

DEPARTMENT OF BIOCHEMISTRY AND BIOPHYSICS (GRAD)

The Department of Biochemistry and Biophysics is an administrative division of the School of Medicine and a member of The Graduate School. The graduate program offers instruction and research opportunities leading to the Ph.D. degree. Applicants are offered admission with the expectation that they will complete their doctorate. While the curriculum is designed as a Ph.D. program, a terminal master's degree can be offered under special circumstances.

Modern research in biochemistry and biophysics is designed to address mechanism and function; it utilizes the paradigms of molecular biology but is influenced by chemistry, physics, and genetics. The philosophy of the department and its graduate program is to provide students with broad training in modern approaches to the field and unique opportunities for multidisciplinary training.

Financial Aid and Admissions

Funds available from the University, the department, and individual research grants provide stipends for students. All applicants are considered for special fellowships and research or teaching assistantships. Students typically receive a stipend and coverage of in-state tuition and fees, along with major medical insurance. Nonresidents with predoctoral fellowships or assistantships are recommended for special tuition rates. Applications are considered from prospective graduate students who present evidence of superior scholarship in biology, chemistry, or biochemistry. The department recommends that students prepare themselves by taking general and organic chemistry, biochemistry, biology, physics, and calculus. It is anticipated that students who have not had these courses will take them, as appropriate, after their arrival. Departmental information may be obtained through the department's website (<http://www.med.unc.edu/biochem/>). Applicants should apply online at The Graduate School's admission website (<http://gradschool.unc.edu/admissions/>).

Research Interests

Faculty member's research interests are diverse and include research in the following areas: cell signaling and growth control, DNA repair and replication, membrane biophysics and function, molecular regulation including transcriptional control, nervous system development and function, and protein structure/function, including enzymology. Model systems used by the faculty range from bacteria to mammals; techniques span molecular biology to physical biochemistry. Please visit the department's website (<http://www.med.unc.edu/biochem/>) for more information.

Facilities

The departmental research facilities are centered in the Genetic Medicine Building, which is within walking distance of other medical school departments, research centers, and the departments of biology, chemistry, and physics. The building is equipped with instruments for molecular biological, biochemical, structural, and biophysical research. Animal care facilities are available to support the department's research endeavors. Research and training support is provided by several core facilities on campus.

Biochemistry and Biophysics, Doctoral Program (Ph.D.)

We offer a PhD with two customizable tracks in either Biochemistry or Biophysics, and we support our students with an array of resources and opportunities for professional growth. Our curriculum includes course requirements for all departmental students intended to help you with skills essential to careers in science. We additionally have course requirements specific to each track, both the Biochemistry & Molecular Biology track, as well as the Biophysics track, to emphasize basic skills and principles, and yet be sufficiently flexible to allow students to focus on different research areas.

Course Requirements

Biochemistry Track

Code	Title	Hours
Core Courses		
BIOC 701	Critical Analysis in Biochemistry	2
BIOC 710	Scientific Communication ¹	4
GNET 888	Responsible Conduct of Research	1
6 credit hours are required from the list below:		6
BIOC 631	Advanced Molecular Biology	
BIOC 650	Macromolecular Thermodynamics and Binding	
BIOC 651	Macromolecular Interactions and Forces	
BIOC 652	Macromolecular Dynamics	
BIOC 706	Biochemistry of Human Disease	
BIOC 740	Contemporary Topics in Cell Signaling: Phosphorylation Control	
BIOC 741	Contemporary Topics in Cell Signaling: GTPases	
BIOC 742	Contemporary Topics in Cell Signaling: Cell Cycle Control	
BIOC 744	Topics on Stem Cells and Development	
BIOC 745	Intercellular Signaling in Development and Disease	
Electives		4
Choose from any graduate-level course in a discipline supportive of biomedical research training, excluding the Biochemistry track and Departmental core courses.		
Thesis/Substitute or Dissertation		
BIOC 994	Doctoral Research and Dissertation ²	3
Minimum Hours		36

¹ Take twice for a total of 4 credits. Students matriculating prior to fall 2021- BIOC 712 (2 credits) and BIOC 715 (2 credits) is equivalent to taking BIOC 710 twice.

² Students must take BIOC 994 twice for a minimum of 6 credit hours.

Biophysics Track

Code	Title	Hours
Core Courses		
BIOC 650	Macromolecular Thermodynamics and Binding	1
BIOC 651	Macromolecular Interactions and Forces	1
BIOC 652	Macromolecular Dynamics	1
BIOC 662	Macromolecular Interactions ³	1
BIOC 704	Seminars in Biophysics	2
BIOC 710	Scientific Communication ¹	4
BIOC 888	Responsible Conduct of Research	1

3 modules are required from the list below:

BIOC 663A	Macromolecular NMR
BIOC 663B	Macromolecular NMR Practice
BIOC 664	Macromolecular Spectroscopy
BIOC 665	Advanced NMR Spectroscopy Course
BIOC 666	X Ray Crystallography of Macromolecules
BIOC 667	Macromolecular Crystallographic Methods
BIOC 669	Macromolecular Crystallographic Methods II
BIOC 670	Structural Bioinformatics ³
BIOC 673	Proteomics, Protein Identification and Characterization by Mass Spectrometry
BIOC 675	Fundamentals of Cryo-Electron Microscopy
BCB 715	Mathematical and Computational Approaches to Modeling Signaling and Regulatory Pathways
PHCO 750	Proteomics Methods and Applications
BMME 590	Special Topics in Biomedical Engineering or BMME 891 Special Topics

Electives

Choose from any graduate-level course in a discipline supportive of biomedical research training, excluding the Biophysics track and Departmental core courses. For students matriculating before 2023, a minimum of one elective credit hour is required. Alternative courses approved by DGS.

Thesis/Substitute or Dissertation

BIOC 994	Doctoral Research and Dissertation ²	3
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Minimum Hours 36

¹ Take twice for a total of 4 credits. Students matriculating prior to fall 2021- BIOC 712 (2 credits) and BIOC 715 (2 credits) is equivalent to taking BIOC 710 twice.

² Students must take BIOC 994 twice for a minimum of 6 credit hours.

³ Students taking BIOC 662 as a core course may take BIOC 670 as one of their module courses and vice versa.

Milestones

The following list of milestones (non-course degree requirements) must be completed; view this list of standard milestone definitions (<https://catalog.unc.edu/graduate/degree-programs/#milestonestext>) for more information.

- Doctoral Committee
- Doctoral Oral Comprehensive Exam
- Doctoral Written Exam
- Prospectus Oral Exam
- Advanced to Candidacy
- Dissertation Defense
- Doctoral Dissertation Approved/Format Accepted
- Residence Credit
- Doctoral Exit Survey
- Doctoral Teaching Experience (Teaching assistant position)
- Doctoral Manuscript Submission (Published first-author or co-first authored manuscript prior to student's defense)
- Doctoral Intradepartmental Review (Annual Committee Meeting and individualized Development Plan submission)

3 Following the faculty member's name is a section number that students should use when registering for independent studies, reading, research, and thesis and dissertation courses with that particular professor.

Professors

Wolfgang Bergmeier, Adhesion Mechanisms of Platelets and Neutrophils

Brian Button, Mucus Biophysical Properties, Role of the Periciliary Layer (PCL), and Mechanisms of Mucociliary Clearance in the Airways

Sharon Campbell (18), Structural Biology of Regulator Molecules in Cell Growth Control and Cell Adhesion

Charles W. Carter Jr. (19), Protein Crystallography, Structural Polymorphism and Function

Xian Chen (12), Systems Cancer Biology and Immunology, Cancer Therapeutic Response, Protein-Protein Interaction Networks

Jean Cook (150), Cell Cycle Control in Human Cells, Cell Proliferation Dynamics, Genome Stability Control, Molecular Biology, Quantitative Single Cell Analysis

Henrik Dohlman (17), Regulators of G Protein Signaling, Mechanisms of Drug Desensitization

Zbigniew Dominiki, Epigenetics, Histone, Structural Biology, Cryo-EM

Jack Griffith, Research Structure of Telomeres: How They Control Cell Aging and Death

Hengming Ke (50), X-ray Protein Crystallography and Biochemistry

Brian Kuhlman (72), Protein Design, Protein Therapeutics, and Molecular Modeling

Andrew Lee (71), Protein Dynamics, Allostery, NMR Spectroscopy, Click Chemistry, Protein Biophysics, Thymidylate Synthase

Patricia F. Maness (68), Specification of Neuronal Connectivity by Cell Recognition Molecules

William F. Marzluff (69), Biochemical & Genetic Analysis of Histone mRNA Processing & Histone Locus Body Formation in Drosophila

Gary Pielak (99), Protein Biophysics Emphasizing Studies in Living Cells

Dale Ramsden (108), Chromosome Breaks, DNA Repair, Enzymes that Repair DNA, Targeting DNA Repair for Cancer Therapy, RNA in the Chromosome

Matthew Redinbo (110), Drug Discovery and the Gut Microbiome

Aziz Sancar (105), DNA Repair Enzymology and Genomics, Mammalian Circadian Clock, Control of DNA Repair by the Circadian Clock

John Sondek (117), Rho GTPases, Dbl-Family RhoGEFs, Phospholipase C Isozymes, Drug Discovery

Brian Strahl (120), Histone Modifications and Epigenetics; Core Techniques: Yeast Genetics, Peptide Synthesis, Peptide Arrays, Mammalian Cell Culture

Ronald I. Swanstrom (123), HIV, Pathogenesis, Replication, NeuroAIDS, Latency, Resistance

Brenda Temple, Bioinformatics, Molecular Structural Analysis, Molecular Dynamics Simulations, Molecular Evolution, Molecular Modeling, Protein-Protein Interaction Prediction

Ashutosh Tripathy, Core Director Mac-in-Fac, Macromolecular Interactions

Cyrus Vaziri, Regulation of DNA Replication and S-Phase Checkpoints, and Post-Replication DNA Repair on Mammalian Cells

Yue Xiong (140), Molecular Mechanisms of Cell Cycle Control, Tumor Suppression and Development

Qi Zhang, Molecular Basis of RNA Function

Associate Professors

Jill Downen, Three-Dimensional Genome Organization and Gene Expression in Stem Cells and Cancer Cells

Krzysztof Krajewski, Core Director of High-Throughput Peptide Synthesis, Peptide Chemistry and Synthesis, Peptide Arrays, Application of Peptides in Biochemical Assays, Histone PTMs

Silvia M Kreda, UNC Cystic Fibrosis Ctr./ Marsico Lung Inst.

Karin Leiderman, Mathematical Biology, Mathematical Modeling of Biochemical Systems, Especially Blood Coagulation, and Computational Biofluid Dynamics

Laura Lindsey-Bolts, DNA Damage, Checkpoint, Excision Repair

Pengda Liu, Cell Signaling; Cancer; mTOR; Akt; Post-Translational Modification; Protein-Protein Interaction

Rob McGinty, Mechanisms of Epigenetic Signaling

Saskia Neher, Lipoprotein Lipase, Heart Disease, Cryo-EM, Drug Discovery, Enzymology, ANGPTL4, Lipids, Structural Biology

Silvia Ramos, Biochemistry, Immunology, Gene Regulation, RNA

Assistant Professors

Rick Baker, Structural Biology, Membrane Trafficking, Cancer Biology, Cryo-EM Methods Development

Rebecca Berlow, Intrinsically Disordered Proteins, Protein-Protein Interactions, Protein Dynamics and Allostery, NMR Spectroscopy, Structural Biology, Biophysics

Joshua Boyer

Venkata Chirasani, R.L. Juliano Structural Bioinformatics Core Director

Gaorav Gupta, Genome Integrity Pathways and Breast Cancer Initiation, Progression, and Response to Therapy

Guochun Jiang, Transcription of HIV, Epigenetics, NF-KappaB Signaling, HIV-Associated Neurocognitive Disorders, HIV Cure Strategies

Robert Lee, Adhesion Mechanism of Platelets and Neutrophils, Thrombotic Disorders, Platelet Signaling, Platelet Transfusion, Anti-Platelet Therapy

Zhijun Li

Stuart Parnham, Director of UNC Biomolecular NMR Core

David Paul, Adhesion Mechanism of Platelets and Neutrophils, Thrombotic Disorders

Nikea Pittman, Instructor

Christopher Selby, Instructor, DNA Repair

Chrystal Starbird, Receptor Signaling, Protein-Protein Interactions, Structural Biology, Crystallography, Cryo-EM

Joshua Strauss, Director of Cryo-EM Core, Cellular and Structural Biology, Biological Electron Microscopy, Cryo-Electron Microscopy

Ling Xie, Biophysical Studies

Yanyan Yang, Circadian Rhythm, DNA Repair

Shuntai Zhou, HIV Center

Professors Emeriti

Michael Caplow

Stephen G. Chaney

Stephen Crews

Ann Erickson

Beverly Erred

Howard Fried

Barry R. Lentz

Gwendolyn B. Sancar

Thomas W. Traut

Richard Wolfenden

IMPORTANT: Not all courses are offered every year. Students should check with Director of Graduate Studies Wolfgang Bergmeier (bergmeie@email.unc.edu) or the student services administrator before they register for classes.

Advanced Undergraduate and Graduate-level Courses

BIOC 601. Enzyme Properties, Mechanisms, and Regulation. 3 Credits.

Focuses on enzyme architecture to illustrate how the shapes of enzymes are designed to optimize the catalytic step and become allosterically modified to regulate the rate of catalysis.

Rules & Requirements

Requisites: Prerequisite, CHEM 430; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

BIOC 603. MiBio Seminar. 2 Credits.

This class is designed to 1) enhance students' ability to present scientific material to their peers in a comprehensive, cohesive manner, 2) familiarize students with scientific concepts and technologies used in multiple disciplines, 3) expose students to cutting edge research, 4) prepare students to gain substantial meaning from seminars and to ask questions, and 5) enhance students' ability to evaluate scientific papers and seminars.

Rules & Requirements

Grading Status: Letter grade.

Same as: BIOL 603, CBPH 603, GNET 603.

BIOC 631. Advanced Molecular Biology. 4 Credits.

This course explores cutting edge research in molecular biology – the investigation at molecule-scale of the mechanisms behind life. We briefly review core-principles in molecular biology, then investigate more recent research that extends or overturns these core principles.

Rules & Requirements

Requisites: Prerequisites, BIOL 202, or BIOL 220, or CHEM 430, and permission of the course director.

Grading Status: Letter grade.

Same as: GNET 631, BIOL 631, MCRO 631.

BIOC 632. Advanced Molecular Biology II. 3 Credits.

Required preparation for undergraduates, at least one undergraduate course in both biochemistry and genetics. The purpose of this course is to provide historical, basic, and current information about the flow and regulation of genetic information from DNA to RNA in a variety of biological systems. Three lecture hours a week.

Rules & Requirements

Grading Status: Letter grade.

Same as: GNET 632, BIOL 632, MCRO 632.

BIOC 649. Mathematics and Macromolecules. 1.5 Credits.

This course focuses on the application of mathematics to topics important in biophysics, such as thermodynamics and electrostatics. The unit is designed to help students perform more efficiently in BIOC 650, 651, and 652.

Rules & Requirements

Grading Status: Letter grade.

BIOC 650. Macromolecular Thermodynamics and Binding. 1 Credits.

Required preparation, two semesters of physical chemistry or permission of the instructor. Basic molecular models and their use in developing statistical descriptions of macromolecular function. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisite, CHEM 430.

Grading Status: Letter grade.

BIOC 651. Macromolecular Interactions and Forces. 1 Credits.

Required preparation, two semesters of physical chemistry or permission of the instructor. Macromolecules as viewed with modern computational methods. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisite, CHEM 430.

Grading Status: Letter grade.

BIOC 652. Macromolecular Dynamics. 1 Credits.

Required preparation, two semesters of physical chemistry or permission of the instructor. Stability of macromolecules and their complexes with other molecules. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisite, CHEM 430.

Grading Status: Letter grade.

BIOC 655. Case Studies in Structural Molecular Biology. 3 Credits.

Principles of macromolecular structure and function with emphasis on proteins, molecular assemblies, enzyme mechanisms, and ATP enzymology.

Rules & Requirements

Requisites: Prerequisite, CHEM 430; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

BIOC 660. Introduction to Light Microscopy. 1 Credits.

Fundamentals of optics and light microscope design for the novice student.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652 or permission of the course director.

Grading Status: Letter grade.

BIOC 662. Macromolecular Interactions. 1 Credits.

Theory and practice of biophysical methods used in the study of interactions between macromolecules and their ligands, including surface plasmon resonance, analytical ultracentrifugation, and calorimetry.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

BIOC 663A. Macromolecular NMR. 1 Credits.

Principles and practice of nuclear magnetic resonance spectroscopy: applications to biological macromolecule structure and dynamics in solution. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

BIOC 663B. Macromolecular NMR Practice. 1 Credits.

Lab section for BIOC 663A. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisite, BIOC 664; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

BIOC 664. Macromolecular Spectroscopy. 1 Credits.

Required preparation, two semesters of physical chemistry or permission of the instructor. Principles of UV, IR, Raman, fluorescence, and spin resonance spectroscopies; applications to the study of macromolecules and membranes. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisite, CHEM 430.

Grading Status: Letter grade.

BIOC 665. Advanced NMR Spectroscopy Course. 1 Credits.

Advanced NMR Spectroscopy

Rules & Requirements

Grading Status: Pass/Fail.

BIOC 666. X Ray Crystallography of Macromolecules. 1 Credits.

Principles of protein crystallography, characterization of crystals, theory of diffraction, phasing of macromolecular crystals and structure refinement. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

BIOC 667. Macromolecular Crystallographic Methods. 2 Credits.

A combined lecture/laboratory workshop for serious students of protein crystallography. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisite, permission of the instructor.

Grading Status: Letter grade.

Same as: PHCO 667.

BIOC 668. Principles of and Simulation of Macromolecular Dynamics. 1 Credits.

A combined lecture/computer lab treatment of the principles of macromolecular dynamics and structure as approached using the tools of molecular dynamics simulations. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

BIOC 669. Macromolecular Crystallographic Methods II. 1 Credits.

A combined lecture/laboratory workshop for serious students of protein crystallography or cryo-electron microscopy, addressing experimental model building, refinement, and analysis. Course intended primarily for graduate students. BIOC 667 is recommended for crystallography students. Permission of the instructor for students lacking the prerequisite.

Rules & Requirements

Requisites: Prerequisite, BIOC 666 or BIOC 675.

Grading Status: Letter grade.

Same as: PHCO 669.

BIOC 670. Structural Bioinformatics. 1 Credits.

A combined lecture/computer lab course introducing the methods and principles of biological data management as this relates to macromolecular sequence analysis. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

Same as: BCB 670.

BIOC 671. Summer Research in Biophysics. 3 Credits.

This class is a 10-week summer course in biophysics.

Rules & Requirements

Grading Status: Letter grade.

BIOC 673. Proteomics, Protein Identification and Characterization by Mass Spectrometry. 1 Credits.

A lecture module that introduces students to mass spectrometry-based proteomics in new biology discovery and precision medicine. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652, or one semester of physical chemistry; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

BIOC 674. Ion Channels Transporters. 1 Credits.

Ion Channels Transporters

Rules & Requirements

Grading Status: Pass/Fail.

BIOC 675. Fundamentals of Cryo-Electron Microscopy. 1 Credits.

This course will provide a survey of biological applications of cryo-EM, with a particular emphasis on single particle techniques used to determine high-resolution structures of macromolecules. Students will have a basic understanding of cryo-EM theory, the methodology for creating samples and collecting data, and strategies for reconstructing 3D models of macromolecules. Course previously offered as BIOC 708.

Rules & Requirements

Grading Status: Letter grade.

BIOC 678. Electrical Signals from Macromolecular Assemblages. 2 Credits.

An intensive, six-hour per week introduction to the fundamentals of ion channel biophysics, including laboratory sessions to demonstrate principles and methods. Course intended primarily for graduate students.

Rules & Requirements

Requisites: Prerequisites, BIOC 650, 651, and 652; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

BIOC 690. Special Topics in Biochemistry. 1-3 Credits.

Special topics course. Content and topics will vary each semester.

Rules & Requirements

Grading Status: Letter grade.

Graduate-level Courses

The following seminar courses are designed for students majoring or minoring in biochemistry who wish to further their knowledge in

particular areas. Unless otherwise stated, two semesters of biochemistry are prerequisites for seminar courses. Most of these courses are given in alternate years by interested staff members. Unless otherwise stated, these seminars may not be repeated for credit. Seminar courses provide teaching experience, which is required for a graduate degree in biochemistry and biophysics. In addition, the courses provide experience in giving a critical review of the current literature.

BIOC 700. Origins and Early Evolution of Life. 2 Credits.

Critical reading and discussion in the origins of, metabolism, inheritance, and natural selection, and biological complexity

Rules & Requirements

Grading Status: Letter grade.

BIOC 701. Critical Analysis in Biochemistry. 2 Credits.

Permission of the instructor. Critical analysis of research papers from departmental seminar series, student presentations, meet seminar speakers, learn about departmental research and current techniques.

Rules & Requirements

Grading Status: Letter grade.

BIOC 702. Advanced Topics in Chromatin and Epigenetics. 2 Credits.

Each class covers a unique topic in epigenetics and provide a historical view of the major discoveries that shaped the field with discussions and examinations of current literature.

Rules & Requirements

Grading Status: Letter grade.

BIOC 703. Seminars in Chromatin and Epigenetics. 0.5 Credits.

Designed to expose students to the broad epigenetic research interests of our large epigenetics focused faculty and expose students to a broad range of epigenetics research techniques.

Rules & Requirements

Repeat Rules: May be repeated for credit. 1 total credits. 2 total completions.

Grading Status: Letter grade.

Same as: PHRS 712.

BIOC 704. Seminars in Biophysics. 2 Credits.

Permission of the instructor. Students present seminars coordinated with the visiting lecturer series of the Program in Molecular and Cellular Biophysics.

Rules & Requirements

Grading Status: Letter grade.

Same as: BIOL 704.

BIOC 705. Advanced Biophysics Laboratory. 2-4 Credits.

Permission of the program director. Designed to introduce students in the Molecular and Cellular Biophysics Program to research methods. Minor investigative projects are conducted with advice and guidance of the staff. May be repeated for credit.

Rules & Requirements

Grading Status: Letter grade.

BIOC 706. Biochemistry of Human Disease. 3 Credits.

Required preparation, biochemistry. Permission of the instructor. Graduate level, involves lectures, critical readings, and discussions of biochemical aspects of human diseases. Core biochemical principles and cutting edge approaches are considered in the following: amyotrophic lateral sclerosis, Alzheimer's, cancer, cystic fibrosis, HIV, thrombosis and heart disease, schizophrenia, V(D)J recombination, and neglected diseases.

Rules & Requirements

Grading Status: Letter grade.

BIOC 707. Cellular Metabolism and Human Disease. 2 Credits.

Open to 1st year BBSP or advanced graduate students with background in basic cellular biochemistry. Permission of the instructor. Addresses the role of cellular metabolism in human disease, including the roles and regulation of biochemical pathways. Recent advances will be emphasized. Diseases addressed will include cancer and diabetes.

Rules & Requirements

Grading Status: Letter grade.

BIOC 710. Scientific Communication. 2 Credits.

Scientific communication is designed to help graduate students improve their scientific communication skills through practice and feedback from instructors and peers. The course will cover both written and oral communication. Both topics are covered in recognition of the commonalities in clarity, organization, and delivery shared by successful scientific communication. Course instructors will provide direction on effective organization and delivery of research products, specifically presentations and grant proposals.

Rules & Requirements

Repeat Rules: May be repeated for credit. 4 total credits. 2 total completions.

Grading Status: Letter grade.

BIOC 711. Research Concepts in Biochemistry. 2 Credits.

Master's candidates in biochemistry and biophysics only. A series of lectures and exercises on formulating a research plan to attack a specific scientific problem, and on presenting the research plan in the form of a grant proposal.

Rules & Requirements

Grading Status: Letter grade.

BIOC 712. Scientific Writing. 3 Credits.

Doctoral candidates in biochemistry and biophysics only. A course of lectures and workshops on the principles of clear scientific exposition with emphasis on the design and preparation of research grants.

Rules & Requirements

Grading Status: Letter grade.

BIOC 715. Scientific Presentation. 1 Credits.

Senior graduate students present original research results as a formal seminar. Feedback on presentation effectiveness and style will be provided by faculty instructors and classmates.

Rules & Requirements

Grading Status: Letter grade.

BIOC 716. Biophysics Colloquium. 0.5 Credits.

The biophysics colloquium provides a variety of professional training opportunities to students in the Molecular and Cellular Biophysics program. Training and learning activities include career development workshops, alumni panels, research presentations from faculty, discussion on topics in rigor and reproducibility, student conference reports and student practice talks in preparation for oral exams.

Rules & Requirements

Repeat Rules: May be repeated for credit. 2 total credits. 4 total completions.

Grading Status: Letter grade.

BIOC 720. The Biochemistry of HIV Replication, Inhibitors, and Drug Resistance. 2 Credits.

Seminar/discussion/literature course on structure-function of HIV proteins. Discussion of polymerases, proteases, protein-protein interactions, protein degradation pathways, protein-nucleic acid recognition, transcriptional control, RNA splicing and transport, and mechanisms of drug resistance.

Rules & Requirements

Grading Status: Letter grade.

BIOC 721. Cell Regulation by Ubiquitination. 2 Credits.

Required preparation, two semesters of biochemistry. Lecture and literature-based discussion course on ubiquitin-mediated regulation of hormone receptor signaling, trafficking, and degradation.

Rules & Requirements

Grading Status: Letter grade.

BIOC 722A. Cellular and Molecular Neurobiology: Introduction and Electrical Signaling. 2 Credits.

Permission of the department. This course explores the experimental and theoretical function of the nervous system. Typically, the first hour is fundamental material presentation and the second hour may be a presentation led by the students. Topics covered include: cellular diversity in the CNS, gross brain anatomy, human and rodent brain imaging, neuromolecular genetics, behavioral methods, membrane potentials/resistance/capacitance, ion channel structure, electrophysiology and propagation of electrical signals in neurons. Basic undergraduate biology, chemistry, physics and intro calculus is assumed.

Rules & Requirements

Grading Status: Letter grade.

Same as: NBIO 722A, PHCO 722A.

BIOC 722B. Cellular and Molecular Neurobiology: Postsynaptic Mechanisms-Receptors. 2 Credits.

Permission of the department. Consideration of membrane receptor molecules activated by neurotransmitters in the nervous system with emphasis on ligand binding behavior and molecular and functional properties of different classes of receptors. Course meets for four weeks with six lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

Same as: NBIO 722B, PHCO 722B.

BIOC 725. Signal Transduction. 2 Credits.

Seminar/discussion course on molecular aspects of the receptors, G-proteins, effector proteins, kinases, and phosphatases that mediate hormone, neurotransmitter, growth factor, and sensory signaling.

Rules & Requirements

Grading Status: Letter grade.

Same as: PHCO 725.

BIOC 738. Nanomedicine. 3 Credits.

This course offers an introduction to the interdisciplinary field of nanomedicine for students with a physical, chemical, or biological sciences background. This course will emphasize emerging nanotechnologies and biomedical applications including nanomaterials, nanoengineering, nanotechnology-based drug delivery systems, nano-based imaging and diagnostic systems, nanotoxicology, and translating nanomedicines into clinical investigation.

Rules & Requirements

Grading Status: Letter grade.

BIOC 740. Contemporary Topics in Cell Signaling: Phosphorylation Control. 1 Credits.

Required preparation, coursework in biochemistry, pharmacology and/or cell & molecular biology. Permission of the instructor. This graduate-level course is an in-depth analysis of how protein kinases and protein phosphorylation regulates key aspects of cell signaling. This class is one of the "Contemporary Topics in Cell Signaling" modules.

Rules & Requirements

Grading Status: Letter grade.

Same as: PHCO 740.

BIOC 741. Contemporary Topics in Cell Signaling: GTPases. 1 Credits.

Required preparation, coursework in biochemistry, pharmacology, and/or cell & molecular biology. Permission of the instructor. This graduate-level course conveys principles of signal transduction controlled by GTPases and emphasizes in-depth discussion of current literature and unanswered questions. This class is one of the "Contemporary Topics in Cell Signaling" modules.

Rules & Requirements

Grading Status: Letter grade.

Same as: PHCO 741.

BIOC 742. Contemporary Topics in Cell Signaling: Cell Cycle Control. 1 Credits.

Permission of the instructor. Required preparation, coursework in biochemistry and/or cell & molecular biology. This graduate-level course conveys principles of eukaryotic cell proliferation control emphasizing in-depth discussion of current literature and unanswered questions. This class is one of the Contemporary Topics in Cell Signaling modules.

Rules & Requirements

Grading Status: Letter grade.

Same as: PHCO 742, PHCO 742.

BIOC 743. Contemporary Topics in Cell Signaling: Signaling Networks. 1 Credits.

Acquire the scientific vocabulary of the signaling network field. Master key concepts from mathematical characterization of signaling circuits. Develop and apply critical analysis skills.

Rules & Requirements

Grading Status: Letter grade.

Same as: PHCO 743.

BIOC 744. Topics on Stem Cells and Development. 2 Credits.

Required preparation, coursework in genetics, cell biology, and molecular biology. Permission of the instructor. Course addresses key issues in developmental biology focused on the role of stem cells and emphasizes in-depth discussion of current literature and unanswered questions. One of the Contemporary Topics in Cell Signaling modules.

Rules & Requirements

Grading Status: Letter grade.

Same as: PHCO 744.

BIOC 745. Intercellular Signaling in Development and Disease. 1 Credits.

This graduate-level course concentrates on up-to-date views of intercellular signal processing, with emphasis on signal transduction mechanisms as they relate to cellular/physiological responses in both normal development and disease. Signaling mechanisms that will be discussed include autocrine, paracrine, juxtacrine signaling and cell-matrix interactions.

Rules & Requirements

Grading Status: Letter grade.

Same as: PHCO 745.

BIOC 749. Biochemical Toxicology. 3 Credits.

Required preparation, one course in biochemistry. Biochemical actions of toxicants and assessment of cellular damage by biochemical measurements. Three lecture hours per week.

Rules & Requirements

Requisites: Prerequisite, CHEM 430; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

Same as: ENVR 749, TOXC 749.

BIOC 750. MOLECULAR DYNAMICS. 1 Credits.

The course is designed to introduce the most important concepts, methods, and software programs used in Molecular Dynamics (MD) simulations. Topics include, but are not limited to, computational models, force fields, simulation algorithms, enhanced sampling, protein folding, ligand binding, protein-protein/nucleic acid interactions, drug design, QM/MM, photobiology, and machine learning. The goal is to help the students to rapidly learn MD as a powerful computational technique and use it to solve relevant problems in their own research.

Rules & Requirements

Requisites: Prerequisite, BCB or BIOC 670.

Grading Status: Letter grade.

Same as: BCB 750.

BIOC 802. Seminar in the Phase Problem in X-Ray Crystallography. 2 Credits.

Permission of the instructor. Image formation is treated from a quite general point of view, drawing from Fourier transform methods used in X-ray crystallography. Isomorphous replacement, multiple wavelength anomalous scattering, and Bayesian direct methods are covered. One two-hour seminar a week.

Rules & Requirements

Grading Status: Letter grade.

BIOC 803. Seminar on Cell Signaling. 2 Credits.

Required preparation, two semesters of biochemistry. Signal transduction in embryonic development.

Rules & Requirements

Grading Status: Letter grade.

BIOC 804. Seminar in DNA-Protein Interactions. 2 Credits.

Required preparation, two semesters of biochemistry. Review of current literature on structural, thermodynamic, and kinetic aspects of binding to DNA of proteins involved in replication, regulation, recombination, and repair.

Rules & Requirements

Grading Status: Letter grade.

BIOC 805. Molecular Modeling. 3 Credits.

Introduction to computer-assisted molecular design, techniques, and theory with an emphasis on the practical use of molecular mechanics and quantum mechanics programs.

Rules & Requirements

Requisites: Prerequisites, MATH 231, 232, and CHEM 481.

Grading Status: Letter grade.

Same as: CBMC 805.

BIOC 806. Macromolecular Modeling. 3 Credits.

Introduction to modeling and simulation techniques for biological macromolecules. Two lecture and three to four laboratory hours per week.

Rules & Requirements

Requisites: Prerequisites, MATH 231, 232, and CHEM 430.

Grading Status: Letter grade.

Same as: MEDC 806.

BIOC 807. Seminar in Cellular Responses to DNA Damage. 2 Credits.

Required preparation, graduate-level courses (one each) in molecular biology and biochemistry. A seminar course on the enzymology of DNA repair and damage tolerance and the regulation of genes involved in these processes. Both classic and recent literature are discussed.

Rules & Requirements

Grading Status: Letter grade.

BIOC 808. From Force to Phenotype: How Biological Structures Respond to Physical Force. 2 Credits.

Literature/discussion course on integrating physics with biology, and the challenge of merging structural dynamics with living cell phenotypes. Forces and biological outcomes will be considered through specific examples.

Rules & Requirements

Grading Status: Letter grade.

BIOC 888. Responsible Conduct of Research. 1 Credits.

Classroom-based graduate level course covering critical topics for ethical and responsible conduct of experimental research. There are both classroom lecture, workshop-type discussion components, in addition to assigned outside of class readings. Case studies and hypothetical situations involving the most likely scenarios confronting graduate students will be covered, these topics include: mentor and mentee relationships, publication authorship, collaboration, peer review, conflicts of interest, intellectual property, plagiarism, data acquisition and data processing. Restricted to students in good standing as a graduate student at UNC; In the unlikely event that classroom space is limited, preference will be given to graduate students who have previously received external federal funding sources and may require a refresher course in RCR.

Rules & Requirements

Repeat Rules: May be repeated for credit. 2 total credits. 1 total completions.

Grading Status: Letter grade.

Same as: BCB 888.

BIOC 901. Research in Biochemistry. 3-9 Credits.

Permission of the department.

Rules & Requirements

Grading Status: Letter grade.

BIOC 902. Research in Biochemistry. 1-15 Credits.

Permission of the department. Six or more hours a week throughout both semesters.

Rules & Requirements

Repeat Rules: May be repeated for credit. 15 total credits. 15 total completions.

Grading Status: Letter grade.

BIOC 992. Master's (Non-Thesis). 3 Credits.**Rules & Requirements**

Repeat Rules: May be repeated for credit.

BIOC 993. Master's Research and Thesis. 3 Credits.**Rules & Requirements**

Repeat Rules: May be repeated for credit.

BIOC 994. Doctoral Research and Dissertation. 3 Credits.**Rules & Requirements**

Repeat Rules: May be repeated for credit.

Contact Information

Department of Biochemistry and Biophysics

Visit Program Website (<http://www.med.unc.edu/biochem/>)

Chair

Jean Cook