Genomics and Bioinformatics

Program and Application Information

Program Director:	Dr. Phillip McClean
Email:	Phillip.McClean@ndsu.edu
Department Location:	Plant Sciences, Loftsgard Hall
Department Phone:	(701) 231-8443
Application Deadline:	International applications are due May 1 for fall semester and August 1 for spring and summer semesters. Domestic applicants should apply at least one month prior to the start of classes.
Degrees Offered:	Ph.D. M.S.
English Proficiency Requirements:	TOEFL ibT 71; IELTS 6

Program Description

Genomics and Bioinformatics is an interdisciplinary graduate program that involves faculty from nine departments. Advanced research and study will focus on either functional or computation genomics. The program is designed to provide both M.S. and Ph.D. students the necessary skills and intellectual background to work cooperatively with others in a research area that takes a systems-wide approach to the study of the organization and expression of the many genes and their products expressed in an organism. Exposure to modern techniques and instrumentation will prepare the student for success in both industrial and academic careers.

Admissions Requirements

It is the intent of the program to admit students in either of two tracks. The Functional Genomics track will be for students interested in the generation and application of genomic information. The Computational Bioinformatics track is intended for students interested in using computer science and statistical approaches to analyze large amounts of genomic data.

The Genomics graduate program is open to qualified graduates of universities of recognized standing. The Graduate School minimum for the TOEFL examination applies. In addition, the following are the requirements to be admitted with full standing.

Functional Genomics track: a B.S. degree with courses in genetics, physiology, biochemistry; an upper-division statistics class; an introductory biology class emphasizing molecular biology; and minimum undergraduate GPA of 3.0.

Computational Bioinformatics track: a B.S. degree with courses in calculus, comparative computer languages, data structures, an upper-division statistics class, an introductory biology class emphasizing molecular biology, and minimum undergraduate GPA of 3.0.

Students can be accepted conditionally into either track without meeting the course or GPA requirements, but will be required to meet those requirements while in residency.

Research

The student is required to perform original research in an area of genomics. This will be under the direction of the student's major adviser. To promote cross-disciplinary research, the student is encouraged to collaborate with a student in the other track. This does not apply to M.S. students pursuing the Comprehensive Study Option.

Adviser and Graduate Committee

During the first year, the student will select an adviser, form a graduate committee, and submit the Plan of Study to the Graduate School. The committee must include the student's major adviser, at least one other faculty member of the Genomics and Bioinformatics program, and the Graduate School appointee. For Ph.D. students only, one member of the committee must be from outside the student's home college.

Core Courses

PLSC 611	Genomics	3
CSCI/MATH/STAT 732	Introduction To Bioinformatics	3
PLSC/BIOC 721	Genomics Techniques	2
796 Current Topics in Genomics 2 [2 x 1 cr. (MS)] or 3 [3 x 1 cr. (Ph.D.)] cr		2-3
790 Graduate Seminar 1 (M.S.) or 2 (Ph.D.) cr		1-2

Ph.D. Program

Functional Genomics Option

- Ph.D. Core Courses 13 credits
- Support Courses (required unless on incoming transcript) BIOL 859 Evolution , PLSC 631 Intermediate Genetics, STAT 726 Applied Regression and Analysis of Variance
- Electives minimum of 15 credits from the Physiology, Gene Expression, Genetics and Computational Elective areas; one course from each of the Physiology, Gene Expression, Genetics elective areas is required
- Research to 90 credits total **(NOTE: a minimum of 15 didactic credits must be 700-level courses)**

Bioinformatics Option

- Ph.D. Core Courses 13 credits
- Support Courses (required unless on incoming transcript) PLSC 731 Plant Molecular Genetics, STAT 661 Applied Regression Models, CSCI 796 Special Topics
- Electives - minimum of 15 credits; a minimum of three courses must be from the Computational area and a minimum of one course must be from either the Physiology, Gene Expression or Genetics Elective areas
- Research to 90 credits total **(NOTE: a minimum of 15 didactic credits must be 700-level courses)**

Elective Areas

Physiology

ANSC 828	Advanced Reproductive Biology	3
MICR 670	Basic Immunology	3
MICR 680	Bacterial Physiology	3
MICR 781	Advanced Bacterial Physiology	3
PPTH 751	Physiology Of Plant Disease	3
ZOO 660	Animal Physiology	3
ZOO 664	Endocrinology	3
ZOO 682	Developmental Biology	3
ZOO 866	Advanced Animal Behavior	3

Gene Expression

BIOC 719	Molecular Biology of Gene Expression and Regulation	3
BOT 820	Advanced Cell Biology	3
MICR 775	Molecular Virology	3
PLSC 731	Plant Molecular Genetics	3

Genetics

BIOL 859	Evolution	3
BIOL 796	Special Topics	3
MICR 682	Bacterial Genetics and Phage	3
MICR 783	Advanced Bacterial Genetics and Phage	3
PLSC 631	Intermediate Genetics (required for Functional Genomics Option)	3
PLSC 741	Cytogenetics	4
PLSC 751	Advanced Plant Genetics	3
PLSC 780	Population Genetics	2
PLSC 781	Quantitative Genetics	2
PPTH 759	Host-Parasite Genetics	3

Computational

CSCI 724	Survey of Artificial Intelligence	3
CSCI 859	Computational Methods in Bioinformatics	3
CSCI 760	Dynamic Programming	3
CSCI 765	Introduction To Database Systems	3
CSCI 783	Topics In Software Systems	3
CSCI 796	Special Topics (Knowledge Discovery in Biological Data)	3
CSCI 796	Special Topics (Signal Processing and Analysis in Bioinformatics)	3

MATH 684	Mathematical Methods of Biological Processes	3
STAT 650	Stochastic Processes	3
STAT 661	Applied Regression Models (required for Bioinformatics Ph.D. option)	3
STAT 730	Biostatistics	3
STAT 764	Multivariate Methods	3
STAT 796	Special Topics (required for Bioinformatics Ph.D. option)	3

M.S. Program - Thesis Option

Functional Genomics Option

- M.S. Core Courses 11 credits
- Electives- minimum of 9 credits from the Physiology, Gene Expression, and Genetics areas; a minimum of one course must be selected from each of two of these areas
- Research to 30 credits total

Bioinformatics Option

- M.S. Core Courses 11 credits
- Electives - minimum of 9 credits; a minimum of one course must be from the Physiology, Gene Expression or Genetics Elective areas; the remainder of the courses must be from the Computational area
- Research to 30 credits total

M.S.Program - Comprehensive Study Option

Functional Genomics Option

- M.S. Core Courses 11 credits
- Electives- minimum of 15 credits from the Physiology, Gene Expression, and Genetics areas; a minimum of one course must be selected from each of two of these areas
- Masters Paper to minimum of 30 credit total

Bioinformatics Option

- M.S. Core Courses 11 credits
- Electives - minimum of 15 credits; a minimum of two courses must be from the Physiology, Gene Expression or Genetics Elective areas; the remainder of the courses must be from the Computational area

Masters Paper to minimum of 30 credit total

Examinations

1. **Qualifying Exam (Ph.D. only):** This exam consists of written and oral portions. The student will complete a written exam that emphasizes the application of materials presented in the core courses. The members of the genomics graduate program will submit these questions. The oral exam will be administered by the student's graduate committee and will focus on material beyond the core courses that are specific to the research of the student. Upon completion of the qualifying exam, the student will be accepted as a Ph.D. candidate.
2. **Final Exam (M.S. and Ph.D.):** The final exam will be an oral defense of the student's research results. The student's graduate committee will administer the exam.
3. **Comprehensive Study Option Paper (M.S. only):** M.S. students pursuing the Comprehensive Study Option will be required to complete an in-depth paper of a specific topic relevant to Genomics. The paper will be reviewed and accepted by the student's graduate committee.

Peter Bergholz, Ph.D.
Michigan State University, 2007
Department: Veterinary and Microbiological Sciences
Research Interest: Bacterial Population and Landscape Genomics

Eugene Berry, Ph.D.
Northeastern University, 1983
Department: Veterinary and Microbiological Sciences
Research Interest: Animal Virology

Xiwen Cai, Ph.D.

Washington State University, 1998
Department: Plant Sciences
Research Interest: Cytogenetics

Michael J. Christoffers, Ph.D.
University of Missouri-Columbia, 1998
Department: Plant Sciences
Research Interest: Weed Molecular Genetics

Anne Denton, Ph.D.
University of Mainz, 1996
Department: Computer Science
Research Interest: Data Mining, Bioinformatics

Justin D. Faris, Ph.D.
Kansas State University, 1999
Department: Plant Sciences
Research Interest: Wheat Molecular Genetics

Nathan Fisher, Ph.D.
University of Michigan, 2006
Department: Veterinary and Microbiological Sciences
Research Interest:Functional Genomics and Gene Exaptation

Timothy Friesen, Ph.D.
North Dakota State University, 2001
Department: Plant Pathology
Research Interest: Host-Pathogen Interactions of Cereals

David P. Horvath, Ph.D.
Michigan State University, 1993
Department: Plant Sciences
Research Interest: Perennial Weed Physiology

Zhaohui Liu, Ph.D.
North Dakota State University, 2006
Department: Plant Pathology
Research Interest: Host-Parasite Interactions of Wheat

Phillip E. McClean, Ph.D.
Colorado State University, 1982
Department: Plant Sciences
Research Interest: Plant Molecular Genetics

Steven W. Meinhardt, Ph.D.
University of Illinois, Champaign-Urbana, 1984
Department: Biochemistry and Molecular Biology
Research Interest: Protein Structure/Function

Kendall Nygard, Ph.D.
Virginia Polytechnic Institute and State University, 1978
Department: Computer Science
Research Interest: Bioinformatics

William Perrizo, Ph.D.
University of Minnesota, 1972
Department: Computer Science and Operation Research
Research Interest: Distributed Database Systems, Centralized Database Systems

Birgit Pruess, Ph.D.
Ruhr-Universitat Bochum, 1991
Department: Veterinary and Microbiological Sciences
Research Interest: Microbial Physiology and Gene Regulation

Jack B. Rasmussen Ph.D.

Michigan State University, 1987
Department: Plant Pathology
Research Interest: Molecular Plant/Microbe Interactions

Katie Reindl, Ph.D.
North Dakota State University, 2006
Department: Biological Sciences
Research interest: Cancer cell biology

Saeed Salem, Ph.D.
Rensselaer Polytechnic Institute, 2009
Department: Computer Science
Research Interest: Bioinformatics Analysis of Biological Networks

Vasant A. Ubhaya, Ph.D.
University of California-Berkeley, 1971
Department: Computer Science and Operations Research
Research Interest: Algorithm Analysis, Operations Research

Changhui Yan, Ph.D.
Iowa State University, 2005
Department: Computer Science
Research interest: Computational Bioinformatics

Yarong Yang, Ph.D.
Northern Illinois University, 2010
Department: Statistics
Research interest: Bioinformatics