MOLECULAR BIOPHYSICS AND BIOCHEMISTRY

Director of undergraduate studies: Karla Neugebauer, CE 28A SHM, 785-3322, MBBUndergrad@yale.edu; (MBBUndergrad@yale.edu)mb&b.yale.edu

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 With DUS approval, the following changes to the requirement of the major may be fulfilled by students who declared their major under previous requirements.

The major for the Class of 2019 and subsequent classes For both degree programs, specific requirements are listed below.

PREREQUISITES

The basic science courses required of all majors include four half-term units of introductory biology (BIOL 101, 102, 103, 104); two general chemistry courses with laboratory (CHEM 161, 165, or CHEM 163, 167 [previously CHEM 112, 113, or CHEM 114, 115, or CHEM 118]); and CHEM 134L, 136L [previously CHEM 116L, 117L, or CHEM 119L]); a year course in organic chemistry with laboratory, (CHEM 174, 175 (previously CHEM 124, 125), or CHEM 220, 221 and CHEM 222L, 223L or CHEM 226L); one term of physical chemistry (CHEM 328); two terms of calculus (MATH 112 and 116); 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 tests or placement examinations sufficient to earn acceleration credits in the particular subjects, even if the student does not choose to accelerate.

REQUIREMENTS OF THE MAJOR

B.S. degree program 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, S&DS 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 program 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, S&DS 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.

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

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.

ADVISING

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 work** 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 Website. (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 first 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).

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<tr>
<th>First-Year</th>
<th>Sophomore</th>
<th>Junior</th>
<th>Senior</th>
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<tbody>
<tr>
<td>BIOL 101, 102, 103, 104</td>
<td>CHEM 220, 221, 222L, 223L</td>
<td>MB&amp;B 300, 301, 251L</td>
<td>CHEM 328</td>
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<tr>
<td>CHEM 161, 165, 134L, 136L</td>
<td>MATH 112, 115</td>
<td>One quantitative reasoning elective</td>
<td>MB&amp;B 302</td>
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<td></td>
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<td>PHYS 180, 181</td>
<td>One MB&amp;B elective</td>
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**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/ycps学术 regulations/special安排) 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 advisory system** All undergraduates are assigned two MB&B advisers specifically appointed for their year, with the idea that undergraduates will have the opportunity to know at least one MB&B faculty member in addition to the DUS and maintain an advising relationship throughout their studies. The advisers are apprised of curriculum-related details for each year and are authorized to sign schedules. Members acting as faculty advisers are:

- **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. Schlicker, 236A BASS (432-5035)

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

- **Class of 2021:**
  - W. Gilbert, C 127 SHM (785-4857)
  - M. Solomon, 218 BASS (436-9093)

**Requirements of the major**

**Prerequisites** B.S. and B.A. – BIOL 101, 102, 103, and 104; CHEM 161, 165, or CHEM 165, 167 (or CHEM 112, 113, or CHEM 114, 115, or CHEM 118); CHEM 134L, 136L (or CHEM 116L, 117L, or CHEM 119L); CHEM 174, 175 (or CHEM 124, 125), or CHEM 220 221; and CHEM 222L, 223L or CHEM 226L; CHEM 328; MATH 112, 116; 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)

**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, Nigel Grindley (*Emeritus*), 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 Reinisch, †David Schatz, Robert Schulman (*Emeritus*), †Frederick Sigworth, Dieter Söll, Mark Solomon, Joan Steitz, Thomas Steitz, Scott Strobel, Patrick Sung, †Sandra Wolin

**Associate Professors**  †Titus Boggon, Wendy Gilbert, Michael Koelle, Christian Schlieker, Chuck Sindelar, Yong Xiong

**Assistant Professors**  Julien Berro, †Erdem Karatekin, Nikhil Malvankar, Matthew Simon, †Sarah Slavoff, †Shervin Takyar

**Adjunct Professors**  Kenneth Williams, Carl Zimmer

**Lecturers**  †Robert Bazell, Aruna Pawashe

†A joint appointment with primary affiliation in another department.