SCHOOL OF HUMANITIES AND SCIENCES

BIOPHYSICS

Emeritus: Harden M. McConnell (Chemistry)
Director: Vijay Pande (Chemistry)
Professors: Russ Altman (Genetics, Medical Informatics), Steve Block (Applied Physics, Biology), Steven Boxer (Chemistry), Axel Brunger (Molecular and Cellular Physiology), Gilbert Chu (Oncology), Mark Davis (Microbiology and Immunology), Sebastian Doniach (Physics, Applied Physics), James Ferrell (Chemical and Systems Biology), Daniel Fisher (Applied Physics), K. Christopher Garcia (Molecular and Cellular Physiology, Structural Biology), Gary Glover (Radiology), Philip C. Hanawalt (Biology), Daniel Herschlag (Biochemistry), Keith O. Hodgson (Chemistry), Theodore Jardetzky (Structural Biology), Chaitan Khosla (Chemical Engineering, Chemistry), Brian Kobilka (Molecular and Cellular Physiology), Eric Kool (Chemistry), Ron Kopito (Biology), Roger D. Kornberg (Structural Biology), Michael Levitt (Structural Biology), Richard Lewis (Molecular and Cellular Physiology), Uel J. McMahan (Neurobiology), Tobias Meyer (Chemical and Systems Biology), W. E. Moerner (Chemistry), Norbert Pelc (Bioengineering, Radiology), Joseph D. Puglisi (Structural Biology), Stephen Quake (Bioengineering), Stephen J. Smith (Molecular and Cellular Physiology), Edward I. Solomon (Chemistry), James A. Spudich (Biochemistry, Developmental Biology), William I. Weis (Structural Biology, Molecular and Cellular Physiology), Richard N. Zare (Chemistry)
Associate Professors: Annelise Barron (Bioengineering), Judith Frydman (Biology), Pehr Harbury (Biochemistry), Craig Levin (Radiology), Vijay Pande (Chemistry), Julie Theriot (Biochemistry)
Assistant Professors: Zev Bryant (Bioengineering), Lynette Cegelski (Chemistry), Xiaoyuan Chen (Radiology), Jennifer Cochran (Bioengineering), Bianxiao Cui (Chemistry), Rhiju Das (Biochemistry), Alexander Dunn (Chemical Engineering), Miriam Goodman (Molecular and Cellular Physiology), KC Huang (Bioengineering), Merritt Maduke (Molecular and Cellular Physiology), Jianghong Rao (Radiology), Mark Schnitzer (Biology, Applied Physics), Jan Skotheim (Biology), Andrew Spakowitz (Chemical Engineering)

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Courses offered by the Biophysics Program are listed under the subject code BIOPHYS on the *Stanford Bulletin's* ExploreCourses web site.

The Biophysics Program offers instruction and research opportunities leading to the Ph.D. in Biophysics. Students admitted to the program may perform their graduate research in any appropriate department.

GRADUATE PROGRAM IN BIOPHYSICS

For information on the University's basic requirements for the Ph.D. degree, see the "Graduate Degrees" section of this bulletin.

A small number of qualified applicants are admitted to the program each year. Applicants should present strong undergraduate backgrounds in the physical sciences and mathematics. The graduate course program, beyond the stated requirements, is worked out for each student individually with the help of appropriate advisers from the Committee on Biophysics. The requirements and recommendations for the Ph.D. degree include:

1. Training in a major with connections to biophysics such as physics, chemistry, or biology, with a quantitative background equivalent to that of an undergraduate physics or chemistry major at Stanford.
2. Completion of the following background courses or their equivalents at other institutions:
   a. CHEM 131, 171, 173, and 175
   b. BIOC 200, 201
3. Completion of the following courses or their equivalents:
   a. SBIO 241 and 242
   b. at least four additional graduate level courses in physical or biological science
   c. BIOPHYS 250
   d. MED 255
4. Opportunities for teaching are available during the first nine quarters, at the discretion of the advising committee.
5. The student must prepare a dissertation proposal defining the research to be undertaken, including methods of procedure. This proposal should be submitted by Winter Quarter of the third year, and it must be approved by a committee of at least three members, including the principal research adviser and at least one member from the Biophysics Program. The candidate must defend the dissertation proposal in an oral examination. The dissertation reading committee normally evolves from the dissertation proposal review committee.
6. The student must present a Ph.D. dissertation as the result of independent investigation that expresses a contribution to knowledge in the field of biophysics.
7. The student must pass the University oral exam, taken only after the student has substantially completed the dissertation research. The examination is preceded by a public seminar in which the research is presented by the candidate.

BIOPHYSICS (BIOPHYS)

GRADUATE COURSES IN BIOPHYSICS

BIOPHYS 227. Functional MRI Methods
(Same as RAD 227) Basics of functional magnetic resonance neuroimaging, including data acquisition, analysis, and experimental design. Journal club sections. Cognitive neuroscience and clinical applications. Prerequisites: basic physics, mathematics; neuroscience recommended.
3 units, Aut (Glover, G)

BIOPHYS 228. Computational Structural Biology
(Same as SBIO 228) Interatomic forces and interactions such as electrostatics and hydrophobicity, and protein structure in terms of amino acid properties, local chain conformation, secondary structure, domains, and families of folds. How protein motion can be simulated. Bioinformatics introduced in terms of methods that compare proteins via their amino acid sequences and their three-dimensional structures. Structure prediction via simple comparative modeling. How to detect and model remote homologues. Predicting the structure of a protein from knowledge of its amino acid sequence. Via Internet.
3 units, not given this year

BIOPHYS 232. Advanced Imaging Lab in Biophysics
(Same as APPPHYS 232, BIO 132, BIO 232, MCP 232) Laboratory and lectures. Advanced microscopy and imaging, emphasizing hands-on experience with state-of-the-art techniques. Students construct and operate working apparatus. Topics include microscope optics, Koehler illumination, contrast-generating mechanisms (bright/dark field, fluorescence, phase contrast, differential interference contrast), and resolution limits. Laboratory topics vary by year, but include single-molecule fluorescence, fluorescence resonance energy transfer, confocal microscopy, two-photon microscopy, and optical trapping. Limited enrollment. Recommended: basic physics, Biology core or equivalent, and consent of instructor.
4 units, Spr (Block, S; Schnitzer, M; Smith, S; Stearns, T)

BIOPHYS 241. Biological Macromolecules
(Same as BIOC 241, SBIO 241) The physical and chemical basis of macromolecular function. Forces that stabilize biopolymers with three-dimensional structures and their functional implications. Thermodynamics, molecular forces, and kinetics of enzymatic and diffusional processes, and relationship to their practical application in experimental design and interpretation. Biological function and the level of individual molecular interactions and at the level of complex processes. Case studies. Prerequisites: introductory biochemistry and physical chemistry or consent of instructor.
3-5 units, Aut (Herschlag, D; Garcia, K; Ferrell, J; Block, S; Weis, W)

BIOPHYS 242. Methods in Molecular Biophysics
(Same as SBIO 242) Experimental methods in molecular biophysics from theoretical and practical standpoints. Emphasis is on X-ray diffraction, nuclear magnetic resonance, and fluorescence spectcroscopy. Prerequisite: physical chemistry or consent of instructor.
3 units, alternate years, not given this year

BIOPHYS 250. Seminar in Biophysics
Required of Biophysics graduate students. Presentation of current research projects and results by faculty in the Biophysics program. May be repeated for credit. (W. Weiss)
1 unit, Aut (Weis, W), Win (Weis, W)

BIOPHYS 297. Bio-Inorganic Chemistry
(Same as CHEM 297) Overview of metal sites in biology. Metalloproteins as elaborated inorganic complexes, their basic coordination chemistry and bonding, unique features of the protein ligand, and the physical methods used to study active sites. Active site structures are correlated with function. Prerequisites: 153 and 173, or equivalents.
3 units, Win (Solomon, E)

BIOPHYS 300. Graduate Research
Investigations sponsored by individual faculty members. Prerequisite: consent of instructor.
1-18 units, Aut (Staff), Win (Staff), Spr (Staff), Sum (Staff)

BIOPHYS 399. Directed Reading in Biophysics
Prerequisite: consent of instructor.
1-18 units, Aut (Staff), Win (Staff), Spr (Staff), Sum (Staff)