

Biochemistry and Structural Biology (BSB)

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Graduate Program Director: Erwin London, Life Sciences Building Room 470, (631) 632-8533

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Degree awarded: Ph.D. in Biochemistry and Structural Biology

The Biochemistry and Structural Biology Graduate Program stresses biochemical, computational, and structural approaches to solving complex biological problems. Training is offered in a broad range of research areas leading to the Ph.D. degree. Research in biochemistry and structural biology includes structure-function studies of proteins and nucleic acids, the molecular basis of gene expression, the chemical basis of enzyme action, as well as membrane and carbohydrate biochemistry. The aim of structural biology is to obtain high-resolution structures of biological macromolecules and molecular complexes through experimental techniques such as nuclear magnetic resonance (NMR) spectroscopy and X-ray diffraction to provide a view of biology at the molecular and atomic levels. High-resolution structures combined with biochemical studies represent the blueprints for understanding enzyme catalysis, cell signaling and transport, gene expression and regulation, and numerous other cellular processes. Advances in instrumentation and computational analysis have laid the groundwork for structure determination of proteins discovered through genome sequencing efforts and have opened up structural studies on membrane proteins and large complexes of proteins and nucleic acids.

The program includes faculty from the Departments of Biochemistry and Cell Biology, Chemistry, Pharmacological Sciences, and Physiology and Biophysics, as well as from Brookhaven National Laboratory.

For more information, visit the BSB Web site at www.grad.sunysb.edu/academics/brochures/biochemistry/index.html

Facilities

State-of-the-art facilities are available for biochemistry and structural biology. The Center for Structural Biology has several high-field NMR instruments and facilities for X-ray crystallography. With close ties to the Brookhaven National Laboratory, Stony Brook takes

advantage of the high-energy beam lines for diffraction studies. Throughout the program there is state-of-the-art equipment for protein purification and analysis, including Raman, infrared, fluorescence, and CD spectrophotometers. The biological sciences complex also has tissue culture facilities, a transgenic mouse facility, and a centralized *Drosophila* facility. These facilities are supported by a wide range of instrumentation for cell and molecular biology including transmission and scanning electron microscopes, confocal microscopes, and phosphoimagers.

Admission

Graduate studies in Biochemistry and Structural Biology require the following in addition to the Graduate School admissions requirements:

A. A bachelor's degree with the following minimal preparation: mathematics through one year of calculus; chemistry, including organic and physical chemistry; general physics; and one year of biology;

B. Letters from three previous instructors;

C. Graduate Record Examination (GRE) General Test scores;

D. Acceptance by the Graduate Program in Biochemistry and Structural Biology and by the Graduate School.

In special cases, students not meeting all of the requirements listed in item A above may be admitted, but such deficiencies must be remedied.

Faculty

Distinguished Professors

Grollman, Arthur P.,⁴ M.D., 1959, Johns Hopkins Medical School: Mechanisms of chemical mutagenesis/carcinogenesis.

Lennarz, William J.,¹ Ph.D., 1959, University of Illinois: Biosynthesis and function of glycoproteins in cell-cell interactions.

Sternglanz, Rolf,¹ Ph.D., 1967, Harvard University: Chromatin structure and function in yeast; histone modifying enzymes.

Professors

Brown, Deborah,¹ Ph.D., 1987, Stanford University: Structure and function of caveolae and cholesterol/sphingolipid-rich membrane domains.

Citovsky, Vitaly,¹ Ph.D., 1987, Hebrew University, Jerusalem: Nuclear targeting and intercellular communication in plants.

Dean, Neta,¹ Ph.D., 1988, UCLA: Protein glycosylation, fungal cell wall biosynthesis; fungal pathogenesis.

Deutsch, Dale,¹ Ph.D., 1972, Purdue University: Metabolism and uptake of the endocannabinoids (anandamide and 2-AG).

Gergen, J. Peter,¹ Ph.D., 1982, Brandeis University: Transcriptional regulation in development; structure and function of Runt domain proteins.

Haltiwanger, Robert,¹ Chair, Ph.D., 1986, Duke University: Glycobiology; role of protein glycosylation in signal transduction; notch signaling.

London, Erwin,¹ Ph.D., 1979, Cornell University: Membrane protein structure/translocation/folding; structure and function of sphingolipid/cholesterol rafts in membranes.

McLaughlin, Stuart,³ Ph.D., 1968, British Columbia: Calcium/phospholipid second messenger system.

Miller, W. Todd,³ Ph.D., 1989, Rockefeller University: Tyrosine phosphorylation and signal transduction.

Raleigh, Daniel P.,⁴ Ph.D., 1988, Massachusetts Institute of Technology: Experimental studies of protein folding and amyloid formation.

Reinitz, John,⁶ Ph.D., 1987, Yale University: Systems biology of development and transcription.

Sampson, Nicole,⁴ Ph.D., 1990, University of California, Berkeley: Role of sterol oxidation in tuberculosis pathogenesis. Structure and function of enzymes in sterol metabolic pathways; mammalian fertilization.

Scarlata, Suzanne,² Ph.D., 1984, University of Illinois: Structure/oligomerization of membrane proteins.

Simon, Sanford R.,¹ Ph.D., 1967, Rockefeller University: Proteinases and their inhibitors in invasiveness, inflammation and tumor metastasis; inhibition of bacterial metalloproteinases.

Smith, Steven O.,¹ Ph.D., 1985, University of California, Berkeley: Structure and function of membrane proteins.

Staros, James V.,¹ Ph.D., 1974, Yale University: Biochemical and biophysical approaches to signal transduction by ErbB family receptors.

Tonge, Peter J.,⁴ Ph.D., 1986, University of Birmingham, England: Tuberculosis pathogenesis and drug discovery; enzyme mechanisms and rational inhibitor design; fluorescent proteins.

Associate Professors

Holdener, Bernadette,¹ Ph.D., 1990, University of Illinois: The role of protein folding in WNT signal transduction and development.

Karzai, Wali,¹ Ph.D., Johns Hopkins University, 1995. Structure-function studies of RNA-protein interactions.

Neiman, Aaron,¹ Ph.D., 1994, University of California, San Francisco: Vesicle trafficking and intracellular signaling in yeast.

Schärer, Orlando D.,^{2,4} Ph.D., 1996, Harvard University: Chemical biology of DNA damage and repair.

Schindelin, Hermann,¹ Ph.D., 1994, Free University Berlin, Germany: Structure and function of proteins involved in ubiquitin-dependent protein degradation and neuroreceptor anchoring.

Simmerling, Carlos L.,⁴ Ph.D., 1991, University of Illinois: Development of tools for efficient simulation of chemical systems and using them to study the structure and dynamics of molecules involved in biological processes.

Thomsen, Gerald H.,¹ Ph.D., 1988, Rockefeller University: Regulation of early vertebrate development by growth factor signals; ubiquitin modification; T box family transcription factors.

Assistant Professors

Boon, Elizabeth M.,⁴ Ph.D., 2003, California Institute of Technology: Nitric oxide signaling in bacteria.

Bowen, Mark E.,³ Ph.D., 1998, University of Illinois, Chicago.

Carrico, Isaac,⁴ Ph.D., 2003, California Institute of Technology: Site-specific protein labeling; glycoproteins.

de los Santos, Carlos,² Ph.D., 1987, Buenos Aires, Argentina: Solution structures of damaged DNA; structural basis of chemical mutagenesis, lesion recognition, and DNA repair.

Garcia-Diaz, Miguel,² Ph.D., 2003, UAM University (Madrid, Spain): Structural enzymology of eukaryotic DNA/RNA transactions.

Green, David, F., Ph.D., 2002, MIT

Rizzo, Robert,⁶ Ph.D., 2001, Yale University: Computational biology; drug design.

Wang Jin,⁴ Ph.D., 1991, University of Illinois: Fundamental mechanism of biomolecular folding and recognition, especially protein folding and protein-protein/protein-DNA interactions.

Scientists

Fu, Dax,⁵ 1996, Mayo Graduate School of Medicine: X-ray crystallography of membrane protein transporters and channels.

Li, Huilin,⁵ Ph.D., 1994, University of Sciences and Technology, Beijing, China: Structural biology of macromolecular assemblies and membrane proteins by cryo-electron microscopy.

Liu, Chang-Jun,⁵ Ph.D., 1999, Shanghai Institute of Plant Physiology, the Chinese Academy of Sciences.

Schwender, Jörg,⁵ Ph. D., 1999, University of Karlsruhe, Germany: Experimental and theoretical analysis of plant metabolic networks.

Shanklin, John,⁵ Ph.D., 1988, University of Wisconsin-Madison: Structure-function relationships of lipid modification enzymes.

Subramanyan, Swaminathan,⁵ Ph.D., 1980, University of Madras, India: Structure-function relationships of bacterial toxins.

Number of teaching, graduate, and research assistantships, Fall 2007: 30

1) Department of Biochemistry and Cell Biology

2) Department of Pharmacological Sciences

3) Department of Physiology and Biophysics

4) Department of Chemistry

5) Brookhaven National Laboratory

6) Department of Applied Mathematics and Statistics

7) Cold Spring Harbor Laboratory

Degree Requirements

Requirements for the Ph.D. Degree

A. Course Requirements

Core courses:

1. Graduate Biochemistry I (MCB 520)
2. Membrane Biochemistry (BSB 517)
3. Computational Methods in Biochemistry and Structural Biology (BSB 515)
4. Physical Biochemistry (MCB 512)
5. Cell Biology (MCB 656) or Molecular Genetics (MCB 503)
6. Experimental Projects in Biochemistry and Structural Biology (BSB 509/510), a two-semester course in which the students spend two months in each of three different faculty laboratories actively participating in the research work of the laboratory.
7. Enrollment every semester in Colloquium in Biochemistry and Structural Biology (BSB 601/602), a series of invited lectures by visiting scientists from other institutions.
8. Two electives from an approved list of biochemistry, chemistry, and molecular and cell biology courses.

9. Enrollment for one semester of Journal Club (BSB 532) in the first and second years.

10. Enrollment for one semester of Student Seminar (BSB 603/604) in the third, fourth, and fifth years.

11. Enrollment in the first year in Ethics (GRD 500).

B. Qualifying Examination

At the beginning of the fourth semester, all students take a written qualifying examination covering the material from the core courses. This examination tests the student's ability to integrate basic concepts and information from the core courses.

C. Research Proposal

After passing the written qualifying examination, each student is required to prepare and defend a research proposal based on their own research. The student presents a detailed writeup of the background and logic of the proposition to test it, which then forms the basis for an oral proposition examination. The qualifying examination and the proposition examination together constitute the preliminary examination specified in the regulations of the Graduate School.

D. Advancement to Candidacy

When the above requirements have been satisfactorily completed, a recommendation for advancement to candidacy for the Ph.D. will be forwarded to the Graduate School.

E. Dissertation

During the second year, the student initiates a dissertation research project in the laboratory of a particular member of the program faculty. After the student has passed the proposition examination, a research committee is appointed to guide the dissertation research, and when the research nears completion, a dissertation examining committee is approved by the Dean of the Graduate School.

F. Dissertation Defense

The dissertation defense, which completes the requirements for the Ph.D., consists of a public seminar presentation of the dissertation work followed by an oral examination before the dissertation examining committee.

G. Teaching Experience

All students in molecular biology and

biochemistry, whether or not they are supported by teaching assistantships, are required to gain experience in teaching by assisting in laboratory sections, leading discussion sections, or helping to formulate and grade examination papers. The teaching experience may be in either undergraduate or graduate courses, and extends over a period of two semesters.

H. Residence Requirement

The University requires at least two consecutive semesters of full-time graduate study. The demands of the course of study necessitate a longer period of residence.

Courses

BSB 509 Experimental Biochemistry and Structural Biology

An introduction to modern biochemical research techniques. The student spends a half-semester in the laboratory of each of four different members of the faculty. In each laboratory, the student participates in some aspect of the research being pursued by the faculty member.

*Fall and spring, 1-6 credits, ABCF grading
May be repeated for credit*

BSB 510 Experimental Biochemistry and Structural Biology

An introduction to modern biochemical research techniques. The student spends a half-semester in the laboratory of each of four different members of the faculty. In each laboratory, the student participates in some aspect of the research being pursued by the faculty member.

*Fall and spring, 1-6 credits, ABCF grading
May be repeated for credit*

BSB 512 Introduction to Structural Biology

Theoretical principles and experimental methods used in the study of proteins and nucleic acids. Lectures and laboratory demonstrations will cover optical spectroscopy, NMR spectroscopy, and X-ray diffraction.

*Spring, 2 credits, ABCF grading
May be repeated for credit*

BSB 515 Computational Methods in Biochemistry and Structural Biology

Computational methods used in sequence searching and analysis, bioinformatics, graphical analysis of proteins, and nucleic acids.

*Prerequisite: This class is restricted to first-year BSB, HBM, and HBH Ph.D. students and second-year MCB Ph.D. students; exception requires approval from the course instructor
Fall, 1 credit, S/U grading*

BSB 517 Membrane Biochemistry

Examines the molecular architecture of membranes; the organization, function, and assembly of lipids and proteins in biological membranes.

Prerequisites: Undergraduate biochemistry,

*matriculation in graduate program, or permission of instructor
Fall, 1 credit, ABCF grading
May be repeated for credit*

BSB 531 Journal Club in Biochemistry and Structural Biology

Provides students with a forum for acquiring skills involved in the critical analysis and presentation of scientific data by active participation in seminars of major topics in structural biology and biochemistry, and critical discussion of selected topics with presentation of papers from the literature.

Prerequisite: Must be registered in the BSB program

*Fall and spring, 1 credit, ABCF grading
May be repeated for credit*

BSB 532 Journal Club in Biochemistry and Structural Biology

Provides students with a forum for acquiring skills involved in the critical analysis and presentation of scientific data by active participation in seminars of major topics in structural biology and biochemistry, and critical discussion of selected topics with presentation of papers from the literature.

Prerequisites: Must be registered in the BSB program

*Spring, 1 credit, ABCF grading
May be repeated for credit*

BSB 580 Advanced Structural Biology

Advanced topics in NMR spectroscopy and structural biology.

Prerequisites: Intro to Structural Biology (BSB 512) or Physical Biochemistry (MCB 512)

*Spring, 2 credits, ABCF grading
May be repeated for credit*

BSB 581 Teaching Honors

Selected students whose performance in the basic required courses for the graduate program is in the top 10 percent conduct tutorials for first-year graduate students in the program and other students taking graduate courses for credit. The tutors are supervised and graded by faculty of the graduate program. Successful completion of this course makes students eligible to receive "Honors in Teaching" on their transcripts.

*Fall and spring, 1 credit, S/U grading
May be repeated for credit*

BSB 599 Research

Original investigation undertaken with the supervision of a faculty member.

*Fall and spring, 1-12 credits, S/U grading
May be repeated for credit*

BSB 601 Colloquium in Biochemistry and Structural Biology

A weekly series of talks and discussions by visiting scientists covering current research and thinking in various aspects of structural biology and biochemistry.

Prerequisites: Must be registered in the BSB program

*Fall, 1 credit, S/U grading
May be repeated for credit*

BSB 602 Colloquium in Biochemistry and Structural Biology

A weekly series of talks and discussions by visiting scientists covering current research and thinking in various aspects of structural biology and biochemistry.

Prerequisites: Must be registered in the BSB program

*Spring, 1 credit, S/U grading
May be repeated for credit*

BSB 603 Student Seminars in Biochemistry and Structural Biology

Seminars given by graduate students on the progress of their own thesis research. Required of all students every semester in which they are registered in the graduate program in Biochemistry and Structural Biology. Attendance is mandatory. Visitors are welcome.

Prerequisite: Must be registered in the BSB program

*Fall and spring, 1 credit, S/U grading
May be repeated for credit*

BSB 604 Student Seminars in Biochemistry and Structural Biology

Seminars given by graduate students on the progress of their own thesis research. Required of all students every semester in which they are registered in the graduate program in Biochemistry and Structural Biology. Attendance is mandatory. Visitors are welcome.

Prerequisite: Must be registered in the BSB program

*Fall and spring, 1 credit, S/U grading
May be repeated for credit*

BSB 699 Dissertation Research On Campus

Original investigations undertaken as part of the Ph.D. program under supervision of a research committee.

Prerequisite: Advancement to candidacy (G5); major portion of research must take place on SB campus or at Brookhaven National Laboratory

Fall, spring, and summer, 1-9 credits, S/U grading

May be repeated for credit

BSB 700 Dissertation Research Off Campus—Domestic

Prerequisite: Must be advanced to candidacy (G5); major portion of research will take place off campus, but in the U.S. and/or U.S. provinces (Brookhaven National Lab and Cold Spring Harbor Lab are considered on campus); all international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor

*Fall, spring, summer, 1-9 credits, S/U grading
May be repeated for credit*

BSB 701 Dissertation Research Off Campus—International

Prerequisite: Must be advanced to candidacy (G5); major portion of research will take place outside the U.S. and/or U.S. provinces; domestic students have the option of the health plan and may also enroll in

*MEDEX; international students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed; international students who are not in their home country are charged for the mandatory health insurance (if they are to be covered by another insurance plan, they must file a waiver by the second week of classes; the charge will only be removed if the other plan is deemed comparable); all international students must receive clearance from an International Advisor
 Fall, spring, summer, 1-9 credits, S/U grading
 May be repeated for credit*

BSB 800 SUMMER RESEARCH

*0 credits, S/U grading
 May be repeated*

