Cellular and Molecular Biology

Department Information

- **Program Coordinator:**
  Jane Schuh, Ph.D.
- **Department Phone:**
  (701) 231-6456
- **Department Web Site:**
  www.ndsu.edu/cellularmolecularbiology/
- **Application Deadline:**
  February 15 is the deadline for applicants seeking consideration of financial assistance (fellowship, assistantships) for fall semester and July 1 for spring semester.
- **Credential Offered:**
  Ph.D.
- **Test Requirement:**
  GRE
- **English Proficiency Requirements:**
  TOEFL iBT 71, IELTS 6

Program Description

The CMB program was formed in 1988 and was the first interdisciplinary graduate program at NDSU. The program was designed to respond to the evolving nature of research in the life sciences in which it was recognized that biological phenomena emerge from molecular and cellular events and that the elucidation of such processes increasingly relies on multidisciplinary approaches.

The CMB program provides cross training of graduate students in the areas of biochemistry and cellular and molecular biology. In this setting, students learn the most up-to-date approaches from a variety of fields. Integration across concepts as well as the application of various approaches to addressing biological problems is developed through their preliminary exam, in which students are required to write a research proposal in the format of a national granting agency different from their dissertation research, and to defend it orally. The students also develop and conduct an original line of research under the supervision of their major adviser. The program also brings together faculty with common interests and who use common approaches and equipment. Such a community of scientists fosters collaboration and engenders a sense of cooperation that leads to shared use of common equipment.

The CMB program prepares students for careers in academia and private industry. All graduates of the program have obtained permanent positions in their field or are engaged in postdoctoral training.

Nearly 40 faculty members in many different departments and representing a variety of colleges participate as faculty mentors. The program is led by the CMB Director, who receives guidance on policy, procedure, and program administration from a multidisciplinary group of faculty who serve on the CMB Steering Committee.

Program Objectives

The CMB program has been designed to respond to the evolving nature of research in the life sciences in which it was recognized that biological phenomena emerge from molecular and cellular events and that the elucidation of such processes increasingly relies on multidisciplinary approaches. In addition, new applications of sensor technology, disease diagnosis and treatment, and other emerging technologies require that scientists work across historical boundaries of their disciplines.

This is a research-oriented degree that requires advanced skills areas of biochemistry, cellular biology, molecular biology, and contemporary research techniques. Prospective students must have a high quantitative aptitude and be prepared to undertake rigorous graduate-level training in research including quantitative methods.

The Cellular and Molecular Biology Ph.D. program is open to qualified graduates of universities and colleges of recognized standing. To be admitted with full status to the program, the applicant must:

- Hold a baccalaureate degree from an educational institution of recognized standing.
- Have earned a cumulative grade point average (GPA) in all courses of at least 3.0 or equivalent at the baccalaureate level. Applications may be submitted directly to The Graduate School at any time.
• Have adequate preparation and show potential to undertake advanced study and research as evidenced by academic performance and experience.
• If possible, applicants should identify at least one Cellular and Molecular Biology faculty member with whom they wish to study.

A recent score (within 12 months) for the general Graduate Record Examination or successful completion of a relevant M.S. degree is required. No minimum GRE score is required, but investigators may use this as a piece of evidence in consideration of the student's application. Foreign students are required to have proficiency in English as shown by a TOEFL iBT of 71 or higher or an IELTS of 5.5 or higher, unless they have matriculated from an institution in which instruction is conducted in English.

The following undergraduate courses are required for graduate work in the CMB program:

• **Biology** - One year of general biology with laboratory and one course in genetics are required. Cellular biology or cellular physiology, animal or plant physiology, and microbiology are recommended.
• **Chemistry** - One year of general chemistry with laboratory and two sequential terms of organic chemistry with laboratory are required. Biochemistry is recommended.
• **Mathematics** - Two terms of life sciences calculus are required.
• **Physics** - Two sequential terms of general physics with laboratories (above the concept level) are required.
• **Recommended** - Introductory courses in computer science, statistics, and technical writing.

With program approval, up to 3 courses may be attempted within the first year of resident study to correct deficiencies in required courses. Graduate credit will not be earned for these courses.

**Applicant Selection**

Applications for the CMB program are accepted on a rolling basis throughout the year; however, for full consideration for a CMB program stipend, application must be made by the deadlines listed for fall admission (July 1). Acceptance into the program is based upon both the quality of the application and the capacity of the program.

As a program that encompasses many departments and core areas of research, as well as being an interdisciplinary training program, it is helpful to potential advisors to know what aspects of research the student is interested in. Students are encouraged to explore potential advisors' work and identify areas of interest that align with one or more CMB faculty research program(s). These areas should be addressed in the applicant's statement of purpose. If an applicant is open to a broad range of research, it is helpful to identify that as well (for example, working with plant genetics, any aspect of infectious disease, aspects of either cancer biology or therapeutics, etc). Students are only admitted to the program if a successful match with a CMB faculty member can be made, so this is a critical aspect of the application demonstrating what the student will bring to the research endeavor.

**Participating Departments/Programs**

North Dakota State University offers an interdisciplinary program leading to the doctoral degree in Cellular and Molecular Biology. The CMB program is a joint effort of the Colleges of Agriculture, Food Systems, Natural Resources; Science and Math; Health Professions; and Engineering and includes the Departments of Animal Sciences, Biological Sciences, Chemistry and Biochemistry, Coatings and Polymeric Materials, Electrical & Computer Engineering (Bioengineering), Microbiological Sciences, Pharmaceutical Sciences, Physics, and Plant Sciences.

**Financial Assistance**

Self-funded students who provide their own support through sponsored funding sources (governmental or grant funding only) may contact CMB faculty members with whom they wish to work or the CMB Director to inquire which investigators are accepting students so that a successful research mentorship can be arranged.

While the CMB program offers a limited number of competitive graduate assistantships that includes a full tuition waiver, financial support is usually provided by the department or laboratory in which the student will carry out research. Therefore, applicants are encouraged to research participating faculty members' areas of expertise and identify them in their statement of purpose. Students are encouraged to contact those with whom they would like to work regarding availability of positions and funding. In instances where specific investigators are not identified in the Statement of Purpose, the Director will contact faculty members who are accepting new students for their appraisal of the application.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOC 701</td>
<td>Comprehensive Biochemistry I (required)</td>
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<tr>
<td>BIOC 702</td>
<td>Comprehensive Biochemistry II (required)</td>
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<tr>
<td>BOT 820</td>
<td>Advanced Cell Biology</td>
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<td>Select one of the following:</td>
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<tr>
<td>BIOC 719</td>
<td>Topics in Biochemistry - Cellular Metabolism, Biochemical Pathways, Membrane Transport, and Signaling</td>
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<td>MICR 783</td>
<td>Advanced Bacterial Genetics and Phage</td>
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<tr>
<td>PLSC 731</td>
<td>Plant Molecular Genetics</td>
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Each student is expected to seek out professional development by attending regular seminars in their home department or in conjunction with their research interests (for example, a seminar series or COBRE science series). Students are required to present at least one scientific seminar per year throughout the program. In addition, students will supplement their knowledge of molecular biology, cell biology, and research techniques by fulfilling the remaining credits in their plan of study with a selection from the following list of electives. Other appropriate electives may be used if approved by the student’s advisory committee, as well as the program Director with input from the Steering Committee:

### Molecular Biology
- ANSC 773: Energy Metabolism
- ANSC 774: Nitrogen Metabolism
- ANSC 875: Vitamins and Minerals
- BIOC 716: Topics in Molecular Biology - Nucleic Acid Metabolism, Diagnostics, and Technologies
- BIOC 723: Structural Basis of Membrane Transport and Signaling
- BIOL 679: Biomedical Genetics and Genomics
- PSCI 746: Neuropharmacology
- PSCI 747: Cardiovascular Pharmacology
- PSCI 762: Advanced Biopharmaceutics
- PPTH 759: Host-Parasite Genetics
- PPTH 759: Host-Parasite Genetics

### Cellular Biology
- ANSC 813: Domestic Animal Endocrinology
- ANSC 828: Advanced Reproductive Biology
- ANSC 830: Growth Biology
- BIOC 683: Cellular Signal Transduction Processes and Metabolic Regulation
- MICR 775: Molecular Virology
- MICR 781: Advanced Bacterial Physiology
- PSCI 765: Cancer Cell Biology
- PPTH 760: Advanced Mycology
- ZOO 682: Developmental Biology

### Techniques
- ANSC 758: Molecular Biological Techniques in Animal Sciences
- BIOC 675: Computer Applications in Biochemistry and Molecular Biology
- CHEM 728: Physical Methods for Chemical and Biomolecular Research
- CHEM 729: X-Ray Structure Determination
- CPM 771: Modern Methods of Polymer Characterization
- ECE 713: Introduction to Lab-on-a-Chip Technology
- PLSC 721: Genomics Techniques

### Research
In addition to didactic credits, students take research credits to fulfill their dissertation studies on a topic of significant and original work. They must pass an oral and written preliminary examination which signifies their matriculation to doctoral candidacy. They also present a public presentation of their work in conjunction with a final dissertation examination on their research to attain the doctoral degree.

**Laura Aldrich-Wolfe**
Biological Sciences
Cornell University, 2006
Field: Community Ecology, Mycorrhizas, Plant-Fungal Interactions

**Teresa Bergholz**
Microbiological Sciences
Michigan State University, 2007
Field: Functional Genomics of Foodborne Pathogens

**Julia Bowsher**
Biological Sciences  
Duke University, 2007  
Field: Evolutionary Development and Biology

**Amanda Brooks**  
Pharmaceutical Sciences  
University of Wyoming, 2006  
Field: Molecular Biology, Spider Silk as a Drug Delivery System

**Yongki Choi**  
Physics  
City University of New York, 2010  
Field: Early Detection of Cancer Cells, Single Molecule Enzymology, Biotechnology

**Chris Colbert**  
Chemistry and Biochemistry  
Purdue University, 2000  
Field: Structure Biology with a Focus on the Biochemistry of Proteins Involved In Iron Import and Utilization

**Carl Dahlen, Ph.D.**  
University of Minnesota, 2009  
Field: Beef Cattle Production

**Glenn Dorsam**  
Microbiological Sciences  
Virginia Commonwealth University, 1998  
Field: Epigenetic Regulation

**Kendra Greenlee**  
Biological Sciences  
Arizona State University, 2004  
Field: Developmental Physiology and Immunology

**Tim Greives**  
Biological Sciences  
Indiana University, 2009  
Endocrine Regulation of Seasonality, Reproductive Neuroendocrinology, Hormones and Behavior

**Jill Hamilton**  
Biological Sciences  
University of British Columbia - 2012  
Field: Plant Evolutionary Genomics

**Lauren Hanna**  
Animal Sciences  
Texas A&M University, 2013  
Field: Quantitative Genetics, Animal Breeding, Whole System Approaches To Genomic Associations of Quantitative Traits

**Stuart Haring**  
Chemistry and Biochemistry  
Texas A&M University, 2013  
Field: Cellular DNA Duplication (Replication) and Mutation Prevention (Repair)

**Britt Heidinger**  
Biological Sciences  
University of Iowa, 2004  
Field: Physiological Ecology

**Yagna Jarajapu**  
Pharmaceutical Sciences  
Indiana University, 2007  
Field: Bone Marrow Dysfunction and Vascular Repair in Diabetes, ACE2-Angiotensin-(1-7)/Mas Receptor Pathway in Bone Marrow Cells, Regulation of Bone Marrow Mobilization by Leptin

**Estelle Leclerc**
Pharmaceutical Sciences  
Glasgow Caledonian University, 2002  
Field: Melanoma, Pancreatic Cancer; Monoclonal Antibodies as Diagnostic and Therapeutic Agents; Mechanism of RAGE Signaling  

Guodong Liu  
Chemistry and Biochemistry  
Hunan University, 2001  
Field: Development of Nano-Bioprobes for Biosensors and Bioassays for Detection of Nucleic Acids and Proteins  

Phil McClean  
Plant Sciences  
University of Paris XI, 1994  
Field: Dry Bean Genetics and Biotechnology  

Dharmakeerthi "Karthik" Nawarathna  
Electrical and Computer Engineering  
Colorado State University, 2982  
Field: Biomedical Engineering  

Stephen O'Rourke  
Pharmaceutical Sciences  
University of Wisconsin-Madison, 1995  
Field: Cerebral Vascular Function in Health and Disease  

Birgit Pruess  
Microbiological Sciences  
Ruhr-Universitat Bochum, 1991  
Field: Bacterial Physiology, Biofilm Biology, and Food Safety  

Steven Qian  
Pharmaceutical Sciences  
University of Iowa, 1999  
Field: Chemistry and Biology of Free Radical and COX-Catalyzed Fatty Acid Peroxidation as Related to Human Health and Disease  

Mohi Quadir  
Coatings and Polymeric Materials  
Freie University of Berlin, 2010  
Field: Polymeric Materials for Drug Delivery  

Sheela Ramamoorthy  
Microbiological Sciences  
Virginia Tech, 2006  
Field: Virology, Immunology, and Vaccinology  

Jiajia Rao  
Plant Sciences  
University of Massachusetts-Amherst, 2013  
Field: Food Chemistry and Ingredient Technology  

Katie Reindl  
Biological Sciences  
North Dakota State University, 2006  
Field: Cancer Cell Biology, Cancer Prevention and Treatment, Evaluating Bioactive Food Components  

Larry Reynolds  
Animal Sciences  
Iowa State University, 1983  
Field: Nutrition and Pregnancy in Ruminants  

Kenton Rodgers  
Chemistry and Biochemistry  
University of Iowa, 1988  
Field: Inorganic and Bioinorganic Chemistry  

Jane Schuh
Microbiological Sciences
North Dakota State University, 2002
Field: Environmental Allergic Asthma Triggered By Mold

**Sangita Sinha**
Chemistry and Biochemistry
Purdue University, 2000
Field: Biochemistry and Structural Biology of Host-Pathogen Interactions

**Kristine Steffen**
Pharmaceutical Sciences
North Dakota State University, 2007
Field: Biology of Obesity and Post-Bariatric Outcomes, Gastrointestinal Microbiome Research

**Chengwen Sun**
Pharmaceutical Sciences
Jilin University, 2000
Field: Blood Pressure Regulation, Cell Signaling

**Kendall Swanson**
Animal Sciences
University of Kentucky, 2000
Field: Ruminant Nutrition, Energy Metabolism, Protein Metabolism, Pancreatic Function, Beef Cattle Production

**Sathish Venkatachalem**
Pharmaceutical Sciences
University of Madras
Field: Pulmonary Physiology and Pharmacology

**Danling Wang**
Electrical and Computer Engineering
Peking University, 2003; University of Washington, 2014
Field: Sensor Design, Fabrication, and Application of Early-State Human Disease Monitoring and Diagnosis

**Alison Ward**
Animal Sciences
University of Saskatchewan, 2011
Field: Livestock Epigenetics, Nutrient-Gene Interactions, and Developmental Programming

**John Wilkinson**
Chemistry and Biochemistry
Vanderbilt University, 2001
Field: Cancer Cell Metabolism, Cell Death Pathways, Mitochondrial Gene Expression, Animal Models of Tumorigenesis

**Qifeng Zhang**
Electrical and Computer Engineering
Peking University, 2001
Field: Nanomaterials for Sensor and Biomedical Applications, Nanotechnology