

Biochemistry, Biophysics, and Molecular Biology

Director: Daniel M. Vernon

Douglas H. Juers (on Sabbatical 2018-2019)

Britney L. Moss

James E. Russo (on Sabbatical, Spring 2019)

Mark Zajac

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 the understanding of biological processes at the molecular level and seeks to prepare students to enter the rapidly developing fields of genomics, genetics, biotechnology, biochemistry, and structural biology.

Distribution: Courses completed in BBMB apply to the science distribution area.

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.
- Demonstrate the ability to 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 or 165, 156 or 166; Mathematics 225; BBMB 324, 325, 326, 334, 335, 336, 400; three credits of BBMB 490 or 498; and at least seven additional credits from BBMB-approved biology, chemistry, mathematics and statistics, or physics courses numbered 200 and above. *Note:* A maximum of two credits from Chemistry 401 and 402 may be applied towards the seven elective credits requirement. 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 a comprehensive 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 write a thesis and to register for BBMB 490. Students do not apply for admission to candidacy for honors. Students who write a thesis graded A- by the BBMB program faculty, who pass the Senior Comprehensive Examination with distinction, and who attain a Cumulative GPA of 3.300 and a major GPA of 3.500, may be considered for Honors in Major Study by the BBMB program faculty. The BBMB program chair will notify the Registrar of those students attaining Honors in Major Study not later than the beginning of the third week of April for spring honors thesis candidates. Two copies of the Honors Theses must be submitted to Penrose Library no later than Reading Day.

The following courses may apply toward the required seven additional credits for the major; additional classes such as special topics courses or classes taught by new faculty may also be approved each year.

Biochemistry, Biophysics, and Molecular Biology 430 *Infectious Diseases*

Biochemistry, Biophysics, and Molecular Biology 481/482 *Special Projects*

Biology 253 *Plant Physiology*

Biology 303 *Cell Biology*

Biology 304 *Cell Biology Laboratory*

Biology 305 *Cellular Physiology and Signaling*

Biology 306 *Cellular Physiology and Signaling Lab*

Biology 310 *Physiology*

Biology 315 *Comparative Vertebrate Anatomy*

Biology 319 *Developmental Biology Seminar*

Biology 320 *Neurobiology*

Biology 323 *Neurophysiology*

Biology 328 *Evolutionary Developmental Biology*

Biology 329 *Developmental Biology*

Biology 330 *Human Physiology*

Biology 331 *Synthetic Cell Biology*

Biology 339 *Microbiology and Immunology*

Biology 342 *Gene Discovery and Functional Genomics*

Biology 350 *Evolutionary Biology*

Biology 351 *Exercise Physiology*

Biology 372 ST: *Genetic Engineering in the 21st century*

Chemistry 320 *Instrumental Methods of Analysis*

Chemistry 345 *Physical Chemistry I: Quantum Chemistry and Spectroscopy*

Chemistry 346 *Physical Chemistry II: Statistical Thermodynamics, Classical Thermodynamics and Kinetics*

Chemistry 360 *Inorganic Chemistry*

Chemistry 388 *Environmental Chemistry and Engineering*

Chemistry 401/402 *Chemistry Seminar*

Chemistry 411 *The Organic Chemistry of Drug Design*

Chemistry 425 *Computational Biochemistry*

Chemistry 447 *Physical Organic Chemistry*

Chemistry 460 *Bioinorganic Chemistry*

Mathematics 247 *Statistics with Applications*

Physics 245 *Twentieth Century Physics I*

Physics 246 *Waves, Electronics, and Quantum Mechanics*

Physics 255 *Twentieth Century Physics Laboratory*

Physics 256 *Electronics and Waves Laboratory*

Physics 325 *Electricity and Magnetism*

Physics 348 *Optics*

Physics 357 *Thermal Physics*

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 or 166, and Mathematics 225.

325 Biochemistry**Fall, Spring****Fall: J. Russo; Spring: Rokhsana, Moss 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****Zajac****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****Moss****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 2018-19****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****Moss and 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.