SYSTEMS, SYNTHETIC, AND PHYSICAL BIOLOGY

Contact Information

Systems, Synthetic, and Physical Biology
https://sspb.rice.edu/
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Program Director
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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. As a unique graduate program, SSPB represents a cooperative effort by faculty in the Schools of Natural Sciences (https://ga.rice.edu/programs-study/departments-programs/natural-sciences/)and Engineering and Computing (https://ga.rice.edu/programs-study/departments-programs/engineering/) to provide training in this highly interdisciplinary field. This program is overseen by a steering committee composed of faculty from the participating departments.

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

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 (https://ga.rice.edu/programs-study/departments-programs/interdisciplinary/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.*

Program Director

Matthew Bennett, *BioSciences*

Professors

Caroline Ajo-Franklin, *BioSciences*
Pedro J.J. Alvarez, *Civil and Environmental Engineering*
Gang Bao, *Bioengineering*
Matthew Bennett, *BioSciences*
Oleg A. Igoshin, *Bioengineering*
Lydia Kavraki, *Computer Science*
Marek Kimmel, *Statistics*
Anatoly B. Kolomeisky, *Chemistry*
Jianpeng Ma, *Bioengineering*
Frederick C. MacKintosh, *Chemical and Biomolecular Engineering*
Caroline A. Masiello, *Earth, Environmental and Planetary Sciences*
Luay K. Nakhleh, *Computer Science*
Edward P. Nikonowicz, *BioSciences*
Jose Nelson Onuchic, *Physics and Astronomy*
George Phillips, *BioSciences*
Cynthia Reinhart-King, *Bioengineering*
Hans Renata, *Chemistry*
Jacob Robinson, *Electrical and Computer Engineering*
Laura Segatori, *Bioengineering*
Yousif Shamoo, *BioSciences*
Jonathan J. Silberg, *BioSciences*
Jeffrey J. Tabor, *Bioengineering*
Yizhi Jane Tao, *BioSciences*
Omid Veiseh, *Bioengineering*
Aryeh Warmflash, *BioSciences*
Peter G. Wolynes, *Chemistry*
Han Xiao, *Chemistry*
Chong Xie, *Electrical and Computer Engineering*

Associate Professors

James Chappell, *BioSciences*
Michael Diehl, *Bioengineering*
Isaac Hilton, *Bioengineering*
Ching-Hwa Kiang, *Physics and Astronomy*
Natasha Kirienko, *BioSciences*
Lan Luan, *Electrical and Computer Engineering*
Robert M. Raphael, *Bioengineering*
Jacob Robinson, *Electrical and Computer Engineering*
Lauren Stadler, *Civil and Environmental Engineering*
Todd Treangen, *Computer Science*
Rosa Uribe, *BioSciences*

Assistant Professors

Caleb Bashor, *Bioengineering*
Jessica Butts, *Bioengineering*
Mingjie Dai, *Bioengineering*
Marcos H. de Moraes, *BioSciences*
Yang Gao, *BioSciences*
Cameron Glasscock, *BioSciences*
Anna-Karin Gustavsson, *Chemistry*
Harini Iyer, *BioSciences*
Laura Lavery, *BioSciences*
Lei Li, *Electrical and Computer Engineering*
Theresa Loveless, *BioSciences*
George Lu, *Bioengineering*
Yuan Ma, *Chemistry*
Quanbing Mou, *Chemistry*
Jerzy Szablowski, *Bioengineering*
Evelyn Tang, *Physics and Astronomy*
Ross Thyer, *Chemical and Biomolecular Engineering*
Julea Vlassakis, *Bioengineering*
Vicky Yao, *Computer Science*

Adjunct Professors

Jimmy Gollihar, *BioSciences*
Susan M. Rosenberg, *BioSciences*
François St-Pierre, *Electrical and Computer Engineering*
Junghae Suh, *Bioengineering*

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).

Systems, Synthetic, and Physical Biology (SSPB)

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.
Course Level: Graduate
Description: Basic introduction to a biophysical view of living systems, from the subcellular to the multicellular scales. Topics include: biomolecular dynamics, cellular biomechanics, cell motility and cell division, calcium signaling, action potential propagation, and tissue organization. Cross-list: BIOE 502, BIOS 505.

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. Enrollment limited to students in a Doctor of Philosophy degree. Enrollment limited to students in the Systems/Synthetic/Phys Biology department.
Course Level: Graduate
Description: The course summarizes techniques for quantitative analysis and simulations of basic circuits in genetic regulation, signal transduction, and metabolism. The class is based on MATLAB, with a brief refresher provided at the beginning. We discuss engineering approaches adapted to computational systems biology and aim to formulate evolutionary design principles explaining the organization of networks in terms of their physiological demands. Topics include end-product inhibition in biosynthesis, optimality and robustness of the signaling networks, and kinetic proofreading. The topics covered include modeling of enzyme kinetics, biochemical reaction networks, gene regulation, stochasticity of gene expression, and evolutionary and epidemiological population dynamics. The final project focuses on modeling synthetic biology circuits. Cross-list: BIOE 552. Recommended Prerequisite(s): Basic knowledge of biochemistry, cell biology, linear algebra, and ordinary differential equations is expected. Experience with MATLAB or Python programming is highly recommended.

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 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.
Course Level: Graduate
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: 3
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 677 - SPECIAL TOPICS
Short Title: SPECIAL TOPICS
Department: Systems/Synthetic/Phys Biology
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory, Independent Study, Internship/Practicum, Laboratory, Lecture, Seminar
Credit Hours: 1-4
Restrictions: Enrollment is limited to Graduate or Visiting Graduate level students.
Course Level: Graduate
Description: Topics and credit hours vary each semester. Contact department for current semester's topic(s). 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 towards this program

Department (or 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

CIP Code and Description [1]

- **SSPB** Major/Program: CIP Code/Title: *30.0101 - Biological and Physical Sciences*

[1] Classification of Instructional Programs (CIP) 2020 Codes and Descriptions from the National Center for Education Statistics: https://nces.ed.gov/ipeds/cipcode/.