

BIOCHEMISTRY AND BIOPHYSICS

Department Website:

<https://www.haverford.edu/biochemistry-biophysics>

The Concentration in Biochemistry and Biophysics recognizes enduring trends in interdisciplinary science, by establishing in the curriculum a formal program of classroom and laboratory training at the interface between the physical, chemical and biological sciences.

Learning Goals

- Identify, formulate, and solve complex problems at the interface of biology and the physical sciences using state-of-the-art equipment and techniques.
- Apply knowledge of chemistry, biology, physics and mathematics to develop a coherent understanding of biological processes and solve problems in living organisms or *in vitro* systems derived from biological specimens.
- Learn to search, read and interpret original scientific literature, both for research and for ongoing learning.
- Recognize enduring trends in interdisciplinary science, while navigating the program of classroom and laboratory training at the interface between the physical and biological sciences.
- (For biochemistry) study the importance of biological macromolecules at all levels of the natural sciences, including the cell, the organ, the organism, and larger ecological systems.
- Examine and analyze natural phenomena at the appropriate level(s) (molecular, cellular, organismal and/or ecological), using a variety of methods informed by evolutionary theory.
- Communicate findings (either verbally and/or via written expression) effectively and clearly to diverse audiences.

Haverford's Institutional Learning Goals are available on the President's website, at <http://hav.to/learninggoals>.

Curriculum

All concentrators must complete a major in biology, chemistry or physics while taking additional coursework that spans mathematics and all of these natural science disciplines. The concentration requirements provide guidance for students while allowing considerable leeway for tailoring the program to specific interests. All concentrators take a required core curriculum as well as advanced

coursework that is integrated with the major program.

We describe below only the four more popular programs of study within the concentration. Students interested in other options, such as a concentration in both biochemistry and biophysics, should consult with the faculty representatives listed above to design a course of study encompassing the required courses and any proposed substitutions. However, students may not obtain both a chemistry minor and a biochemistry concentration, or both a physics minor and a biophysics concentration.

Concentration Requirements

Biochemistry/Biophysics Core Curriculum (required of all):

- BIOL H200 (Evolution, Genetics and Genomes) and BIOL H201 (Molecules, Cells, and Organisms)
- CHEM H104, CHEM H112, CHEM H114 (Chemical Dynamics).
- MATH H118 (Calculus II) or a one semester mathematics or statistics course with MATH H118 as a prerequisite.
- PHYS H105 and PHYS H106, or PHYS H101 and PHYS H102 (two semesters of Introductory Physics), or the Bryn Mawr equivalents.

Concentrators typically complete required coursework at the 200-level and higher in participating Haverford departments. One course taken elsewhere may be substituted with prior approval of the relevant department and the Concentration coordinator; students seeking additional flexibility may petition the Concentration Committee in advance regarding their needs and plans.

The advanced interdisciplinary coursework requirements vary by major and desired concentration:

Biology Major with a Biochemistry Concentration:

Biology majors seeking a biochemistry concentration must complete the biochemistry/biophysics core curriculum (see above) as well as the following additional requirements:

- CHEM H111 or CHEM H113 or CHEM H115 (Chemical Structure and Bonding), CHEM H222 and CHEM H225 (Organic Chemistry).
- CHEM H304 (Statistical Thermodynamics and Kinetics) or CHEM H305 (Quantum Chemistry).
- One semester of advanced biochemistry-related laboratory coursework: CHEM H301 or CHEM H302 (Laboratory in Chemical Structure and Reactivity) or BIOL/CHEM H303 (Laboratory in Biochemical Research). For concentrators, this course will

count toward the Biology major in lieu of either BIOL H300 or BIOL H301.

- Two half-semester advanced courses with significant biochemistry content: CHEM H351 (Bioinorganic Chemistry), CHEM H352 (Topics in Biophysical Chemistry), and CHEM H357 (Topics in Bioorganic Chemistry); students may take topics courses multiple times with different topics.
- Two half-semester courses with significant biochemistry content: BIOL H311 (Advanced Genetic Analysis), BIOL H313 (Structure and Function of Macromolecules), BIOL H314 (Biochemistry: Metabolic Basis of Disease and Adaptation), BIOL H316 (Inter- and Intra-Cellular Communication), BIOL H320 (Molecular Microbiology), BIOL H322 (Cell Architecture), BIOL H324 (Photosynthesis), BIOL H326 (Biochemical Adaptations), BIOL H328 (Immunology), BIOL H334 (Biochemistry of Gene Expression), BIOL H336 (Cell Cycle), BIOL H337 (Pathogenic Microbiology), BIOL H451 (Molecular Motors and Biological Nano-Machines), BIOL H452 (Advanced Topics in Immunology), BIOL H454 (Advanced Topics in Virology), and BIOL H457 (Topics in Protein Science).

Biology Major with a Biophysics Concentration:

Biology majors seeking a biophysics concentration must complete the biochemistry/biophysics core curriculum (see above) as well as the following additional requirements:

- MATH H121 (Calculus III) or MATH H216 (Advanced Calculus).
- PHYS H213 (Waves and Optics), PHYS H211 (Laboratory in Electronics, Waves and Optics); half-credit course, and PHYS H301 (Advanced Laboratory in Modern Physics). For concentrators, PHYS H301 will count toward the Biology major in lieu of either BIOL H300 or BIOL H301.
- PHYS H214 (Quantum Mechanics) or CHEM H305 (Quantum Chemistry).
- PHYS H303 (Statistical Physics) or CHEM H304 (Statistical Thermodynamics and Kinetics).
- PHYS H320 (Topics in Biological Physics) or a similar course approved by the coordinating committee.
- Two half-semester courses with significant biophysics content: BIOL H311 (Advanced Genetic Analysis), BIOL H313 (Structure and Function of Macromolecules), BIOL H314 (Biochemistry: Metabolic Basis of Disease and Adaptation), BIOL H316 (Inter- and Intra-Cellular Communication), BIOL H320 (Molecular Microbiology), BIOL H322 (Cell Architecture), BIOL H324 (Photosynthesis), BIOL H326 (Biochemical Adaptations), BIOL H328

(Immunology), BIOL H336 (Cell Cycle), BIOL H337 (Pathogenic Microbiology), BIOL H451 (Molecular Motors and Biological Nano-Machines), BIOL H452 (Advanced Topics in Immunology), BIOL H454 (Advanced Topics in Virology), and BIOL H457 (Topics in Protein Science).

Chemistry Major with a Biochemistry Area of Concentration:

Chemistry majors desiring a biochemistry area of concentration must complete the biochemistry/biophysics core curriculum (see above) as well as the following additional requirements:

- One semester of advanced biochemistry-related laboratory coursework: normally BIOL H300 or BIOL H301 (Advanced Lab in Biology) or BIOL/CHEM H303 (Laboratory in Biochemical Research). Any of these courses, along with one semester of either CHEM H301 or CHEM H302, satisfy the advanced laboratory requirement for the Chemistry major.
- Two half-semester courses with significant biochemistry content: CHEM H351 (Bioinorganic Chemistry), CHEM H352 (Topics in Biophysical Chemistry), and CHEM H357 (Topics in Bioorganic Chemistry). Students may take topics courses multiple times with different topics.
- Two half-semester courses with significant biochemistry content: BIOL H311 (Advanced Genetic Analysis), BIOL H313 (Structure and Function of Macromolecules), BIOL H314 (Biochemistry: Metabolic Basis of Disease and Adaptation), BIOL H316 (Inter- and Intra-Cellular Communication), BIOL H320 (Molecular Microbiology), BIOL H322 (Cell Architecture), BIOL H324 (Photosynthesis), BIOL H326 (Biochemical Adaptations), BIOL H328 (Immunology), BIOL H334 (Biochemistry of Gene Expression), BIOL H336 (Cell Cycle), BIOL H337 (Pathogenic Microbiology), BIOL H451 (Molecular Motors and Biological Nano-Machines), BIOL H452 (Advanced Topics in Immunology), BIOL H454 (Advanced Topics in Virology), and BIOL H457 (Topics in Protein Science).

Physics Major with a Biophysics Area of Concentration:

Physics majors desiring a biophysics area of concentration must complete the biochemistry/biophysics core curriculum (see above) as well as the following additional requirements:

- An advanced biochemistry or biology laboratory course: one semester of BIOL H300 or BIOL H301 (Advanced Lab in Biology) or BIOL/CHEM H303 (Laboratory in Biochemical Research).
- Either PHYS H320 (Topics in Biological Physics) or two half-semester courses with significant

biophysics content: BIOL H311 (Advanced Genetic Analysis), BIOL H313 (Structure and Function of Macromolecules), BIOL H314 (Biochemistry: Metabolic Basis of Disease and Adaptation), BIOL H316 (Inter- and Intra-Cellular Communication), BIOL H320 (Molecular Microbiology), BIOL H322 (Cell Architecture), BIOL H324 (Photosynthesis), BIOL H326 (Biochemical Adaptations), BIOL H328 (Immunology), BIOL H336 (Cell Cycle), BIOL H337 (Pathogenic Microbiology), BIOL H451 (Molecular Motors and Biological Nano-Machines), BIOL H452 (Advanced Topics in Immunology), BIOL H454 (Advanced Topics in Virology), and BIOL H457 (Topics in Protein Science).

The advanced biochemistry or biology laboratory course satisfies the Physics major requirement for an upper level laboratory course requirement, and Physics 320 may count as one of the 300-level physics lecture courses required for the Physics major.

Concentration Coordinating Committee

Suzanne Amador Kane

The John and Barbara Bush Professor in the Natural Sciences; Professor of Physics and Astronomy

Lou Charkoudian

Professor of Chemistry

Amy Cooke

Assistant Professor of Biology; Coordinator of Biochemistry and Biophysics

Rob Fairman

Professor of Biology

Karl Johnson

Professor of Biology

Casey Londergan

Professor and Chair of Chemistry

Robert Scarrow

Professor of Chemistry

Walter Smith

The Paul and Sally Bolgiano Professor of Physics; Professor of Physics and Astronomy

Kristen Whalen

Associate Professor of Biology

Helen White

The William H. and Johanna A. Harris Professor in Environmental Studies and Chemistry; Associate Provost for Curricular Development & Research; Professor of Chemistry and Environmental Studies