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.

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**
- Pedro J.J. Alvarez, Civil and Environmental Engineering
- Gang Bao, Bioengineering
- George N. Bennett, BioSciences
- Cecilia Clementi, Chemistry
- Michael W. Deem, Bioengineering
- Lydia Kavraki, Computer Science
- Marek Kimmel, Statistics
- Anatoly B. Kolomeisky, Chemistry
- Christy F. Landes, Chemistry
- Herbert Levine, Bioengineering
- Jianpeng Ma, Bioengineering
- Frederick C. MacKintosh, Chemical and Biomolecular Engineering
- Luay K. Nakhleh, Computer Science
- Jose Nelson Onuchic, Physics and Astronomy
- George Phillips, BioSciences
- Ka-Yiu San, Bioengineering
- Yousif Shamoo, Bioengineering
- Peter G. Wolynes, Chemistry

**Associate Professors**
- Matthew Bennet, BioSciences
- Michael Diehl, Bioengineering
- Ido Golding, Bioengineering
- Oleg A. Igoshin, Bioengineering
- Ching-Hwa Kiang, Physics and Astronomy
- Michael H. Kohn, BioSciences
- Robert M. Raphael, Bioengineering
- Laura Segatori, Chemical and Biomolecular Engineering
- Junghae Suh, Bioengineering
- Jeffrey J. Tabor, Bioengineering

**Assistant Professors**
- Caleb Bashor, Bioengineering
- James Chappell, BioSciences
- Xue Gao, Chemical and Biomolecular Engineering
- Isaac Hilton, BioSciences
- Natasha Kirienko, BioSciences
- Xaq Pitkow, Electrical and Computer Engineering
- Jacob Robinson, Electrical and Computer Engineering
- Lauren Stadler, Civil and Environmental Engineering
- François St-Pierre, Electrical and Computer Engineering
- Aryeh Warmflash, BioSciences
- Han Xiao, Chemistry
- David Zhang, Bioengineering

**Adjunct Professors**
- Ramon Gonzalez, Chemical and Biomolecular Engineering
- Amina A. Qutub, Bioengineering
- Susan M. Rosenberg, Biochemistry & Cell Biology

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.

**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 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:** 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 677 - SPECIAL TOPICS**

**Short Title:** SPECIAL TOPICS  
**Department:** Systems/Synthetic/Phys Biology  
**Grade Mode:** Satisfactory/Unsatisfactory  
**Course Type:** Internship/Practicum, Lecture, Seminar, Laboratory  
**Credit Hours:** 1-4  
**Restrictions:** Enrollment is limited to 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 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

CIP Code and Description

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

1 Classification of Instructional Programs (CIP) 2010 Codes and Descriptions from the National Center for Education Statistics: https://nces.ed.gov/ipeds/cipcode/