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 and Engineering to provide training in this highly interdisciplinary field. This program is overseen by the Institute of Biosciences and Bioengineering (IBB) and 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 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

* 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 J. Silberg, 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
Christy F. Landes, Chemistry
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
Ka-Yiu San, Bioengineering
Yousif Shamoo, BioSciences
Jonathan J. Silberg, BioSciences
Yizhi Jane Tao, BioSciences
Peter G. Wolynes, Chemistry

**Associate Professors**

Michael Diehl, Bioengineering
Ching-Hwa Kiang, Physics and Astronomy
Natasha Kirienko, BioSciences
Robert M. Raphael, Bioengineering
Hans Renata, Chemistry
Jacob Robinson, Electrical and Computer Engineering
Laura Segatori, Bioengineering
Jeffrey J. Tabor, Bioengineering
Aryeh Warmflash, BioSciences
Chong Xie, Electrical and Computer Engineering

**Assistant Professors**

Caleb Bashor, Bioengineering
James Chappell, BioSciences
Mingjie Dai, Bioengineering
Marcos H. de Moraes, BioSciences
Xue Gao, Chemical and Biomolecular Engineering
Yang Gao, BioSciences
Anna-Karin Gustavsson, Chemistry
Isaac Hilton, Bioengineering
Laura Lavery, BioSciences
George Lu, Bioengineering
Lan Luan, Electrical and Computer Engineering
Lauren Stadler, Civil and Environmental Engineering
Jerzy Szablowski, Bioengineering
Evelyn Tang, Physics and Astronomy
Ross Teyler, Chemical and Biomolecular Engineering
Todd Treangen, Computer Science
Omid Veiseh, Bioengineering
Julea Vlassakis, Bioengineering
Han Xiao, Chemistry
Vicky Yao, Computer Science

**Adjunct Professors**

Herbert Levine, Bioengineering
Jianpeng Ma, Bioengineering
Xaq Pitkow, Electrical and Computer Engineering
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/ISWKSCAT.cat?p_action=cata)
To view the most recent semester’s course schedule, please see Rice’s Course Schedule (https://courses.rice.edu/admweb/ISWKSCAT.cat)

**Systems/Synthetic/Phys 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.
- **Course Level:** Graduate
- **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 505 - SYNTHETIC BIOLOGY**
- **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 601 - NAVIGATING INTERDISCIPLINARY TEAMS IN SCIENCE AND ENGINEERING**
- **Short Title:** INTERDISCIPLINARITY I
- **Department:** Systems/Synthetic/Phys Biology
- **Grade Mode:** Standard Letter
- **Course Type:** Seminar
- **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 602 - INNOVATIONS AND CHALLENGES IN BIOELECTRONICS RESEARCH**
- **Short Title:** INTERDISCIPLINARITY II
- **Department:** Systems/Synthetic/Phys Biology
- **Grade Mode:** Standard Letter
- **Course Type:** Seminar
- **Credit Hour:** 1
- **Restrictions:** Enrollment is limited to Graduate level students.
- **Course Level:** Graduate
- **Prerequisite(s):** SSPB 601
- **Description:** Covers literature on past biotechnological innovations that required interdisciplinary collaboration for success. Instructor Permission Required.
SSPB 610 - INTERDISCIPLINARY BIOELECTRONICS RESEARCH
COLLOQUIUM
Short Title: BIOELECTRONICS COLLOQUIUM
Department: Systems/Synthetic/Phys Biology
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Covers effective oral communication in the interdisciplinary field of bioelectronics. Repeatable for Credit.

SSPB 620 - INTERDISCIPLINARY BIOELECTRONICS PEER WRITING GROUPS
Short Title: BIOELECTRONICS WRITING
Department: Systems/Synthetic/Phys Biology
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Covers effective written communication in the interdisciplinary field of bioelectronics. 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 700 - INTERDISCIPLINARY BIOELECTRONICS RESEARCH
Short Title: BIOELECTRONICS RESEARCH
Department: Systems/Synthetic/Phys Biology
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Research
Credit Hours: 1-3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Covers research in the interdisciplinary field of bioelectronics. 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
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/