The Cellular and Molecular Biology (CMB) program, approved 1988, was the first interdisciplinary graduate program at North Dakota State University (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 examination, in which students are required to author a research proposal in the format of a national granting agency 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 program graduates are in permanent positions in their field or are engaged in post-doctoral training.

Nearly 40 faculty members in many different departments and representing a variety of colleges participate as faculty mentors. The CMB program coordinator 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 is 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. For consideration for full-standing admission, 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 are 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. International students are required to have proficiency in English as shown by a TOEFL iBT of 71 or higher or an IELTS of 6 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, students may take up to three courses within the first year of resident study to correct deficiencies in required courses. These courses may not be used on the Plan of Study or towards the credits required to complete the degree.

**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 advisers to know what aspects of research the student is interested in. Students are encouraged to explore potential advisers’ 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 Mathematics; 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, 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.

In addition to the stipend, graduate assistants receive a graduate tuition waiver. Tuition waivers cover base tuition for NDSU graduate credits only. Students are responsible for differential tuition, student fees, and tuition for non-graduate level credits taken or Cooperative Education credits.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOC 674</td>
<td>Methods of Recombinant DNA Technology</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 701</td>
<td>Comprehensive Biochemistry I</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 702</td>
<td>Comprehensive Biochemistry II</td>
<td>4</td>
</tr>
<tr>
<td>BOT 820</td>
<td>Advanced Cell Biology</td>
<td>3</td>
</tr>
</tbody>
</table>

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 supervisory committee, as well as the program director with input from the Steering Committee.
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

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

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

Christopher 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  
Animal Sciences  
University of Minnesota, 2009  
Research Interests: 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

Ang Guo  
Pharmaceutical Sciences  
Chinese Academy of Sciences - 2010  
Field: Cardiovascular Disease

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

Jiha Kim  
Biological Sciences  
University of Georgia, 2006  
Field: Tumor Microenvironment

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 "Keerthi" Nawarathna  
Electrical and Computer Engineering  
University of Houston, 2005
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

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

Sheela Ramamoorthy
Microbiological Sciences
Virginia Polytechnic Institute and State University, 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 and Pharmacology

Lawrence 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

Sarah Signor
Biological Sciences
University of California-Davis, 2013
Field: Insect Evolutionary Genomics

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 Venkataraman  
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

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