BIOPHYSICS PROGRAM

Emeritus: Harden M. McConnell (Chemistry)
Director: William I. Weis
Professors: Russ Altman (Genetics, Medical Informatics), Steve Block (Applied Physics, Biological Sciences), Steven Boxer (Chemistry), Axel Brunger (Molecular and Cellular Physiology), Douglas Brutlag (Biochemistry), Gilbert Chu (Oncology), Mark Davis (Microbiology and Immunology), Sebastian Doniach (Physics, Applied Physics), James Ferrell (Chemical and Systems Biology), K. Christopher Garcia (Molecular and Cellular Physiology, Structural Biology), Gary Glover (Radiology), Philip C. Hanawalt (Biological Sciences), Daniel Herschlag (Biochemistry), Keith O. Hodgson (Chemistry), Chaitan Khosla (Chemical Engineering, Chemistry), Brian Kobilka (Molecular and Cellular Physiology), Eric Kool (Chemistry), Ron Kopito (Biological Sciences), Roger D. Kornberg (Structural Biology), Michael Levitt (Structural Biology), Richard Lewis (Molecular and Cellular Physiology), David B. McKay (Structural Biology), 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: Judith Frydman (Biological Sciences), Pehr Harbury (Biochemistry), Craig Levin (Radiology), Vijay Pande (Chemistry), Julie Theriot (Biochemistry)
Assistant Professors: Zev Bryant (Bioengineering), Xiaoyuan Chen (Radiology), Jennifer Cochran (Bioengineering), Miriam Goodman (Molecular and Cellular Physiology), Merritt Maduke (Molecular and Cellular Physiology), Jianghong Rao (Radiology), Mark Schnitzer (Biological Sciences, Applied Physics)

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Web Site: http://med.stanford.edu/biophysics/

Courses given in Biophysics have the subject code BIOPHYS. For a complete list of subject codes, see Appendix.

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

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 physics or chemistry 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 and expressing 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 research. The examination is preceded by a public seminar in which the research is presented by the candidate.

COURSES

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. Recommended: neuroscience.

3 units, alternate years, not given this year

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, Aut, Spr (Levitt, M)

BIOPHYS 232. Advanced Imaging Lab in Biophysics—(Same as BIOSCI 132/232, 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, Biological Sciences 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; Puglisi, J; Garcia, K; Ferrell, J; Block, S; Pande, V; Weis, W)

BIOPHYS 242. Methods in Molecular Biophysics—(Same as SBIO 242.) The potential utility of physical approaches to research, and how to evaluate literature that incorporates these methods. Experimental methods in molecular biophysics from theoretical and practical stand-points. Emphasis is on X-ray diffraction and nuclear magnetic resonance spectroscopy. Additional topics include fluorescence spectroscopy, circular dichroism, calorimetry, and separation methods. 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.

1 unit, Aut, 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: CHEM 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, Win, Spr, Sum (Staff)

BIOPHYS 399. Directed Reading in Biophysics—Prerequisite: consent of instructor.

1-18 units, Aut, Win, Spr, Sum (Staff)

COGNATE COURSES

See respective department listings for course descriptions and General Education Requirements (GER) information. See degree requirements above or the program's student services office for applicability of these courses to a major or minor program.

BIOC 210. Advanced Topics in Membrane Trafficking

3 units, Spr (Staff)

BIOSCI 205. DNA Repair and Genomic Stability

3 units, Spr (Hanawalt, P; Ford, J)

MCP256. How Cells Work: Energetics, Compartments, and Coupling in Cell Biology

4 units, Spr (Maduke, M; Goodman, M)