MOLECULAR BIOPHYSICS AND BIOCHEMISTRY

Director of undergraduate studies: Karla Neugebauer, CE 28A SHM, 785-3322, MBBUndergrad@yale.edu; (MBBUndergrad@yale.edu)
medicine.yale.edu/mbb/academicprograms/undergraduate

FACULTY OF THE DEPARTMENT OF MOLECULAR BIOPHYSICS AND BIOCHEMISTRY

Professors † Karen Anderson, Susan Baserga, † Ronald Breaker, † Gary Brudvig, † Sandy Chang, Enrique De La Cruz, † Daniel DiMaio, Donald Engelman, Alan Garen, Mark Gerstein, Mark Hochstrasser, Jonathon Howard, Anthony Koleske, William Konigsberg, Peter Lengyel (Emeritus), † Patrick Loria, † I. George Miller, Andrew Miranker, † Peter Moore (Emeritus), Karla Neugebauer, † Thomas Pollard, Lynne Regan, † Karen Reinsch, † David Schatz, Robert Schulman (Emeritus), † Frederick Sigworth, Dieter Söll, Mark Solomon, Joan Steitz, Thomas Steitz, Scott Strobel, † William Summers, Patrick Sung, Kenneth Williams (Adjunct), † Sandra Wolin

Associate Professors † Titus Boggon, Michael Koelle, Christian Schlierke, Yong Xiong

Assistant Professors † Richard Baxter, Julien Berro, † Erdem Karatekin, Nikhil Malvankar, Matthew Simon, Chuck Sindelar, † Sarah Slavoff, † Shervin Takyar

Lecturer Aruna Pawashe

† A joint appointment with primary affiliation in another department.

The programs offered by the Department of Molecular Biophysics and Biochemistry are planned for students interested in the molecular and chemical basis of biological processes and are well suited to students hoping to attend medical school or pursue graduate studies in biochemistry, molecular biology, genetics, or biophysics. The B.S. major, designed for those with a strong commitment to research, provides an intensive introduction to laboratory techniques in biochemistry and biophysics. Students in this program usually carry out research projects in faculty laboratories during their junior and senior years. The B.A. major provides the intellectual discipline of biochemistry and biophysics for students who also wish to have sufficient time to pursue in-depth studies outside the major or who are interested in molecular biology as a liberal education; they too may engage in research during their junior and senior years.

The major for the Class of 2018 and previous classes Students in the Class of 2018 and previous classes may fulfill the requirements of the major that were in place when they entered the major in Molecular Biophysics and Biochemistry, as described in previous editions of this bulletin. Alternatively, they may fulfill the requirements for the major as described below for the Class of 2019 and subsequent classes.

The major for the Class of 2019 and subsequent classes The major requires a group of prerequisites or equivalents; several courses beyond the prerequisites for both degree programs; and a senior requirement, as indicated below.

Basic science prerequisites The basic science courses required of all majors include four half-term units of introductory biology (BIOL 101, 102, 103, 104); a general chemistry course with laboratory, (CHEM 161, 165, or CHEM 163, 167, or CHEM 112, 113, or CHEM 114, 115, or CHEM 118; and CHEM 134L, 136L, or CHEM 116L, 117L, or CHEM 119L); a year course in organic chemistry with laboratory, (CHEM 174, 175, or CHEM 124, 125, or CHEM 220 with 221 or 230); and CHEM 222L, 222L); one term of physical chemistry (CHEM 328); two terms of calculus (MATH 112 and 115); and one year of physics (PHYS 170, 171, or PHYS 180, 181, or PHYS 200, 201). Some of the prerequisites in biology, chemistry, mathematics, and physics may be satisfied by scores on Advanced Placement Placement tests or placement examinations sufficient to earn acceleration credits in the particular subjects, even if the student does not choose to accelerate.

B.S. degree Nine courses are required beyond the prerequisites: MB&B 251L, 300, 301, 302, and 490; two additional upper-level MB&B electives, one of which must be a non-laboratory course; one quantitative reasoning elective (e.g., MATH 120 or above, STAT 105 or 230 or above, CPSC 201 or above, or ENAS 130 or above); and one elective in the natural sciences at a level higher than required in the prerequisites. Students choose the elective courses in consultation with a faculty adviser (see below). Only two course credits of MB&B 470, 471, and 478, 479 may count toward these electives. Students may substitute CHEM 333 for MB&B 302. The quantitative reasoning requirement may not be fulfilled by Advanced Placement test scores.

B.A. degree Seven courses are required beyond the prerequisites: MB&B 251L, 300, 301, 302, and 490; one additional upper-level MB&B elective; and one quantitative reasoning elective (e.g., MATH 120 or above, STAT 105 or 230 or above, CPSC 201 or above, or ENAS 130 or above). Students choose the elective courses in consultation with a faculty adviser (see below). Students may substitute CHEM 333 for MB&B 302. The quantitative reasoning requirement may not be fulfilled by Advanced Placement test scores.

Senior requirement The senior requirement for both the B.S. and the B.A. is fulfilled by successful completion of MB&B 490, The Senior Project. Students enrolled in this course prepare a written report and make an oral presentation of a literature project. Students meet with faculty members in charge of the colloquium during the first two weeks of the spring term to agree on a topic and an approach. It is appropriate for students who took research for credit earlier in their training to write on their research topic. It is inappropriate for students to submit a revised version of a past research report or to resubmit a literature paper prepared for another course. The literature project for the senior requirement should be original work approved by the faculty member overseeing the senior colloquium.

The major for the Class of 2018 and previous classes Students in the Class of 2018 and previous classes may fulfill the requirements of the major as described below for the Class of 2019 and subsequent classes.

Basic science prerequisites The basic science courses required of all majors include four half-term units of introductory biology (BIOL 101, 102, 103, 104); a general chemistry course with laboratory, (CHEM 161, 165, or CHEM 163, 167, or CHEM 112, 113, or CHEM 114, 115, or CHEM 118; and CHEM 134L, 136L, or CHEM 116L, 117L, or CHEM 119L); a year course in organic chemistry with laboratory, (CHEM 174, 175, or CHEM 124, 125, or CHEM 220 with 221 or 230); and CHEM 222L, 222L); one term of physical chemistry (CHEM 328); two terms of calculus (MATH 112 and 115); and one year of physics (PHYS 170, 171, or PHYS 180, 181, or PHYS 200, 201). Some of the prerequisites in biology, chemistry, mathematics, and physics may be satisfied by scores on Advanced Placement Placement tests or placement examinations sufficient to earn acceleration credits in the particular subjects, even if the student does not choose to accelerate.

B.S. degree Nine courses are required beyond the prerequisites: MB&B 251L, 300, 301, 302, and 490; two additional upper-level MB&B electives, one of which must be a non-laboratory course; one quantitative reasoning elective (e.g., MATH 120 or above, STAT 105 or 230 or above, CPSC 201 or above, or ENAS 130 or above); and one elective in the natural sciences at a level higher than required in the prerequisites. Students choose the elective courses in consultation with a faculty adviser (see below). Only two course credits of MB&B 470, 471, and 478, 479 may count toward these electives. Students may substitute CHEM 333 for MB&B 302. The quantitative reasoning requirement may not be fulfilled by Advanced Placement test scores.

B.A. degree Seven courses are required beyond the prerequisites: MB&B 251L, 300, 301, 302, and 490; one additional upper-level MB&B elective; and one quantitative reasoning elective (e.g., MATH 120 or above, STAT 105 or 230 or above, CPSC 201 or above, or ENAS 130 or above). Students choose the elective courses in consultation with a faculty adviser (see below). Students may substitute CHEM 333 for MB&B 302. The quantitative reasoning requirement may not be fulfilled by Advanced Placement test scores.

Senior requirement The senior requirement for both the B.S. and the B.A. is fulfilled by successful completion of MB&B 490, The Senior Project. Students enrolled in this course prepare a written report and make an oral presentation of a literature project. Students meet with faculty members in charge of the colloquium during the first two weeks of the spring term to agree on a topic and an approach. It is appropriate for students who took research for credit earlier in their training to write on their research topic. It is inappropriate for students to submit a revised version of a past research report or to resubmit a literature paper prepared for another course. The literature project for the senior requirement should be original work approved by the faculty member overseeing the senior colloquium.
The written report is expected to be 15–25 pages in length (double-spaced, twelve-point font, exclusive of figures). A first draft of the paper is due two weeks prior to the date of the oral presentation. Faculty in charge of the program will review the draft and return it to the student with suggestions. A final draft of the paper is due the first day of the reading period in the student’s final term.

Students make a fifteen-minute oral presentation during the last three weeks of their final term in a general scientific forum open to the public. Other students in the series are expected to attend all presentations.

Credit/D/Fail Courses taken Credit/D/Fail may not be counted toward the requirements of the major.

Recommended courses All B.S. majors are encouraged to include MB&B 470 or 471 among their MB&B electives. Declared MB&B majors may take up to two credits of these independent research courses for a letter grade. The prerequisites in either general or organic chemistry should be taken in the freshman year.

Students with a strong interest in biophysics, including those planning to attend graduate school, are strongly encouraged to take courses beyond the basic requirements of the major. Such students are advised to take mathematics through differential equations (ENAS 194, MATH 246, or PHYS 301) and a full year of physical chemistry (CHEM 328 or 332, and 333). In place of one term of biophysics (MB&B 302) they may elect a full year of upper-level biophysics (MB&B 420 and graduate courses in optical spectroscopy and macromolecular interactions). Such revisions to the basic curriculum must be made in consultation with the faculty adviser.

Graduate courses in molecular biophysics and biochemistry, biology, and the biomedical sciences that may be of interest to undergraduates are listed in the bulletin of the Graduate School (http://www.yale.edu/printer/bulletin/htmlfiles/grad), and many are posted on the Biological and Biomedical Sciences Web site (http://bbs.yale.edu). Additional information is available from the directors of undergraduate and graduate studies. Undergraduates with an appropriate background may enroll with the permission of the director of graduate studies and the instructor.

Typical programs Programs with the minimal number of science courses required of B.A. and B.S. majors are shown below. Students whose scores on the Advanced Placement tests make them eligible for advanced courses are urged to replace the elementary science courses with more advanced ones in their freshman year, and to complete the required biochemistry and physics courses by the end of their sophomore and junior years, respectively. Students are permitted to take the biochemistry sequence (MB&B 300, 301) after one term of organic chemistry (CHEM 220).

Freshman
- BIOL 101, 102, 103, 104
- CHEM 161, 165, 134L, 136L

Sophomore
- CHEM 220, 230, 222L, 223L
- MATH 112, 115

Junior
- MB&B 300, 301, 251L
- One quantitative reasoning elective
- PHYS 180, 181

Senior
- CHEM 328
- MB&B 302
- One MB&B elective
- And, for B.S. major: One science elective and a second MB&B elective
- MB&B 490

Combined B.S./M.S. degree program Exceptionally able and well-prepared students may complete a course of study leading to the simultaneous award of the B.S. and M.S. degrees after eight terms of enrollment. See "Simultaneous Award of the Bachelor’s and Master’s Degrees" under Special Arrangements (http://catalog.yale.edu/archive/2016-2017/ycps/academic-regulations/special-arrangements) in the Academic Regulations. Interested students should consult the director of undergraduate studies prior to the sixth term of enrollment for specific requirements in Molecular Biophysics and Biochemistry.

MB&B Faculty Committee on the Undergraduate Major Committee members are available for consultation throughout the year and are the only faculty advisers eligible to approve and sign MB&B majors' course schedules at the beginning of each term. Members acting as faculty advisers are:

Class of 2017:
- L. Regan, 322 BASS (432-9843)
- M. Simon, 220 BASS (432-5158)

Class of 2018:
- K. Neugebauer, C 123 SHM (785-3322)
- J. Berro, 309C JWG (737-3285, 432-5437)

Class of 2019:
- J. Howard, 334A BASS (432-7245)
- C. Schlieker, 236A BASS (432-5035)

Class of 2020:
- E. De La Cruz, 336A BASS (432-5424)
- P. Sung C 130A SHM (785-4553)
REQUIREMENTS OF THE MAJOR

Prerequisites  B.S. and B.A. – BIOL 101, 102, 103, and 104; CHEM 161, 165, or CHEM 163, 167 (or CHEM 112, 113, or CHEM 114, 115, or CHEM 118); CHEM 134L, 136L (or CHEM 116L, 117L, or CHEM 119L); CHEM 174 (or CHEM 124), or 220, and CHEM 175 (or CHEM 125), 221, or 230; CHEM 222L, 223L; CHEM 328; MATH 112, 115; PHYS 170, 171, or PHYS 180, 181, or PHYS 200, 201

Number of courses  B.S. – 9 term courses beyond prereqs, incl senior req; B.A. – 7 term courses beyond prereqs, incl senior req

Specific courses required  B.S. and B.A. – MB&B 251L, 300, 301, 302

Distribution of courses  B.S. – 2 addtl MB&B electives, 1 quantitative reasoning elective, and 1 science elective, all as specified; B.A. – 1 addtl MB&B elective and 1 quantitative reasoning elective, as specified

Substitution permitted  CHEM 333 for MB&B 302

Senior requirement  Senior project (MB&B 490)