

Biochemistry, Biophysics, and Molecular Biology

Director: Daniel M. Vernon

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The program in biochemistry, biophysics, and molecular biology (BBMB) offers a major at the interface of the physical and biological sciences. The curriculum focuses on biological processes at the molecular level and prepares students to enter the rapidly developing fields of genomics, genetics, biotechnology, biochemistry, and structural biology.

Distribution: Courses completed in BBMB do not apply to the science distribution area.

Total credits required to complete an Biochemistry, Biophysics, and Molecular Biology major: 63

Learning Goals: Upon graduation, a student will be able to:

- Integrate concepts from biology, chemistry, and physics to understand the structure and function of biological molecules and the interactions of these molecules in cells and organisms.
- Read and critique the molecular life science literature.
- Effectively communicate science orally and in writing.
- Perform experiments to address research questions in the molecular life sciences.

The BBMB major: Biology 111, 205; either Chemistry 125, 135, 126, 136, or Chemistry 140; Chemistry 245, 246, 251, 252; Physics 145 or 155 and 156; Mathematics & Statistics 225; BBMB 324, 325, 326, 334, 335, 336, 400; three credits of BBMB 490 or 498; and at least seven additional credits from biology, chemistry, computer science, mathematics and statistics, or physics courses numbered 200 and above. Only 1 credit of Chemistry 401 or 402 or Mathematics 299 may count towards the BBMB major; up to two credits of independent projects (Biology 481, 482, Chemistry 390, 451, 452, Computer Science 481 and 482, or Physics 483, 484) can count towards the BBMB major; Biology 206 may not be used to fulfill BBMB elective requirements. The P-D-F grade option is not allowed for any BBMB, biology, chemistry, or physics course that applies to the BBMB major.

In the senior year, all BBMB majors must complete a senior assessment consisting of an oral examination administered by two or more faculty, and a written research-based thesis.

Honors in the major: All students majoring in BBMB are required to register for BBMB 490, write a thesis, and present their research in a departmental seminar. Honors in the BBMB major are awarded by the BBMB faculty in consultation with a student's thesis advisor. Students who meet the following criteria may be nominated by the faculty for Honors candidacy: 1) demonstrate an outstanding commitment to research, thesis, and thesis presentation; 2) pass both the written and oral components of their Senior Assessment with distinction; and 3) meet the college's academic criteria for Honors. Therefore, BBMB majors cannot apply for honors or register themselves for BBMB 498.

324 Biophysics

Fall

Zajac

3 credits

The application of concepts and approaches from physics (e.g. mechanics, thermodynamics and electromagnetism) to deepen understanding of molecular and cell biology. We will focus on simplified models that capture the salient features of biological systems. Example topics include diffusion, hydrodynamics and cellular locomotion, free energy transduction, ligand binding, entropic forces, enzyme kinetics, molecular motors, macromolecular conformation, and signal propagation in neurons. Three one-hour lectures per week; weekly problem sets; exams.
Prerequisites: Physics 156, and Mathematics 225.

325 Biochemistry

Fall, Spring

Fall: J. Russo; Spring: D. Biswas, J. Russo

3 credits

A detailed examination of protein structure and function, focusing on the role of proteins in molecular recognition and catalysis. Topics include: techniques used to characterize proteins; enzyme kinetics and mechanisms; signal transduction across membranes; bioenergetics; catabolism of proteins, fats, and carbohydrates; integration of

metabolism and disease. Three lectures per week. Counts towards the Molecular/Cell requirement for the Biology major. *Prerequisites:* Biology 111 and Chemistry 246.

326 Molecular Biology

Fall

Vernon

3 credits

Examination of nucleic acid structure and function, focusing on gene expression and mechanisms of gene regulation. Other topics include molecular biology of viruses, mobile genetic elements, the genetic basis of cancer, and aspects of genomics. Required for BBMB majors. Counts towards the Molecular/Cell requirement for Biology majors.

Prerequisites: Biology 205 and BBMB 325 or consent of instructor.

334 Biophysics Laboratory

Fall

Juers

1 credit

Laboratory exercises on a range of biophysical topics. Experimental testing of models developed in BBMB 324. Study of macromolecules using techniques that may include absorption spectroscopy, fluorescence spectroscopy, circular dichroism, NMR, crystallization and structure determination via X-ray diffraction. One three- to four- hour laboratory per week. *Corequisite:* BBMB 324. Open to non-BBMB majors only with consent of instructor.

335 Biochemistry Laboratory

Spring

J. Russo

1 credit

Laboratory exercises in protein biochemistry, including biochemical reagent preparation, enzyme isolation and purification, enzyme and protein assays, and gel electrophoresis. One three- to four-hour laboratory per week. Counts towards the Molecular/Cell requirement for the Biology major. *Prerequisites:* Biology 111 and Chemistry 136 or 140; *Corequisite:* BBMB 325. Chemistry 310 is strongly recommended. Open to non-BBMB majors only with consent of instructor.

336 Molecular Biology Laboratory

Fall

Vernon

1 credit

Laboratory exercises in nucleic acid biochemistry, including molecular cloning, PCR, and DNA and RNA isolation and analysis techniques. One three-hour laboratory per week. Counts towards the Molecular/Cell requirement for the Biology major. *Corequisite:* BBMB 326; consent required for non-BBMB majors.

337 Techniques in Biochemistry and Biophysics

Not offered 2019-20

1 credit

Laboratory exercises emphasizing protein structure and function. Methods may include reagent preparation; protein isolation, purification, and identification; enzyme and protein assays; structure determination via X-ray diffraction; spectroscopic analysis of protein folding and ligand binding; and models of thermal motion via particle tracking. One three-hour laboratory per week. Counts towards the Molecular/Cell requirement for the Biology major. *Prerequisites:* Biology 111 and Chemistry 136 or 140; *Corequisite:* BBMB 324 or 325. Open to non-BBMB majors only with consent of instructor.

360-363 Special Topics in BBMB

1-4 credits

Any current offerings follow.

400 Senior Seminar

Spring

Juers, J. Russo, Vernon

1 credit

The senior seminar will serve as the capstone of the major by providing a forum for all seniors to make a full-length oral presentation. Each student will describe the background, methodologies, and experimental results of the senior research project and respond to questions and critiques of his or her peers. Open to non-BBMB majors only with consent of instructors.

430 Infectious Disease**Fall****J. Russo****3 credits**

The role of infectious disease in human mortality and morbidity. Discussion topics include: epidemiology and etiology of disease, cellular targets of microbial infection, immune responses, design and mechanism of action of antibiotic drugs, drug resistance, the development of vaccines for disease prevention, and the ethical dilemmas and social consequences of infectious disease. Case studies may include polio, influenza, malaria, tuberculosis, Hepatitis B, and HIV. *Prerequisite:* consent of instructor.

481, 482 Special Projects**Fall, Spring****Staff****1-2 credits**

Research projects or independent studies arranged with individual students. The students must consult with a faculty member prior to the semester of the anticipated project to determine if the project is suitable, and the project must be done with the supervision of a Whitman faculty member. *Prerequisite:* consent of instructor.

490 Senior Thesis**Fall, Spring****Staff****1-3 credits**

Each student will take part in a research project involving the collection and analysis of data, and write a thesis on that research in accepted scientific style. One or more drafts of the thesis will be required before the final version is due in the last week of classes. Each student also will publicly present his/her research results in the BBMB 400 Senior Seminar or a similar presentation venue. A total of three credits are required in the senior year; credits may be taken in the Fall and/or Spring. *Prerequisite:* consent of the thesis adviser.

498 Honors Thesis**Fall, Spring****Staff****3 credits**

Research and writing of the senior honors thesis. Students register for BBMB 490, not for BBMB 498. The registration will be changed from BBMB 490 to 498 for those students who attain honors in BBMB. Open only to senior BBMB majors.