Biochemistry and Molecular Biology

 Degrees Offered

- Doctor of Philosophy
- Joint Doctor of Medicine and Doctor of Philosophy

The disciplines of biochemistry and molecular biology seek to understand biology by exploring the functions of the molecular components of cells. A major goal of this program is to foster ability for independent thought. To this end, our faculty cultivates an open, collegial relationship with one another and with our students. Close collaboration between scientists, the sharing of ideas, and open inquiry are critical components of our training plan. Our goal is to develop independence as a scientist.

The hallmarks of graduate training in biochemistry and molecular biology are the emphasis placed on the use of the scientific literature in advanced coursework and on protecting time for laboratory research. In addition, students will have time for professional development through seminar presentation, attendance at national meetings, teaching opportunities, and seminar programs both within the department and throughout the Health Sciences Center.

The doctoral program in Biochemistry and Molecular Biology focuses on the understanding of biology by exploring the functions of the molecular components of cells. The goal of the program is to foster the student's ability for independent thought, in preparation for a career as an independent scientist. During the second year, specialized courses in biochemistry are offered as students continue their research projects. During subsequent years, students emphasize independent dissertation research, and a few formal courses may be taken. Completion of the Ph.D. degree is realized when the student successfully presents the research results to faculty of the graduate dissertation committee and program/department. Typically, four to five years are required to realize this goal.

Faculty research in the program can provide the student with training in multiple basic sciences areas:

- Regulation of gene expression
- Chromatin silencing
- RNA processing
- Cell survival mechanisms
- Regulation of metabolism
- Regulation of signal transduction by nutrients and metabolites
- Proteosome function
- Cell proliferation and cell cycle regulation
- Cell adhesion
- Kinases and phosphatases in signal transduction mechanisms involved in cancer cell metabolism
- Spirochete biology
- Oxidant-induced cellular stress
- Structure/function relationships of proteins
- Molecular genetics of visual and auditory development
- G protein-mediated signaling in retina photoreceptors
- Molecular basis of age-related blindness
- Development and application of new magnetic resonance approaches to biomedicine

These research areas provide fundamental knowledge toward both the normal health-state and the amelioration of multiple diseases: atherosclerosis, blindness, cancer, deafness, diabetes, and metabolic disorders.

FACULTY

GRADUATE PROGRAM DIRECTOR
- Brad Hillgartner, Professor - Ph.D. (Michigan State University)

ASSOCIATE PROFESSORS
- Yehenew Agazie - Ph.D. (University of Saskatchewan)
- Michael Gunther - Ph.D. (Colorado State University)
- Pete Mathers - Ph.D. (California Institute of Technology)
- Visvanathan Ramamurthy - Ph.D. (Weslyan University)
- Andrew Shiemke - Ph.D. (Oregon Graduate Institute)
- Maxim Sokolov - Ph.D. (Weizmann Institute of Science)

PROFESSORS
- Steven Frisch - Ph.D. (University of California-Berkeley)
- Valery Khramtsov - Ph.D. (Institute of Chemical Kinetics and Combustion)
- Qiang Ma - Ph.D. (Rutgers University)
- Vaishaikurichi Rajendran - Ph.D. (University of Madras)
- Mike Ruppert - Ph.D. (Johns Hopkins University)
- Lisa Salati - Ph.D. (University of Minnesota)
- Michael Schaller - Ph.D. (McMaster University)
- George Spirou - Ph.D. (University of Florida)

ASSISTANT PROFESSORS
- Roberta Leonardi - Ph.D. (University of Southampton)
- Elena Pugacheva - Ph.D. (Russian Academy of Science)
- Aaron Robart - Ph.D. (University of Calgary)
- David Smith - Ph.D. (University of South Florida)
- Peter Stoiilov - Ph.D. (Friedrich Alexander University)
- Mark Tseytlin - Ph.D. (Russian Academy of Sciences)
- Eric Tucker - Ph.D. (University of Arizona)

RESEARCH ASSISTANT PROFESSOR
- Andrey Bobko - Ph.D. (Institute of Chemical Kinetics and Combustion)
- Alexey Ivanov - Ph.D. (Russian Academy of Sciences)

Doctor of Philosophy

MAJOR REQUIREMENTS

A minimum GPA of 3.0 is required.

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<th>Course Code</th>
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<th>Credits</th>
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<tr>
<td>BMS 700</td>
<td>Scientific Integrity</td>
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<td>BMS 702</td>
<td>Biomedical Lab Experience</td>
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<td>BMS 706</td>
<td>Cellular Methods</td>
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<td>Experiential Learning for Biomedical Trainees</td>
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<td>BMS 715</td>
<td>Molecular Genetics</td>
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<td>BMS 720</td>
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<td>Biochemistry and Molecular Biology Journal Club</td>
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Advanced Graduate Course - select one of the following: 4

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<td>Protein Chemistry/Enzymology</td>
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<tr>
<td>BIOC 751</td>
<td>Advance Molecular Biology</td>
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<td>CCB 701</td>
<td>Biochemical and Oncogenic Signaling</td>
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Advanced Graduate Course - select one of the following: 3-5

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<tr>
<td>CCB 701</td>
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Seminars and Research Forum

Students will present three seminars during their graduate study. The first seminar is on a topic outside of the student’s research area. The second seminar is the public presentation of the dissertation proposal, which is the background and proposed research for the dissertation project. The third seminar is the public presentation of the dissertation defense.

Journal Club

Students are required to enroll in Journal Club each semester. The course involves the presentation and discussion of current research papers and will help acquaint students with the variety of methods used in scientific research.

Doctoral Research

Students will conduct research with a dissertation mentor during time in the program. Students register for research credits each semester, and their performance is graded by their dissertation mentor.

Qualifying and Dissertation Proposal/Ph.D. Candidacy

The written qualifying exam is given at the end of the first year of study. The candidacy is completed in the second year of study. Admission to Ph.D. candidacy occurs following the successful defense of the dissertation proposal.

Dissertation Defense and First-Author Paper Requirement

Students are allowed to defend their dissertation when a minimum of one manuscript with the student as first author, based on dissertation research, is accepted in a peer-reviewed journal. The final examination for the Ph.D. degree consists of orally defending a written dissertation in a public seminar and then in private to the dissertation committee. Satisfactory performance in the oral defense will result in recommendation for granting of the PhD.

Suggested Plan of Study*

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<th>First Year</th>
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Biochemistry and Molecular Biology

Fourth Year

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<th>Fall Hours</th>
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Total credit hours: 87

NOTE: The graduate curriculum is finalized with a plan of study once the mentor and laboratory have been selected in the first year. The plan of study is developed by the graduate committee in consultation with the student. The courses listed above include the required and elective coursework necessary for the student to finalize his/her plan of study. When the student enters the laboratory of his/her doctoral dissertation mentor repetitive enrollments in research, seminars, and colloquia are typical and will determine total hours necessary for degree completion.

*This is a suggested plan of study. Course sequences and length of time in program may vary depending on student and altered total credit hours.

Major Learning Goals

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Students will:

- Demonstrate a general knowledge of physics, chemistry, biology and cell biology, biochemistry and molecular biology, and a detailed knowledge of his or her area of research
- Be familiar with the research literature in biochemistry and in their specific field of study and should have the ability to keep abreast of major developments and to acquire a working background in any area
- Demonstrate skill in the recognition of meaningful problems and questions for research in Biochemistry and Molecular Biology
- Possess technical skill in laboratory manipulation
- Demonstrate that oral, written, and visual communication skills have been acquired
- Demonstrate skill in designing experimental protocols and in conducting productive self-directed research

COURSES

**BIOC 531. General Biochemistry. 4 Hours.**
PR: General chemistry, organic chemistry. (For pharmacy students; others by consent.) Consisting of the lecture portion of BIOC 705, this course is designed to be a general introduction to biochemical compounds, processes and concepts for students in the pharmacy program. Master's program students and others by consent. Four lectures per week.

**BIOC 551. Cell and Molecular Biochemistry 1. 4 Hours.**
PR: General Chemistry and Organic Chemistry. Part I of a two-semester graduate-level course that instills comprehension of biochemistry, molecular biology and cell biology necessary for bio-medical research. This course covers biochemical principles, proteins, and molecular biology.

**BIOC 552. Cell and Molecular Biochemistry 2. 4 Hours.**
PR: BIOC 551. Part II of a two-semester graduate-level course that instills comprehension of biochemistry, molecular biology and cell biology necessary for bio-medical research. This course covers metabolism, metabolic regulation, cell structure and cellular communication.

**BIOC 595. Independent Study. 1-6 Hours.**
Faculty supervised study of topics not available through regular course offerings.

**BIOC 650. Supervised Teaching. 1-6 Hours.**
PR: Consent. Supervised college teaching of biochemistry.

**BIOC 652. Journal Club. 1-6 Hours.**
Discussions of recent important topics in scientific literature.

**BIOC 690. Teaching Practicum. 1-3 Hours.**
PR: Consent of chairperson. Supervised practice in college teaching of biochemistry. (Graded as S/U.).

**BIOC 693A-Z. Special Topics. 1-6 Hours.**
A study of contemporary topics selected from recent developments in the field.

**BIOC 697. Research. 1-15 Hours.**
PR: Consent. Research activities leading to thesis, problem report, research paper, or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

**BIOC 698. Thesis or Dissertation. 1-6 Hours.**
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.
BIOC 699. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use the University's facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department's 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.

BIOC 701. Biochemical and Oncogenic Signaling. 3 Hours.
This advanced course is designed for upper level graduate students. It will focus on the biochemical and oncogenic mechanisms of cellular signaling. Students will explore the experimental techniques required to understand the scientific literature in biochemistry and cancer cell biology. (cross listed as CGB 701).

BIOC 705. General Biochemistry. 5 Hours.
PR: General chemistry, organic chemistry. (For dental students.) General introduction to biochemical compounds, processes and concepts as part of the training for the practice of dentistry, including passage of the Dental Board Exam. Four lectures and one clinical correlation or small group discussion per week.

BIOC 750. Protein Chemistry/Enzymology. 4 Hours.
PR: Consent. Advanced topics in protein structure function relationships and enzymology. Emphasis is placed on emerging topics in the literature.

BIOC 751. Advance Molecular Biology. 4 Hours.
PR: Consent. A study of contemporary topics in molecular biology. This is an advanced seminar-style class using material from the current literature.

BIOC 785. Biochemistry and Molecular Biology Journal Club. 1 Hour.
(May be repeated for a maximum of 16 credit hours.) Guided reading and critiquing of the current scientific literature for graduate students in the Biochemistry and Molecular Biology Graduate Programs.

BIOC 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of biochemistry. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading will be S/U.).

BIOC 791A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

BIOC 792A-B. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

BIOC 793. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

BIOC 794. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

BIOC 796. Graduate Seminar. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

BIOC 797. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

BIOC 798. Thesis or Dissertation. 1-6 Hours.
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

BIOC 799. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use the University's facilities, and participate in its academic and cultural programs. Note: graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department's 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.