

Biochemistry, Biophysics, and Molecular Biology

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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, biotechnology, biochemistry, and structural biology.

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.

Distribution: Courses completed in BBMB do not apply to the science distribution area. BBMB 430 applies to the cultural pluralism distribution area.

Total credit requirements for a BBMB major: 63

The BBMB major:

- 63 Credits (including all introductory chemistry and calculus credits)
- Required Courses
 - Biology 111, 205
 - Chemistry 125/135 and 126/136, or Chemistry 140; Chemistry 245, 246, 251, 252
 - Physics 145 or 155, and 156
 - Mathematics 225 (prerequisite Mathematics 124 or 125 and 126)
 - BBMB 324, 325, 326, 334, 335, 336, 400
 - BBMB, Biology, Chemistry, or Physics 490 or 498
 - At least seven additional credits in courses numbered 200 and above from biology (excluding Biology 206), chemistry, computer science, mathematics and statistics, or physics
- Other notes
 - Only 1 credit of Chemistry 401 or 402 or Mathematics 299 may be applied toward the 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
 - No P-D-F courses
- Senior Requirements
 - BBMB 400 and BBMB, Biology, Chemistry, or Physics 490 or 498
- Senior assessment
 - Oral examination administered by two faculty members
 - Research-based thesis
- Honors
 - Students do not apply for admission to candidacy for honors
 - Accumulated at least 87 credits
 - Completed two semesters of residency at Whitman.
 - Cumulative GPA of at least 3.3 on all credits earned at Whitman College
 - Major GPA of at least 3.5

- Complete a written thesis or research project prepared exclusively for the satisfaction of this program
- Earn a grade of at least A- on the honors thesis.
- Pass both the oral and written components of the senior assessment with distinction
- Chair of the department will notify the Registrar of students who are candidates for Honors no later than the beginning of week 12 of the semester
- An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

324 Biophysics

Spring

Juers

3 credits

The application of concepts and approaches from physics and mathematics (e.g. mechanics, thermodynamics, electromagnetism, quantum physics, probability) 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, molecular motors, macromolecular conformation, signal propagation in neurons, gene expression, and vision. Includes exercises in computation; no prior coding experience assumed. Three one-hour lectures per week; weekly problem sets; exams. May be elected as Physics 324. *Prerequisites:* Physics 156 and Mathematics 225.

325 Biochemistry

Fall, Spring

Fall: Russo; Spring: Moss

3 credits

This course provides students with 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; and integration of metabolism and disease. Students will actively participate in group problem-solving, and gain experience reading and critiquing scientific journal articles. Applies to 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. Applies to the Molecular/Cell requirement for Biology majors. *Prerequisite:* Biology 205. *Pre- or corequisite:* BBMB 325. Open to non-BBMB majors only with consent of instructor.

334 Biophysics Laboratory

Spring

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. May be elected as Physics 334. *Corequisite:* BBMB 324. Open to non-BBMB majors only with consent of instructor.

335 Biochemistry Laboratory

Spring

Moss

1 credit

A semester-long team project introducing students to the core laboratory techniques and methods in protein biochemistry for characterizing a catalytic protein. Students will engage in biochemical reagent preparation, enzyme isolation and purification, enzyme and protein assays, gel electrophoresis, and immunodetection methods. Applies to the Molecular/Cell requirement for the Biology major. *Prerequisites:* Biology 111 and Chemistry 136 or 140. *Pre- or corequisite:* BBMB 325. 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. Applies to the Molecular/Cell requirement for the Biology major. *Corequisite:* BBMB 326. Open to non-BBMB majors only with consent of instructor.

337 Techniques in Biochemistry and Biophysics**Not offered 2023-24****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. Applies to 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.

340 Immunobiology**Spring****Russo****3 credits**

The human immune system possesses a remarkable ability to distinguish among a wide array of molecular structures. This evolutionary adaptation enables the recognition and response to microbial pathogens as well as host cancer cells, while tolerating normal host cells, commensal microbes, and harmless environmental exposures. This course will explore the molecular and cellular basis of immune system function (hematopoiesis, innate immunity, molecular diversity of antigen recognition and presentation, and T- and B-cell adaptive immunity), perturbations of the immune response (allergies, autoimmunity, and tissue transplantation) and the use of immunotherapies to manipulate the immune system (vaccines, monoclonal antibodies, T-cell therapies). Coursework will involve instructor- and student-led presentations, the reading and discussion of peer-reviewed research articles, and case-studies that highlight host-pathogen interactions, evolutionary pressures, immune modulation, and the development of diagnostics and therapeutics. Applies to the Molecular/Cell requirement for the Biology major. *Prerequisites:* Biology 205 and Chemistry 245.

360-363 Special Topics in BBMB**1-4 credits**

Any current offerings follow.

400 Senior Seminar**Spring****Juers, Moss, 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 from his or her peers. Open to non-BBMB majors only with consent of instructors.

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

This course will use the practices of public health to explore the role of infectious disease on human mortality and morbidity from biomedical, social, and economic perspectives. Readings, discussion, and journal writing will focus on: epidemiology and burden of disease, the immune system and the host response to viruses, bacteria, and parasites; antimicrobial agents and drug resistance; and vaccine development and policy. Each student will work in a team to present a week-long Case Study on a disease of global importance such as COVID, influenza, dengue, HIV, malaria, or tuberculosis. *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 thesis advisor.

498 Honors Thesis**Fall, Spring****Staff****1-3 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.