Translational Program. Repeatable to 15 credits. F,S,SS.