SYSTEMS, SYNTHETIC AND PHYSICAL BIOLOGY

Contact Information
Systems, Synthetic and Physical Biology
http://sspb.rice.edu/
170 BioScience Research Collaborative
713-348-5961

Jonathan (Joff) Silberg
Program Director
joff@rice.edu

Systems, Synthetic and Physical Biology (SSPB) is a new discipline that draws upon principles from physics, chemistry, engineering, and mathematics and integrates experimental biochemical, cell biological, and molecular genetics approaches with computational design, simulation, and modeling to anticipate the properties of complex and multiscale biological systems. The Graduate Program in SSPB represents a cooperative effort by faculty in the schools of Natural Sciences and the Engineering to provide training in this highly interdisciplinary field. This program is overseen by the Institute of Biosciences and Bioengineering (IBB) and overseen by an executive committee composed of members from any of the participating departments.

The interdisciplinary nature of the SSPB program allows students to achieve their graduate degree requirements by taking select classes from any of the participating departments and performing their dissertation research under supervision of any faculty associated with the program.

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Systems, Synthetic, and Physical Biology does not currently offer an academic program at the undergraduate level.

Master’s Program

- Master of Science (MS) Degree in the field of Systems, Synthetic, and Physical Biology*

Doctoral Program

- Doctor of Philosophy (PhD) Degree in the field of Systems, Synthetic, and Physical Biology (ga.rice.edu/programs-study/departments:programs/engineering/systems-synthetic-physical-biology/systems-synthetic-physical-biology-phd)

* Although students are not normally admitted to a Master of Science (MS) degree program, graduate students may earn the MS as they work towards the PhD.

Director
Jonathan (Joff) Silberg, BioSciences

Professors
Pedro Alvarez, Civil and Environmental Engineering
Gang Bao, Bioengineering
George N. Bennett, BioSciences
Cecilia Clementi, Chemistry
Michael Deem, Bioengineering
Ramon Gonzalez, Chemical and Biomolecular Engineering

Lydia E. Kavraki, Computational and Applied Mathematics
Marek Kimmel, Statistics
Anatoly B. Kolomeisky, Chemistry
Christy Landes, Chemistry
Herbert Levine, Bioengineering
Jianpeng Ma, Bioengineering
Fred Mackintosh, Chemical and Biomolecular
Jose Onuchic, Physics and Astronomy
George Phillips, BioSciences
Susan Rosenberg, Biochemistry & Cell Biology
Ka-Yiu San, Bioengineering
Yousif Shamoo, Bioengineering
Peter G. Wolynes, Chemistry

Associate Professors
Matthew R. Bennett, BioSciences
Michael Diehl, Bioengineering
Ido Golding, Bioengineering
Oleg A. Igoshin, Bioengineering
Ching-Hwa Kiang, Physics and Astronomy
Michael Kohn, BioSciences
Christy Landes, Chemistry
Luay K. Nakhleh, Computational and Applied Mathematics
Robert Raphael, Bioengineering
Laura Segatori, Chemical and Biomolecular Engineering
Junghae Suh, Bioengineering Jeffrey J. Tabor, Bioengineering

Assistant Professors
Caleb Bashor, Bioengineering
James Chappell, BioSciences
Sherry Xue Gao, Chemical and Biomedical Engineering
Isaac Hilton, Bioengineering
Natasha Kirienko, BioSciences
Xaq Pitkow, Electrical and Computer Engineering
Amina A. Qutub, Bioengineering
Jacob Robinson, Electrical and Computer Engineering
Francois St-Pierre, Electrical and Computer Engineering
Lauren Stadler, Civil and Environmental Engineering
Jeffrey J. Tabor, Bioengineering
Aryeh Warmflash, BioSciences
Han Xiao, Chemistry
David Y. Zhang, Bioengineering
Weiwei Zhong, BioSciences

For Rice University degree-granting programs:
To view the list of official course offerings, please see Rice’s Course Catalog (https://courses.rice.edu/admweb/!SWKSCAT.cat?p_action=cata)
To view the most recent semester’s course schedule, please see Rice’s Course Schedule (https://courses.rice.edu/admweb/!SWKSCAT.cat)
SSPB 501 - PHYSICAL BIOLOGY
Short Title: PHYSICAL BIOLOGY
Department: Systems/Synthetic/Phys Biology
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Description: Basic introduction to physical biology. Topics include: biomolecular dynamics, cellular biomechanics, cell motility and cell division, calcium signaling, action potential propagation, and tissue organization. Cross-list: BIOE 502.

SSPB 502 - INTRO COMPUTATIONAL SYSTEMS BIOLOGY: MODELING & DESIGN PRINCIPLES OF BIOCHEM NETWORKS
Short Title: INTRO SYSTEMS BIOLOGY MODELING
Department: Systems/Synthetic/Phys Biology
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Description: The course summarizes techniques for quantitative analysis and simulations of basic circuits in genetic regulation, signal transduction and metabolism. We discuss engineering approaches adapted to computational systems biology and aim to formulate evolutionary design principles explaining organization of networks in terms of their physiological demands. We discuss biochemical simulation methodology and software as well as recent advances in the field. Topics include end-product inhibition in biosynthesis, optimality and robustness of the signaling networks and kinetic proofreading. More emphasis on recent advances in the field - paper reading and presentations. Cross-list: BIOE 552. Recommended Prerequisite(s): Basic knowledge of biochemistry, cell biology, linear algebra, and ordinary differential equations is expected.

SSPB 503 - SYNTHETIC BIOLOGY
Short Title: SYNTHETIC BIOLOGY
Department: Systems/Synthetic/Phys Biology
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Design of biology at scales from molecules to multicellular organisms will be covered by lecture, primary literature, and student presentations. Students will write a research proposal at the end of the course. Cross-list: BIOE 508.

SSPB 504 - NONLINEAR SYSTEM ANALYSIS & CONTROL
Short Title: NONLINEAR SYSTEM ANALYSIS & CONTROL
Department: Systems/Synthetic/Phys Biology
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Design of biology at scales from molecules to multicellular organisms will be covered by lecture, primary literature, and student presentations. Students will write a research proposal at the end of the course. Cross-list: BIOE 508.

SSPB 550 - GRADUATE SEMINAR
Short Title: GRADUATE SEMINAR
Department: Systems/Synthetic/Phys Biology
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to students with a major in Systems/Synthetic/Phys Biology. Enrollment is limited to Graduate level students.
Description: Seminar course to introduce SSPB students to current research topics and activities in the systems, synthetic, and physical biology fields. Repeatable for Credit.

SSPB 575 - INTRODUCTION TO RESEARCH
Short Title: INTRODUCTION TO RESEARCH
Department: Systems/Synthetic/Phys Biology
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Research
Credit Hours: 2
Restrictions: Enrollment is limited to students with a major in Systems/Synthetic/Phys Biology. Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction of first-year graduate students to the research programs and laboratories of individual faculty members. Repeatable for Credit.

SSPB 599 - GRADUATE TEACHING IN SSPB
Short Title: GRADUATE TEACHING IN SSPB
Department: Systems/Synthetic/Phys Biology
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Internship/Practicum
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Supervised instruction in teaching systems, synthetic, and physical biology. Repeatable for Credit.

SSPB 800 - GRADUATE RESEARCH
Short Title: GRADUATE RESEARCH
Department: Systems/Synthetic/Phys Biology
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Research
Credit Hours: 1-15
Restrictions: Enrollment is limited to students with a major in Systems/Synthetic/Phys Biology. Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Graduate students will conduct independent research/thesis project under the direction of their advisor. Repeatable for Credit.

Description and Code Legend
Note: Internally, the university uses the following descriptions, codes, and abbreviations for this academic program. The following is a quick reference:

Course Catalog/Schedule
- Course offerings/subject codes: Courses from various subjects may apply toward this program

Program Description and Code
- Systems, Synthetic, and Physical Biology: SSPB
Graduate Degree Descriptions and Codes
• Master of Science degree: MS
• Doctor of Philosophy degree: PhD

Graduate Degree Program Description and Code
• Degree Program in Systems, Synthetic and Physical Biology: SSPB