



**SYSTEMS, SYNTHETIC, AND PHYSICAL  
BIOLOGY GRADUATE PROGRAM**

STUDENT HANDBOOK

2016-2017

*last updated August 8<sup>th</sup>, 2016*

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## I. PROGRAM OVERVIEW

### A. Overview of the Program

Systems, Synthetic, and Physical Biology (SSPB) is a new discipline that combines the approaches of systems and synthetic biology with biophysical research to build a complete and quantitative approach to the study of highly complex biological problems and the engineering of biological systems. There is a great deal of methodological and intellectual overlap between these research areas, a research interface that is rapidly becoming one of the most important areas of life sciences of this century. Within the next 50 years we are likely to see a dramatic shift in manufacturing and medicine towards much more biologically based technologies and discoveries. While the recent period has been called the Information Age, the next period will be a Biological one in which cells are engineered to produce new medicines, biofuels, and materials. Before we can reliably re-engineer cells to make new tissues or produce high value molecules, we must understand how to speak the language of life. While DNA is part of the language of all life, as scientists we struggle to read and write stories of any real sophistication. Systems, synthetic and physical biology research is at the heart of reading, understanding, and using this elegant language to construct and deconstruct genetic circuits that will allow us to determine how cells operate, interact with each other, and adapt to their environment. If we truly understand this language we will be able to re-program cells to make new tissues, biofuels, chemicals, materials and medicines.

1) Systems Biology is the study of the emergence of functional properties that are present in a biological system but not in its individual components. Systems biology attempts to understand how a process, a cell, a group of cells, or tissue works at a global level and how different components of the process interact. The topics include the studies of signaling, gene regulatory and biochemical networks, multicellular organization, and signaling. The field combines both science and engineering approaches and uses mathematical, computational and statistical tools for data analysis and modeling.

2) Synthetic Biology is the purposeful construction of new cells to elicit engineered behaviors. By engineering genetic and metabolic networks, synthetic biologists are able to simplify the complexity of biochemical networks and thus elucidate the quantitative and qualitative behavior of network components. This knowledge is applied toward engineering goals such as the production of a high-value chemicals or therapeutic agents. As with Systems Biology, Synthetic Biology is a highly interdisciplinary field, combining aspects of molecular biology, biochemistry, computational biology and theoretical physics.

3) Physical Biology is an integration of biology with chemistry, physics, mathematics, and computer science to provide a quantitative approach to problems in biology, biomedicine and biotechnology. Like systems and synthetic biology, physical biology unifies two approaches in science: the study of diseases and organisms *in toto* (a holistic or "top down" approach) and the study of specific molecular mechanisms (a "bottom up" approach) to develop models that anticipate the physicochemical properties of molecules, cellular and organismal behaviors and fitness, and the effects of changing environments on these properties.

The SSPB graduate program represents a cooperative effort by faculty in the schools of Natural Sciences and the Engineering to provide training in these rapidly growing research areas. The interdisciplinary nature of the SSPB program allows students to achieve their graduate degree requirements by taking select classes from the different participating departments and performing their dissertation research under supervision of faculty associated with the program who reside within seven different science and engineering departments.

## **B. Goals of the Program**

The SSPB graduate program provides advanced specialized training beyond baccalaureate programs. The goals of the graduate training provided by this program are to guide students as they develop into doctoral recipients. There are three major goals of this program.

1. Understand research achievements in the disciplines of systems, synthetic, and physical biology.
  - build foundational knowledge (research findings and techniques) in the disciplines that underlie systems, synthetic, and physical biology,
  - integrate knowledge from diverse fields to develop a solution plan for defined biological problems that currently exist (critical thinking),
  - apply knowledge from Biology, Mathematics, and Physics to open ended biological challenges (integrate biological and quantitative techniques), and
  - develop deep knowledge within the sub-area where students pursue their dissertation research (*i.e.*, find the edge of the wave so that they can ride it!)
2. Perform independent research in systems, synthetic, and/or physical biology.
  - identify and pose a research problem and place that problem in context within the field's established literature,
  - develop a solution to an open-ended research question that has not yet been answered,
  - thoughtfully relate research achievements to others in the SSPB fields through peer-reviewed publications, and
  - assume responsibility for continued professional growth by striving to acquire new knowledge and skills (and display high professional standards).
3. Develop professional skills in oral and written communication.
  - write well-organized, coherent technical prose that is at a level observed within peer-reviewed manuscripts and disseminate original results through peer-reviewed publications,
  - deliver oral presentations that are of the caliber that is expected at national conferences and disseminate original results and finding to the community, and
  - demonstrate critical thinking skills when confronted with unanticipated questions.

## **C. Becoming a Leading Researcher**

To maximize training in SSPB, graduate students must be committed to:

- assuming full responsibility in their research and scholarly activities
- initiating and completing innovative and productive research activities,
- engaging in active learning, such as participating in weekly seminars, attending relevant seminars outside of the program, and reading extensively within their chosen field of study,
- developing advanced oral and written communication skills,
- accepting and providing constructive scientific criticism, and
- exercising high professional standards in all aspects of work.

The SSPB graduate program faculty members are committed to training and mentoring graduate students to reach their full potential as scientists. We seek to facilitate students' progression towards fulfilling and exciting careers in academia, industry, or government, and to develop their skills as future leaders in science and society

#### **D. Participating Departments and Faculty**

Bioengineering Department (<http://bioe.rice.edu>): Gang Bao, Michael Deem, Mike Diehl, Ido Golding (*adjunct*), Oleg Igoshin, Herb Levine, Jianpeng Ma, Amina Qutub, Rob Raphael, Ka-Yiu San, Junghae Suh, Jeff Tabor, and David Zhang

Biosciences Department (<http://biosciences.rice.edu>): George Bennett, Matt Bennett, Natasha Kirienko, Michael Kohn, George Phillips, Susan Rosenberg (*adjunct*), Yousif Shamoo, Jonathan Silberg, Aryeh Warmflash, and Weiwei Zhong

Chemical & Biomolecular Engineering Department (<http://chbe.rice.edu>): Ramon Gonzalez, Deepak Nagrath, and Laura Segatori

Chemistry Department (<http://chemistry.rice.edu>): Cecilia Clementi, Anatoly Kolomeisky, Christy Landes, and Peter Wolynes

Civil and Environmental Engineering (<http://ceve.rice.edu>): Lauren Stadler and Pedro Alvarez

Computer Science Department (<http://compsci.rice.edu>): Lydia Kavradi and Luay Nakhleh

Electrical and Computer Engineering (<http://www.ece.rice.edu>): Xaq Pitkow, Jacob Robinson, and Francois St-Pierre

Physics Department (<http://physics.rice.edu>): Ching-Hwa Kiang and Jose Onuchic

Statistics Department (<http://statistics.rice.edu>): Marek Kimmel

**E. Useful Websites.** A few links are provided that students frequently use.

Center for Written, Oral and Visual Communication (<http://cwovc.rice.edu>)

- provide feedback on written texts and oral/visual presentations

Course Management System (<https://owlspace-ccm.rice.edu>)

- Owlspace system used by instructors to disseminate course information

Employee and Student Tools, Help, and Electronic Resources (<https://esther.rice.edu>).

- application used regularly for registration, grades, and information

Environmental Health and Safety (<http://safety.rice.edu>)

- safety department that provides training for safety

General Announcements (<http://ga.rice.edu>)

- contains information on academic policies and procedures, student services and organizations, and rights and responsibilities

Office of Graduate Studies (<http://graduate.rice.edu>)

- great resource for finding forms related to enrollment, candidacy, and thesis

Registrar (<http://registrar.rice.edu>)

- contains information on course schedules, academic calendars, registering, and more

Student Health (<http://health.rice.edu>)

- information about on campus preventive and outpatient clinical care

Systems, Synthetic, and Physical Biology Program (<http://sspb.rice.edu>)

- contains information specific to this graduate program

## II. ADMINISTRATIVE

### A. Using this handbook

Students should use this handbook as a reference to the processes that will occur at the different stages of their graduate studies in the SSPB program. In addition to being in agreement with the regulation stated in this SSPB handbook, students must also be in agreement with the General Announcements (<http://ga.rice.edu>) and the Code of Conduct (<http://www.students.rice.edu/students/Conduct.asp>). In cases where there is conflicting information, university-wide regulations take precedence over SSPB regulations, which take precedence over research group regulations. When in doubt, students should seek help first at the SSPB program level (Program Coordinator, Graduate Advising Committee, Advisor, and/or Program Director) and then at the central administration level (Office of Graduate and Postdoctoral Studies).

Please contact the Associate Director if you have suggestions for additions or clarifications to this handbook. These suggestions will be considered in the annual revision of this handbook.

### B. Graduate Program Organization

Program Coordinator. The first person students should contact if they have questions.

Dyani Banda, Biosciences Research Collaborative (BRC) Suite 171  
Email: [dhb1@rice.edu](mailto:dhb1@rice.edu)  
Phone: 713-348-5961

Program Director.

Dr. Herbert Levine, Bioengineering  
Email: [herbert.levine@rice.edu](mailto:herbert.levine@rice.edu)

Associate Director.

Dr. Jonathan (Joff) Silberg, Biosciences  
Email: [joff@rice.edu](mailto:joff@rice.edu)

Graduate Advising Committee. This committee identifies remedial course work that students require, advises students in the coursework that complies with program requirements, and deals with rotation and TA assignments. Any correspondence should be directed to the chair of the committee. The current committee members are:

Matt Bennett, chair ([matthew.bennett@rice.edu](mailto:matthew.bennett@rice.edu)); Jonathan (Joff) Silberg

Curriculum Committee. This committee oversees curriculum changes, makes adjustments to course and entry requirements, and reviews and responds to student petitions for course substitutions or waivers. Any correspondence should be directed to the chair of the committee. The current committee members are:

Herbert Levine, chair ([herbert.levine@rice.edu](mailto:herbert.levine@rice.edu)); George Phillips; Junghae Suh

Steering Committee. This committee oversees the academic policies of the program and student progress. The current members include the Director, two Natural Sciences faculty, two Engineering faculty, and the IBB Director. Any correspondence should be directed to the chair of the committee.

Herbert Levine, chair ([herbert.levine@rice.edu](mailto:herbert.levine@rice.edu)); Oleg Igoshin; Marek Kimmel; Jane Grande-Allen (*ad hoc*); Jonathan (Joff) Silberg; Peter Wolynes

### **C. Graduate Stipends and Health insurance**

Stipend. Students receive a constant amount of pay twice each month. Paychecks are issued on the 15<sup>th</sup> day of the month and the last day of the month, or the previous business day if the pay date falls on a holiday or weekend. If students have any questions regarding their stipend, they should contact the Program Coordinator.

Health Insurance. Rice University requires all degree-seeking students to have health insurance. Students electing to enroll in the Rice Student Health Plan may opt to be billed annually or semi-annually. Contact the Cashier's Office for payment options (713-348-4946). Students must complete an Insurance Waiver Form to waive enrollment in this health plan.

### **D. Graduate Student Mail**

The SSPB Mail Stop (MS) for all correspondence is MS-180, which corresponds to the mailboxes in the entry cubicle of BRC Suite 170. Students should see the Program Coordinator if they do not have a mailbox. Fed Ex and UPS packages are received in BRC Suite 170.

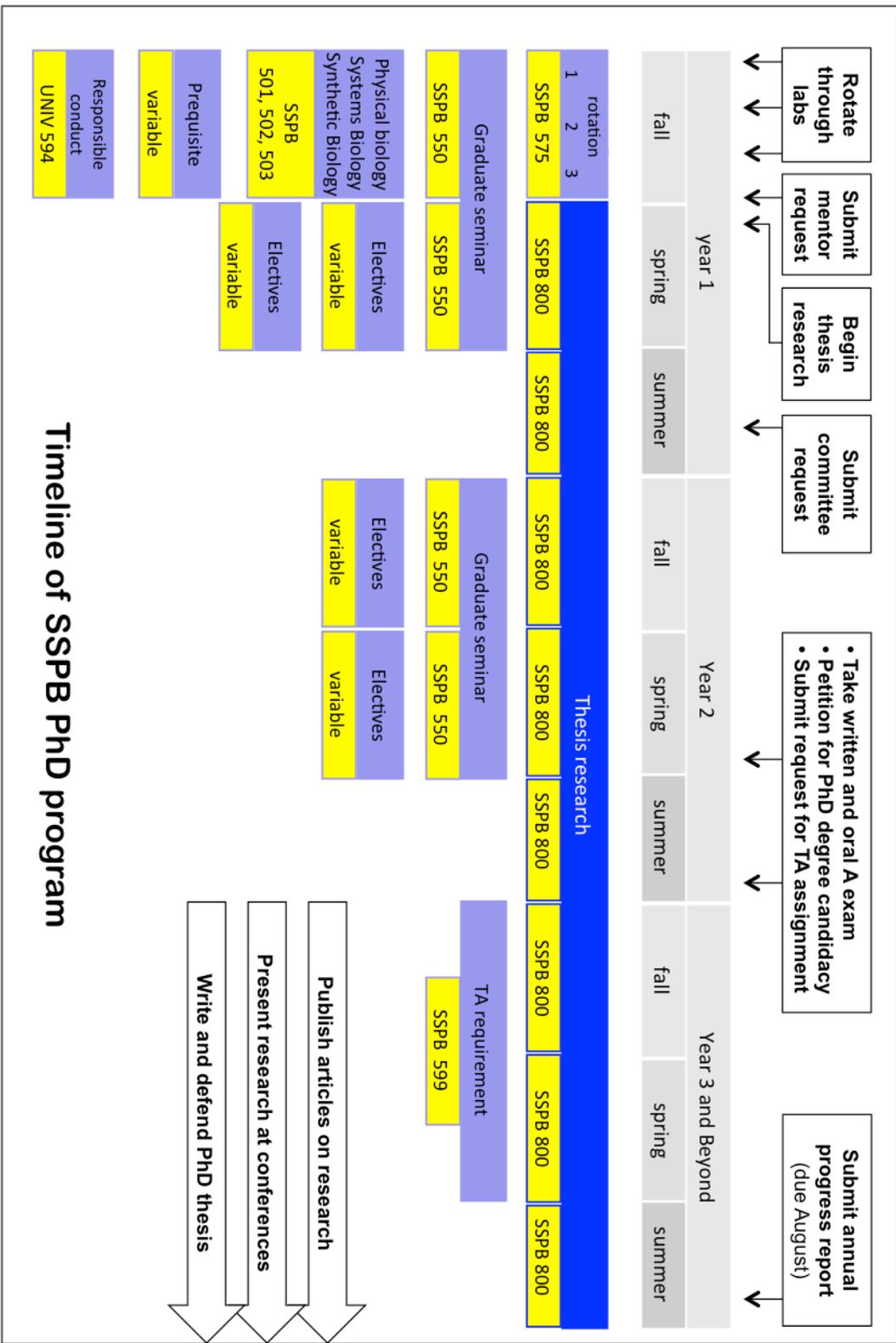
### **E. Employee and Student Tools, Help, and Electronic Resources (Esther)**

Esther is a web application that students use to register for classes and retrieve data such as grades and account information. The Rice Registrar's website contains instructions for using Esther. Esther is used to: (i) update contact information, (ii) register for classes, add/drop courses, and view enrollment verification, (iii) view course schedule, (iv) access final grades, (v) view past course and instructor evaluation comments, (vi) view unofficial transcript, (vii) print degree application, (viii) identify holds on accounts and pay account balances online, (ix) view financial aid information, (x) view employment information, such as past pay stubs, (xi) review charges and payments, and (xii) review changes to various forms (tax form and direct deposit information).

### **F. Graduate Studies Forms**

All forms related to candidacy, thesis defense, thesis submission, and degree conferral can be found at the Office of Graduate and Postdoctoral Studies (GPS) website. Their website (<http://graduate.rice.edu>) contains a link for these forms.

### III. TYPICAL TIMELINE FOR A SSPB STUDENT



## IV. REQUIREMENTS AND COURSE REGISTRATION

### A. Prerequisite courses

Because of the interdisciplinary nature of SSPB training, students are required to have undergraduate training in the following 5 foundational areas:

1. Molecular Biology (Introductory Biology and at least one upper-level biology class, such as Cell Biology, Genetics or Biophysics),
2. Biochemical reaction kinetics (Biochemistry, Bioreaction Engineering, or equivalent),
3. Physical Chemistry or Thermodynamics or Statistical mechanics,
4. Ordinary Differential Equations, and
5. Statistics.

If students are missing formal training in one or more of these subjects, they are required to take the equivalent background courses during their first year at Rice. The corresponding courses at Rice include the following:

1. Cell Biology (BIOC 341),
2. Biochemistry (BIOC 301) or Bioreaction Kinetics (BIOE 330),
3. Physical Chemistry or Thermodynamics (BIOC 352, BIOE 332, PHYS 425 or CHEM 310),
4. Ordinary Differential Equations (MATH 211 or 213), and
5. Applied Statistics for Bioengineering and Biotechnology (BIOE 439), Probability and Statistics (STAT 310), or Introduction to Statistics for the Biosciences (STAT 305).

These classes should be taken for a “pass/fail” grade. Students taking these courses as pass/fail will receive a grade of “pass” if they make a grade of A, B, C, or D. If a student earns a grade of “F”, it will appear on their transcript. These courses do not count toward the required credit hours for the degree program.

### B. Lecture courses

Students are required to accumulate 24 semester hours of coursework by taking the following courses for a letter grade:

1. Physical Biology (SSPB 501),
2. Introduction to Systems Biology Modeling (SSPB 502),
3. Synthetic Biology (SSPB 503), and
4. Advanced topics in SSPB (three courses from approved list in Appendix).
5. Open-elective courses (two courses that are 300-level or above; must be approved by Graduate Advising Committee)

It is recommended that at least one of the courses in Advanced Topics apply quantitative concepts from computer science, physics, and mathematics or statistics to biological problems, and at least one of the courses focus on biology within the sub-area where each student is pursuing their dissertation research. Students must take at least 15 semester hours of lecture courses during their first year, including their prerequisite courses, the core requirements (SSPB 501/502/503) for which they have sufficient prerequisites, and additional approved lecture courses. Additionally, all of the core course requirements (SSPB 501/502/503) must be taken before the fourth semester in residence.

### C. Responsible Conduct of Research

All students are required to take “Responsible Conduct of Research” (UNIV 594) during their first semester. Responsible conduct of research is defined as the practice of scientific

investigation with integrity. It involves the awareness and application of established professional norms and ethical principles in the performance of all activities related to scientific research. UNIV 594 does not count towards the 24 hours of coursework.

#### **D. Seminars**

Seminar attendance is an integral part of our education of scientists during our formal studies and beyond. For this reason, students are required to enroll in the graduate seminar course (SSPB 550) each semester of their first two years to accumulate a total of four semesters of course credit. Students that have a class or TA-assignment conflict with the seminar timing during one of their first 4 semesters at Rice can petition the Graduate Advising Committee to postpone their fulfillment of the seminar requirement to a subsequent semester. SSPB 550 is graded on a “Satisfactory/Unsatisfactory” basis based on attendance. Students are encouraged to ask questions and engage speakers who will be leaders in synthetic, systems, and physical biology disciplines. The attendance policy for SSPB 550 is set by an instructor and announced in the course syllabus each semester. In cases where students have more absences, they are required to attend approved seminars and submit a short write up on those presentations. Students who have fulfilled their seminar requirement are encouraged to continue attending the SSPB seminar series and other proximal seminars of relevance to their research and education.

#### **E. Research**

First semester. During their first semester in residence, all students must register for “Introduction to Research” (SSPB 575) and participate in research rotations. The student performance in the research rotations (SSPB 575) will be graded as Satisfactory/Unsatisfactory.

Subsequent semesters. To be a full-time student and receive a stipend during the fall and spring semesters, students must be registered for a minimum of 9 credit hours. The university minimum requirement for the doctorate degree is 90 semester hours beyond the bachelor’s degree (60 hours beyond the master’s degree). After the first semester, program policy requires that full-time students be registered for at least 12 credit hours each semester. After joining a research group, students should register for “Graduate Research” (SSPB 800). Students should consider course load when deciding on the number of credit hours to take for SSPB 800. In cases where students only take SSPB 800, they should register for 12 credit hours per semester during the terms they are engaged in research. In semesters where students are taking courses, they should enroll in SSPB 800 for a minimum of 9 credit hours. Students are expected to fulfill the research requirements as defined by their advisor to earn a “satisfactory” grade in SSPB 800.

Summer semesters. To be a full-time student and receive a stipend during the summer session, students must be registered for a minimum of 6 credit hours. Students are expected to enroll in SSPB 800 for six credits during each summer.

#### **F. Teaching**

Each graduate student must satisfactorily complete SSPB 599 during 1 semester (before the end of their third year in residence) to fulfill their teaching requirement. Students must submit a request for their teaching assignment to the Program Coordinator before the end of the fourth semester. This request should include at least one of the core courses (SSPB 501/502/503) and a second course outside of the core. Assignments will be determined by the SSPB Program Director in coordination with the research advisor. Students interested in additional teaching experience for future academic career are encouraged to participate in teaching another course to develop their pedagogical skills (e.g., subject mastery required for teaching, presentation skills including effective public speaking, setting clear expectations, and judging performance). This additional teaching must be approved by the research advisor.

## V. FIRST YEAR IN THE PROGRAM

### A. Early Matriculation

Some students will come to Houston early (between May 16 and August 1) to work in a lab over the summer. This is a way to get a head start on picking an advisor during a time when students do not have all of the distractions of course work and teaching assignments. During this time, students are paid at the existing stipend rate. In order to do this, students need an agreement that the particular faculty member is willing and able to support them during this time. It is important to realize that by working for a faculty member during the summer neither the student nor the professor is committed to a long-term relationship.

### B. O-week, Advising, and Registering for Courses

SSPB Bootcamp and Orientation. SSPB students will typically be required to arrive on campus three weeks in advance of their first fall semester. During this time, students are provided an overview of the program, students meet with the Graduate Advising Committee, students attend presentations by SSPB faculty interested in recruiting students, and students submit rotation requests. Students will also participate in SSPB bootcamps where they will participate in activities that help them begin to obtain foundational knowledge in the laboratory and quantitative skills that they will need to develop during their first year of study.

Rice O-week. The first semester at Rice will begin with Orientation Week (or O-week) during which students learn the basics about Rice and have a chance to socialize with more senior students. During this week, there are special orientations conducted by the Office of International Students and Scholars to assist international students.

Advising. The Graduate Advising Committee helps students plan their coursework during their first semester in residence. Students meet with the chair of this committee before O-week to identify prerequisite courses that are required in addition to core requirements and to develop a plan for coursework during their first year in the program. Upon joining a lab, the faculty mentor is responsible for providing guidance on advanced elective coursework. Although the student's advisor will take over the advising role once the student officially joins a lab, the Graduate Advising Committee is always available to answer questions.

Registering for courses. Students should register via Esther. Log onto Esther using your ID and follow the instructions under the registration tab. To be a full-time student and receive a stipend, students must be enrolled in a minimum of 9 credit hours during the spring and fall semesters and 6 credit hours during the summer session. Depending on the semester, the number of credit hours for Graduate Research (SSPB 800) will be adjusted based on course load so that the total credit hours equal at least 12 credit hours.

### C. Peer mentoring

An outstanding resource that all entering students should tap is the knowledge base of the current graduate students. To help connect entering and existing graduate students in the program, one or more social activities will occur prior to the beginning of the first semester. Beyond these activities, entering students are encouraged to proactively engage more senior graduate students in the program for advice about various topics of interest, such as the transition to graduate school and graduate life. Entering students often benefit from discussing information about navigating the city, the university, rotations, courses, writing fellowships, and choosing an advisor.

#### **D. Research Rotations and Joining a Lab**

Research rotations. To facilitate learning about the various thesis opportunities, students participate in three laboratory rotations during their first semester. The purpose of lab rotation is to assist the first-year students in choosing a faculty advisor and a lab for conducting thesis research. Rotation selection involves many steps, including:

1. Faculty research presentations. These presentations occur before rotations and provide students an opportunity to hear about the diversity of research opportunities in the program.
2. Students coordinate one-on-one discussions with faculty. Students are responsible for setting up meetings with faculty to discuss possible rotations based on their interests after the presentations. These can be scheduled in advance of the faculty presentations.
3. Students submit a rank ordered list of rotation preferences. This list is submitted to the Chair of the Graduate Advising Committee near the end of August. Students have an opportunity to update this list before the second and third rotations begin.
4. Students enroll in SSPB 575 to receive course credit for rotations in the semesters where they rotate through labs. One semester of SSPB 575 is required of all students.
5. Rotations are assigned. The Graduate Advising Committee will work to match student with labs that match their research interests.
6. Students discuss rotation expectations with mentors. To ensure a good rotation experience for both the student and the faculty, student should set up meetings with their advisors well in advance of the rotation to discuss expectations, goals, requirements and lab guidelines.
7. Students rotate through three different labs. These laboratory rotations occur during the first semester and are typically 4 weeks in duration. Students are expected to spend approximately six hours in lab per week for each rotation.

Submitting advisor preferences. Upon completing the lab rotations, students submit a ranked list of their preferred thesis advisors to the Graduate Advising Committee near the end of their first fall semester. Students must list *a minimum of three different possible advisors*. Students may include laboratories that were not among the three approved rotation labs. However, they should not include an advisor on their ranked list unless they have discussed research opportunities that lab. Students are responsible for developing a list of at least three different faculty members within the SSPB program who could serve as their thesis advisors.

Advisor assignments. The Graduate Advising Committee works to match the wishes and needs of the students to those of the SSPB faculty and available funded research projects. This matching occurs after all students have submitted their thesis advisor preferences and after consultation with the requested advisors. Several factors are considered during the matching process, including funding, available space, academic standing, rotation performances, and the relationship between the student and the potential advisor. In most cases, the student will be granted his or her primary choice for a thesis research advisor. When a match with the top choice is not possible, the student will likely be matched with one of his or her alternative choices. In special circumstances where a student cannot be placed with an advisor by the beginning of the spring semester, the student will be notified of the delay and efforts to assign an advisor will be handled on a case-by-case basis.

In extraordinary cases, students may submit a petition to request that a faculty member outside of the program be considered as their research advisor. To do this, the student must submit a formal petition to the Program Director which indicates: (i) the name of faculty member they would like considered as their thesis advisor, (ii) the reasons that they would like that faculty member considered as a thesis mentor, (iii) how the research that they will pursue in that group

is aligned with the SSPB program, and (iv) additional factors that are relevant to their request. Students should only make this request if they have had previous discussions with the faculty member who they are proposing as a thesis advisor, and if that faculty member is amenable to serving as their thesis advisor.

In the very rare case when no match satisfactory to both the student and a faculty member is made, the Program Director will recommend that the student transfer to another graduate program at Rice or to another institution that is more in line with the student's interests.

### **E. Evaluation of Progress**

At the end of each of the first two semesters of residence, the Steering Committee will review each student's course work, performance in laboratory rotations, and motivation. Students must maintain at least a B average (GPA = 3.0), obtain satisfactory marks in research rotations, participate in the graduate seminar, complete the required coursework, and demonstrate potential for research to continue in the PhD program. Additionally, students must take courses that have been approved by the chair of the Graduate Advising Committee.

Students who do not meet the above requirements will be placed on probation. The Program Director after consultation with the Graduate Advising Committee will determine what the student must do to address deficiencies to be removed from probation. Clear expectations for resolving deficiencies will be communicated in writing.

Failure to adequately address deficiencies in the indicated period of time will result in dismissal from the program.

## VI. SECOND YEAR IN THE PROGRAM

### A. Research and Coursework

Students are expected to devote a majority of their time to research activities during their second year in the program, although some students may take additional coursework during this time. In each semester including the summer, student should register for “Graduate Research” (SSPB 800). Students are expected to fulfill the research requirements as defined by their advisor to earn a “satisfactory” grade in SSPB 800, and they are expected to continue maintaining a B average (GPA = 3.0) in their coursework.

### B. Research Progress Committee

The Research Progress Committee should be formed before the end of the second semester in residence, and the student is responsible for assembling their committee. A list of the assembled committee must be emailed to the Program Coordinator.

Committee role. The purpose of the committee is to evaluate the student’s research progress by administering the Admission to Candidacy Exam before their fifth semester in residence. This committee will also read, critique, and provide feedback on the student’s annual progress reports, and the committee administers the student’s final oral defense and evaluates the formal written proposal.

Committee structure. The student in consultation with their thesis advisor should develop a plan for a Research Progress Committee. This committee must include a minimum of three tenure-track faculty members who are SSPB faculty with primary appointments within at least two different Rice University departments. Additional members are allowed and are not subject to these restrictions. The student should choose a Thesis Director and Committee Chair. The Committee Chair and Thesis Director need not be the same person. However, the Chair must be either a tenured or tenure-track member of the SSPB Program whose primary faculty appointment is at Rice University.

Committee formation. Once the student has organized a willing Research Progress Committee, they must communicate the names of these individuals to the Program Coordinator and their thesis advisor by email. This must happen before the end of the second semester in residence. Any deviation from these rules and this timeline must be approved by the Program Director and must follow university-wide rules.

Getting the most out of the Research Progress Committee. It is important that the student and committee maintain an effective working relationship. Committee members can supply scientific and technical advice, assist the student in achieving career goals, and might ultimately provide references for a student when s/he searches for professional positions after the PhD is awarded. In addition, the committee can help resolve disputes (if any) between student and thesis advisor.

### C. Admission to Candidacy Examination

Timing. The admission to candidacy examination (A-exam) **must occur before the beginning of the fifth semester in residence.** The student is responsible for scheduling the A-exam and informing participants of the date well in advance of the deadline. The Program Coordinator must be made aware of the exam date and location at least two weeks in advance of the exam.

Students who are unable to defend their thesis proposal before the beginning of their fifth semester (excluding summers) must request an extension by submitting a petition to the Program Coordinator who will forward the petition to the Program Director for approval. The

petition should include the following: (i) the current time boundary, (ii) requested time boundary, which cannot be more than 12 months, (iii) reasons that resulted in the need for an extension, (iv) list of tasks/milestones to be completed that will result in meeting the requested time boundary, (v) additional factors that are relevant, and (vi) approval (signature) of the thesis advisor. Failure to submit a petition or rejection of a petition will lead to program dismissal.

Overview. The A-exam includes a *formal written proposal* and an *oral examination* conducted by the student's Research Progress Committee. This committee will determine the suitability of the student's candidacy for further pursuit of the doctoral degree based on his or her performance on the written and oral portions of the A-exam. The student's overall academic record and research progress also are considered in determining the student's "pass" or "fail."

Written Exam. The written proposal contains a summary of research progress up to that point and future research plans. This document must be submitted to the Research Progress Committee and the Program Coordinator at least 2 weeks before the scheduled Oral Exam. The Program Coordinator must receive a hard copy of the exam.

The format of the proposal should be of a quality that could be submitted to a federal funding agency (e.g., NIH NRSA). Students are encouraged to request feedback from their advisor, other lab members, and the writing center (i.e., CWOVC) to ensure that the written document is clear and cogent. This document should contain (as a minimum) the following sections:

1. Abstract (not to exceed 250 words).
2. Background with extensive literature survey. Provide a historical background of the proposed research including major relevant findings by others.
3. Problem statement. Concisely and clearly describe the point of departure for the proposed research project.
4. Research plan. Describe in detail the rationale, hypotheses, methodology, controls, expected outcomes, interpretations, and possible alternative approaches.
5. Preliminary results. Present data from initial experiments that support the research plan. This section can be integrated into the research plan.
6. References.
7. Proposed time-line for completion of thesis research

The advisor may, within reason, require additional information be included. Portions of manuscripts or reports to sponsors (if available) can be incorporated in the written proposal.

Note that preliminary data should be presented in publication-quality figures and diagrams, and there should be no typographical or spelling errors. The length of the proposal may vary. However, it should not exceed 10 pages (single spaced, font Times 12 or Arial 11), including specific aims, figures and tables, but excluding references and the title page.

Oral Exam. The goal of the oral exam is to test both the student's understanding of the proposed thesis project and his or her understanding of fundamental principles in systems, synthetic, and physical biology. The oral exam involves a formal presentation of the student's proposed research plan, which if uninterrupted would last about 30 to 45 minutes. The student should be prepared for substantial questioning by their committee, whose charge is to assess the depth of the student's general knowledge and to determine the student's familiarity and overall understanding of his/her research topic. The oral exam is generally scheduled for 2 hours in length. At the conclusion of the oral exam, the committee will decide among one of the following three possible outcomes:

1. Pass. The written proposal was judged to be a well written and logical, and the thesis project was viewed as feasible. In addition, the student demonstrated exemplary knowledge in all areas covered during the exam.
2. Conditional pass. The student effectively communicated exemplary knowledge in most areas covered during the exam, but displayed incomplete knowledge or communication of some aspect of the project or the underlying science. In this case, the committee may assign the student additional reading, writing, or coursework on specific topics to improve the student's basic science foundation and to facilitate thesis completion. The committee will communicate a deadline for this additional material, and then determine if that works addresses the deficiencies, and if so, then the student will formally "pass" the oral examination.
3. Fail. If the committee decides that the student has failed the written or oral exam, the student may be dismissed from the program. Alternatively, at the discretion of the committee and in consultation with the Program Director, a make-up exam may be scheduled within six months. If the student fails the second exam, the student will be dismissed from the program. Students who fail the candidacy exam can request permission to complete a Master's degree within one year from the date of the candidacy exam. The thesis advisor, the progress review committee, and the Program Directors must approve this request. A primary consideration in granting this request will be whether the preliminary research already conducted supports the likelihood of successful completion of a novel research project within the one-year time frame. Once approved to complete a Master's degree, students must submit an original research thesis and defend the thesis in a public oral examination.

#### **D. Petition for PhD Degree Candidacy**

Immediately following successful completion of the Admission to Candidacy examination, the student must submit a petition through the Program Director to the Graduate Council for official approval of his/her candidacy for the PhD degree. **Prior to submitting this form, students must identify an "outside" member of their thesis committee**, since the university requires the student to name the "outside" member of his or her thesis committee. This outside member must be a faculty member who is outside the SSPB program and outside of the department where their thesis advisor has a primary appointment.

SSPB Program policy is that the petition should be filed within one month of passing the candidacy exam, or the Program Director will be notified that the student has not filed in a timely fashion. The Petition for Candidacy form can be found at <http://graduate.rice.edu/forms>. On the form, the thesis advisor should be listed as the Director of the Thesis Committee, the outside committee member should be a Rice faculty member from outside the program and thesis advisor's department, the chair of the progress review committee should be listed as the member from within the program, and everyone else on the progress review committee should be listed as additional members.

## VII. ADVANCEMENT TO CANDIDACY TO GRADUATION

### A. Research and Teaching Responsibilities

Research. Students are expected to immerse themselves in full time research after completing their advancement to candidacy exam. They are also expected to publish their research findings in peer-reviewed journals. To advance as a scientist, it is essential that students publish most or all of their dissertation research in peer-reviewed journals. A strong publication record is the most important metric by which research accomplishment is evaluated, and is necessary for a student to establish a scientific career following the receipt of their PhD. Students should not plan to defend their dissertation until the bulk of their research has been accepted for publication.

Teaching. Students must fulfill their teaching (SSPB 599) requirements to graduate. Students must submit a request written request for their teaching assignment to the Program Coordinator before the end of the fourth semester. This request should include: (i) at least one of the core courses SSPB 501/502/503, and (ii) a second course outside of the core. Students must fulfill this requirement before the end of their third year in residence.

Students may submit a petition to request delay their teaching requirement. To do so, the student must submit a formal petition to the Program Director indicating: (i) the rationale for the request, and (ii) the course and semester where they wish to fulfill their teaching requirement.

Scientific Conferences. The program encourages students to participate in local, national and international scientific conferences. This participation enables students to present their work to a wide audience, listen to research presentations from a range of speakers, and meet with individuals sharing common research interests. Students should also use these meetings to network with future collaborators and employers. The Program Coordinator can help students with travel guidelines related to scientific conferences, and they can make sure that students understand costs that are reimbursable versus costs that are considered personal.

### B. Annual Evaluation of Progress

Student Progress Review Reports. Following the A exam, students are required to submit annual reports to their Research Progress Committee, Advisor, and Program Coordinator by August 1 each year. These reports should contain:

- (i) a list of articles published, submitted, or in preparation,
- (ii) a list of oral and poster presentations,
- (iii) a short summary of the research progress,
- (iv) the research plans for the upcoming year, and
- (v) the students full curriculum vitae.

The research progress and plans should not exceed 1,000 words. Students can additionally request a meeting with their committee if they have faced any challenges that they would like to discuss. The Program Coordinator will schedule any meetings that are requested. If the student plans to defend within 1 semester of the annual report due date, then they should submit an outline of their thesis for approval with their report.

Review of Research Progress. Following the A exam, the research advisor must submit a letter by August 1 each year, which contains a written evaluation of the student's progress, to the Program Coordinator. The Program Coordinator will send this letter and the student's report to the full committee for evaluation. The committee will then decide whether the student's progress

is satisfactory and any activities that might be beneficial to the student in their efforts, and this information will be conveyed to the student in writing.

If the student is not making satisfactory progress, then the Program Coordinator will schedule a meeting for the student with their Research Progress Committee to discuss their progress in greater depth. Following this meeting, the committee can recommend to the Program Director that the student be placed on research probation or dismissed from the program.

### **C. Thesis Defense**

The Committee. The University committee for the final oral examination (defense of thesis exam) must be approved by the Office of Graduate Studies at the same time as the candidacy is approved. This committee includes the faculty members that conduct the advancement to candidacy exam, and it must additionally include a member that is not affiliated with the program. A student may elect to have an “external examiner” from another university also serve on the committee. In such cases, the Program Director must secure the approval of the Office of Graduate Studies for the addition of an “external examiner” to the committee. The formal structure of thesis committees is described in the General Announcements and regularly reviewed by the Office of Graduate and Postdoctoral Studies.

Scheduling the Defense. After a student’s candidacy has been approved and upon completion of his or her research project, the student must schedule, in coordination with his or her research advisor, a public oral examination of the defense of his or her thesis. The student is responsible for reserving a room for the thesis defense. Generally, a 2-hour block of time is sufficient for the lecture and subsequent examination.

The final thesis defense seminar is public, and the student must arrange to have it announced in the Rice weekly Calendar of Events at least two weeks before the scheduled date, and the student must notify the Program Coordinator to post the defense on the SSPB website. Oral examination announcements are to be submitted to the Office of Graduate and Postdoctoral Studies by entering the information into the online Graduate Students Thesis Defense Announcement form. This form can be found at <http://events.rice.edu/rgs>. Students should refer to the Graduate and Postdoctoral Studies website (<http://graduate.rice.edu/thesis>) for specific information regarding scheduling requirements. Exceptions to this policy are granted only in very rare circumstances and must be approved by Graduate and Postdoctoral Studies.

Written Thesis Requirements. Graduate students must conclude an original investigation that is formalized in an approved written thesis. The requirements and format of the written dissertation are set forth by the Office of Graduate Studies. It is to the student’s advantage to be fully aware of these requirements before undertaking the writing process. The title page should list the thesis advisor first, then the remaining committee members should be listed in alphabetical order. The thesis advisor should read preliminary drafts of the thesis and must approve the final copy before its distribution to the other committee members. For the examination, the final copy shall consist of a printed document, which, if accepted, could be bound and submitted without editing to the Office of Graduate Studies. The final copies must be submitted to the thesis committee members, along with a copy to the Program Coordinator, at least two weeks before the final oral examination. In the course of the examination, the thesis committee members may recommend revisions or additions, which must be incorporated in the final thesis, which is then signed by all committee members.

The student should note that, in order to participate in the commencement ceremonies at the end of the academic year, the committee members must approve the final copy of the thesis before the deadlines imposed by the Office of Graduate Studies.

Thesis Examination. The final thesis examination consists of two parts. (1) Initially, the student presents an hour-long public lecture that is handled like a departmental seminar. (2) The official examination by the thesis committee follows the seminar. The student is expected to defend in detail his/her research work and the text of the written thesis. The committee members will consider both the student's research work and the final copy of the thesis. If the committee members approve the student's performance and the text of the thesis, they sign the Candidacy Approval Form, which must be brought to the examination by the student. The student should obtain this form from the Program Coordinator prior to the defense. If alterations in the written text of the thesis are requested, the student must submit a revised copy of the thesis to the dissenting members for their approval and signatures on the title page. In the case of an unsatisfactory performance, a second examination can be scheduled. A second unsatisfactory performance will result in dismissal from the program.

Acceptance of Thesis. No later than six months from the date of the examination, candidates who successfully passed the oral examination in defense of their thesis must submit their thesis to the Office of Graduate and Postdoctoral Studies. A student's thesis must be submitted electronically. The Graduate and Postdoctoral Studies website (<http://graduate.rice.edu/thesis>) contains specific instructions regarding how to submit the thesis. If the thesis is not ready for final signatures by the end of the six-month period, the "pass" may be revoked and an additional oral defense must be scheduled.

Degree Conferral. Students who wish to have their degree conferred in the same semester in which they defend, must file their applications for degree conferral before November 1 for the fall semester and March 1<sup>st</sup> for the spring semester. These dates are subject to change, therefore, students should consult the Registrar's webpage academic calendar (<http://registrar.rice.edu/calendars>) to confirm these deadlines.

Deadlines. Rice University requires the thesis to be defended before the end of the 16th semester of residency at Rice. However, the normal limit of financial support for graduate students is ten semesters (excluding summers). Students, who anticipate taking longer than 10 semesters for completion of their PhD degree must consult with their advisor as outlined in Section VIII-C.

## **VIII. ADDITIONAL PROGRAM PROTOCOLS**

### **A. Vacation**

Arrangements for holidays and other time off must be made in advance in consultation with the advisor and must be in compliance with university rules and any guidelines from funding agencies. During the first semester of study, graduate students observe the same holiday schedule as other students engaged in course work. Beginning in the second semester, PhD students are engaged in research full time and must have any vacation time approved by their advisor. During this time, students follow the designated staff holidays. For example, winter break is a staff holiday where students receive time off, since the university is officially closed. However, students do not receive spring break as time off because the university is not officially closed during this time. Note that vacation time must not conflict with requirements of the granting agency that provides student support.

Medical leaves and other types of interruptions of study should be handled according to the guidelines in the General Announcements (<http://ga.rice.edu>).

### **B. Conflict Resolution**

Any student who has a conflict with a faculty member or a student colleague is first encouraged to settle the conflict directly. Should this not be possible or should the conflict remain unresolved, the student may file a formal grievance with the Chair of Graduate Advising Committee. Graduate Student grievances and problem resolution will be handled by the Chair for Graduate Advising Committee in consultation with the Graduate Advising Committee. If the student's advisor, members of his or her thesis committee, or other faculty involved in the conflict are members of this Committee then the pre-doctoral student will have recourse directly to the SSPB Associate Director who will act as an Ombudsman. Additional faculty members may be consulted by the Graduate Advising Committee and/or SSPB Director and Associate Director to assure the student's grievance is heard by an appropriate audience.

### **C. Financial Support**

Students who receive a stipend in support of their graduate work are expected to devote full-time to their studies and are not allowed to take outside employment. Full-time for first-year students during their first semester of study will typically consist of six courses (SSPB 501, SSPB 502, SSPB 503, SSPB 550, SSPB 575, and UNIV 594). Financial support is dependent upon satisfactory performance in coursework and research, reasonable progress toward degree requirements, the availability of funds, and placement in a lab by the end of the second semester in residence. Student stipends are subject to all of the usual federal taxes.

The program will fund students during the first semester of study. In most cases this covers the first semester in residence. Advisors become responsible for financially supporting students beginning on the first day of February. Advisors are expected to pay 100% of the student's stipend unless that stipend is funded by an external fellowship, scholarship, training grant, or other source of external funding which covers all or a portion of the student's stipend. If alternative sources of funding only cover a portion of the student's stipend, then the advisor is responsible for the remaining portion.

The normal limit of financial support for graduate students is ten semesters (excluding summers). Students, who anticipate taking longer than 10 semesters for completion of their PhD degree must consult with their advisor. The advisor, in consultation with the thesis committee, shall consider the student's progress, circumstances that justify continued funding, and the

availability of funding when making a decision regarding whether the student's funding should be continued for a specific period. Continued support will be reevaluated annually or more often as appropriate. Students whose funding has been terminated may continue to register and work on research projects as long as they continue to make acceptable progress toward the degree requirements.

#### **D. Changing Laboratories**

Because switching advisors will likely affect progress toward the degree and/or any financial support arranged by the previous advisor, students should not consider switching advisors except in exceptional circumstances. However, the program recognizes that in rare circumstances a student may feel their interests could be better served by working with a different advisor. Requests to voluntarily switch advisors will be handled on a case-by-case basis. In such cases the program will make every effort to assist the student, however, the student bears the ultimate responsibility of finding a new advisor.

Procedure. Students should first discuss issues with their current advisor in an attempt to resolve any concerns or problems. If the student feels issues are insurmountable, he/she is encouraged to request the guidance of the Graduate Advising Committee. If the student still wishes to switch advisors, the student should speak with a potential advisor whose research interests are in line with their interests, who is willing to serve as the student's advisor, and who has funding to support the student. If the student finds another faculty member willing to serve as his or her advisor, the student should submit a written petition to the Graduate Advising Committee for approval of the switch in advisors. This petition *must* have the endorsement of the new advisor. If the Committee approves the switch, Program Coordinator will process the paperwork required to switch advisors.

Students may not initiate the process to change advisors more than twice nor have total of more than three advisors, including their initial advisor, during their tenure as a student.

#### **E. Probation and Dismissal**

Grades. Students must maintain a GPA of 3.0 or higher. If a student's GPA falls below 3.0, then the student will be placed on probation. The Program Director after consultation with the Steering Committee will determine what the student must do to address deficiencies to be removed from probation. Clear expectations for resolving any academic deficiency will be communicated in writing to the student. Failure to address deficiencies will result in dismissal from the program. If the student's GPA falls below 2.67 for two consecutive semesters (including the summer semester), the student will be immediately dismissed without further warning in accordance with University policy. Students will be notified of their dismissal once final grades have been received and posted to their records.

Research Progress. Student must make adequate progress on research. Progress includes receiving satisfactory grades for SSPB 575 and SSPB 800 (the research-related courses), passing the advancement to candidacy exam, and submitting annual progress review reports that demonstrate progress. A lack of progress will lead to placement of a student on probation. The Program Director after consultation with the Steering Committee will determine what the student must do to address deficiencies to be removed from probation. Clear expectations for resolving any research progress deficiency will be communicated in writing to the student. A failure to rectify the problems would be grounds for dismissal under the terms of the "satisfactory progress" rule in the graduate requirements.

## **F. Guidelines for Petitions and Appeals**

As outlined in the General Announcements, graduate students may petition for exceptions to academic requirements, regulations, and judgments. A course requirement is an example of an academic requirement. Allowed time to degree is an example of an academic regulation. Course grades and dismissals from programs are examples of academic judgments. If a petition is denied, one level of appeal is allowed.

Detailed information on the university policies related to these protocols can be found within the General Announcements ([http://ga.rice.edu/GR\\_disputes](http://ga.rice.edu/GR_disputes)).

## IX. APPENDIX

### Approved Advanced Courses in SSPB

(\* indicates required course)

<b>SSPB</b>	
501	Physical Biology*
502	Systems Biology Modeling*
503	Synthetic Biology*
<b>BIOC</b>	
301	Biochemistry
313	Experimental Synthetic Biology
352	Physical Chemistry for Biosciences
524	Microbiology & Biotechnology
551	Molecular Biophysics
552	Structural Biology
555	Computational Synthetic Biology
570	Computation with Biological Data
578	Biotechnology Practicum
583	Molecular Interactions
590	Special Topics in Synthetic Biology
<b>BIOE</b>	
307	Systems Biology of Blood Vessels
321	Cellular Engineering
330	Bioreaction Engineering
332	Thermodynamics
391	Numerical Methods
420	Biosystems Transport & Reaction
507	Systems Biology of Blood Vessels
521	Microcontroller applications
522	Gene Therapy
523	Control Theory/Synthetic Biology
542	Macromolecular Systems Bioengineering
561	Principles of Bioengineering I
562	Principles of Bioengineering II
577	Foundations of Biotechnology
589	Computational Molecular Bioengineering
610	Methods of Molecular Simulation

<b>CEVE</b>	
544	Environmental Microbiology
<b>CHBE</b>	
540	Metabolic Engineering
580	Protein Engineering
682	Systems Biology of Diseases
<b>CHEM</b>	
537	Biophysical Chemistry
<b>COMP</b>	
470	Bioinformatics: Sequence to structure
571	Bioinformatics: Sequence Analysis
572	Bioinformatics: Network Analysis
650	Physical Computing Seminar
670	Computational Biology Seminar
<b>EBIO</b>	
328	Evolution of genes and genomes
333	Evolutionary Bioinformatics
541	Ecology & Evolutionary Biology
561	Topics in Evolutionary Biology
<b>PHYS</b>	
551	Biological Physics
<b>STAT</b>	
581	Mathematical Probability
623	Probability in Bioinformatics/Genetics
650	Stochastic Differential Equations
673	High-Dimensional Data
699	Statistical Learning: High-Dimensional Data

## List of important deadlines

### First year in program

August	<ul style="list-style-type: none"> <li>• meet with Graduate Advising to make coursework plan for first year</li> <li>• first rotation requests submitted to chair of Graduate Advising Committee</li> </ul>
September	<ul style="list-style-type: none"> <li>• second rotation requests submitted to chair of Graduate Advising Committee</li> </ul>
October	<ul style="list-style-type: none"> <li>• third rotation requests submitted to chair of Graduate Advising Committee</li> </ul>
November	
December	<ul style="list-style-type: none"> <li>• thesis mentor requests submitted to chair of Graduate Advising Committee</li> </ul>
January	
February	
March	<ul style="list-style-type: none"> <li>• register for a minimum of six research credits in summer semester using Esther</li> </ul>
April	
May	<ul style="list-style-type: none"> <li>• Research Progress Review committee request submitted to Administrator</li> </ul>
June	
July	

### Second year in program

August	
September	
October	
November	
December	
January	
February	
March	<ul style="list-style-type: none"> <li>• register for a minimum of six research credits in summer semester using Esther</li> </ul>
April	
May	<ul style="list-style-type: none"> <li>• teaching assignment requests submitted to Program Administrator</li> </ul>
June	
July	

### Third year in program

August	<ul style="list-style-type: none"> <li>• deadline for completing advancement to candidacy exam</li> </ul>
September	<ul style="list-style-type: none"> <li>• submit petition for PhD degree candidacy (must find outside committee member first)</li> </ul>
October	<ul style="list-style-type: none"> <li>• coordinate teaching assignment for spring if not enrolled in SSPB599</li> </ul>
November	
December	
January	
February	
March	<ul style="list-style-type: none"> <li>• register for a minimum of six research credits in summer semester using Esther</li> </ul>
April	
May	<ul style="list-style-type: none"> <li>• make plan to complete any required coursework during the fourth year</li> </ul>
June	
July	<ul style="list-style-type: none"> <li>• submit annual student progress report (<i>advisor submits progress letter</i>)</li> </ul>

### Fourth year and beyond

March	<ul style="list-style-type: none"> <li>• register for a minimum of six research credits in summer semester using Esther</li> </ul>
July	<ul style="list-style-type: none"> <li>• submit annual student progress report (<i>advisor submits progress letter</i>)</li> </ul>

## SSPB Class Requirement Checklist

### Prerequisites:

- \_\_\_\_\_ Cell/Molecular Biology (BIOC 341, BIOC 344, BIOE 321)
- \_\_\_\_\_ Biochemistry (BIOC 301, BIOE 330)
- \_\_\_\_\_ PChem/Thermo (BIOC 352, BIOE 332, PHYS 425, CHEM 310)
- \_\_\_\_\_ Ordinary Diff. Equations (MATH 211, MATH 213)
- \_\_\_\_\_ Statistics (STAT 305, STAT 310, BIOE 439)

### Specific Class Requirements:

- \_\_\_\_\_ Responsible Conduct of Research (UNIV 594)
- \_\_\_\_\_ Physical Biology (SSPB 501)
- \_\_\_\_\_ Systems Biology (SSPB 502 / BIOE 552)
- \_\_\_\_\_ Synthetic Biology (SSPB 503 / BIOE 508)
- \_\_\_\_\_ Intro to Research (SSPB 575)
- \_\_\_\_\_ Graduate Seminar (SSPB 550; four semesters)
- \_\_\_\_\_ Teaching (SSPB 599)

### General Class Requirements:

- \_\_\_\_\_ 24 semester hours of graduate approved lecture courses
- \_\_\_\_\_ Maintain 3.0 GPA or above
- \_\_\_\_\_ 3 Advanced SSPB classes (from approved list on page 22)
- \_\_\_\_\_ 2 open elective courses (300-level or above)
- \_\_\_\_\_ 90 semester hours of coursework (including SSPB 800)