

1. Appendix A: Undergraduate Research Guide for Biophysics Majors

Research Requirements

Independent research is a key component (and a formal requirement) of the Hopkins Biophysics Major. Research is typically scheduled as a series of formal courses:

The research requirement for the major in biophysics is 6 credits, by taking two semesters of the course AS.250.520, entitled “Introduction to Biophysics Research”. This six-credit sequence is not given a letter grade but is taken S/U. After completing this sequence, students are encouraged to continue their research, enrolling in the course AS.250.521 entitled “Research in Biophysics”. Because students will have achieved proficiency in independent research from their first year of research, they can take AS.250.521 for a letter grade, for up to six credits per year. Each of these two courses are offered in the fall, spring, and summer terms. Note that research during Intersession is not accepted for credit.

Research during intersession is not accepted to meet the Biophysics major requirements.

Research Philosophy

The undergraduate biophysics research experience is an apprenticeship in which majors engage in guided but independent research Johns Hopkins research laboratories. To initiate this apprenticeship, students must search for and initiate a relationship with a “Research Supervisor” who is willing to work directly with the student.

In the initial phase, which may last for as long as a semester, the student may simply learn techniques, become familiar with the research problem and relevant literature and learn and understand the questions and goals of the overall research project. By the second semester, the student is expected to become a semi-independent researcher able to perform experiments and come up with improvements in procedures and experimental design. The first year of research (AS.250.520) must be taken S/U. From the second year onward (AS.250.521), research will be graded based on the student’s performance (see the rubric on page 23). Although productivity in the first semester of research will likely be low, effort should be constant. As described above, an averaged of 10-12 hours of active, engaged research over the 13 week semester is required for 3 credits of research. This does not include being in the lab but browsing the internet or social media while a reaction or simulation runs)

By the end of the second semester, most students are able to obtain publishable data. Many students who complete more than two semesters of biophysics research become co-authors of abstracts and papers published with their Research Supervisor. Thus, it is strongly encouraged that students participate in research for two or more years. Students and Supervisors both benefit from the extended training, and are more likely to make significant discoveries in their second year of research. Along these lines, students are *STRONGLY* encouraged *NOT* to switch labs from semester to semester, but rather to pursue one research project during their time at Hopkins.

When to add research to your schedule

It is a good idea to start thinking about undergraduate research as a freshman or sophomore. Many students who enter JHU with AP credits start their research projects early their sophomore year, but starting in your junior year is also fine. Although it is permitted, waiting until senior year to start research is strongly discouraged

“Research Supervisor” *versus* “Faculty Sponsor:

The “Research Supervisor” is defined as the head of the laboratory in which you carry out your research.

The “Faculty Sponsor” must be a full-time faculty member in the Jenkins Dept. of Biophysics. This will normally be your academic advisor in the Biophysics department. In your second year and beyond, your sponsor will assign your research grade in close consultation with your Research Supervisor. You must register for the Biophysics research using the section number of your Faculty Sponsor.

The Jenkins Faculty Sponsor must be confident that the Research Supervisor is qualified for and committed to this apprenticeship program. The Research Supervisor must be able and willing to observe and evaluate the performance of the student. Moreover, the research topic should be appropriate to the biophysics major, broadly defined.

If you are conducting research under the supervision of a full-time faculty member in the Jenkins Department of Biophysics, that person can also serve as your “Faculty Sponsor”.

Biophysics research topics and locations

The Biophysics major allows undergraduate research experiences in a broad range of topics; however clinical research and survey-type investigations are not allowed. With these restrictions in mind, students can initiate an apprenticeship with a Research Supervisor in any laboratory in Arts and Sciences, Medicine, Engineering and Public Health. A vigorous and wide-ranging search for potential Research Supervisors is the best way to ensure a successful apprenticeship. Repetitive tasks that require little or no initiative or intellectual input from the student, such as plate scoring or bottle washing, do not, by themselves, constitute a suitable research apprenticeship. Rather, research activities by the student must directly test a hypothesis or enhance our understanding of a specific area of science.

Labs outside of JHU

Students can be approved to perform summer research for credit at a lab outside of JHU. The research must fulfill the same criteria as JHU research (no clinical or survey-based research). Students cannot receive credit if they are participating in an internship or otherwise being financially supported by the research supervisor. The research supervisor must be an MD or PhD who agrees to evaluate the student (and not a parent/family member), and the research must be taken S/U.

Four steps to find a research position at JHU

1. Find out what research interests you that is being carried out at JHU.

Follow your natural interests in searching the JHU web pages of science faculty. The web pages for the [Jenkins Biophysics Department](#) and the [Graduate Program in Biophysics](#) are both good places to start.

As you read faculty research descriptions, you may come across a topic that caught your interest in a previous class or a technique that just sounds cool. Your faculty advisor can help direct you to research labs that match your interests. Do not hesitate to ask them for advice, as your advisor may have insight from previous undergraduate research experiences that you may not be able to identify from published and/or posted material.

Once you have identified two or three labs that interest you, download a paper or two from those labs and familiarize yourself with the scientific questions being addressed as well as the techniques that are employed.

2. Contact faculty members.

As soon as you have identified a research lab that interests you, send an email to the faculty member in charge, inquiring whether he or she has an opening. Since the process of identifying a lab and a research project takes a lot of effort on both sides, it is *strongly advised* that you make faculty contacts the semester *prior* to when you want to start research. It is important in this first contact to introduce yourself to faculty members with a thoughtful paragraph: tell them about yourself (courses you have taken, any previous research experience, your long-term goals), and state why you are interested in his or her lab. Be prepared to send a short resume, transcript, or recommendation from an instructor or TA. If the faculty member is interested, make an appointment to discuss potential research projects. Since most faculty have busy schedules, you will have the best luck making an appointment by providing the faculty member with a readable, formatted table letting them know all the times you are available to meet during the week, rather than asking "when can you meet".

3. Register for research.

Log into SIS. Under the Registration menu, click on Online Forms. Select Independent Academic Work. Complete the form, providing full explanations where needed, and submit it. The form will be sent to your faculty sponsor for approval. Once the sponsor approves it, you will see the position/ project in your Confirmed Enrollment screen in SIS.

Students are limited to *six total credits per academic year*. This almost always involves two one-semester three-credit courses (course numbers listed above), taken in the fall, winter, or summer. A maximum of three credits may be taken in any of these three terms. Fewer credits may be taken, although this is not advised, since most research projects require a "critical mass" of effort by the student.

Note that the six-credit limit per year of research is strictly enforced by the registrar's office. The registrar's academic year starts with the summer semester. If you earn 3 research credits in the summer and 3 in the fall, you are not eligible to earn additional research credits in the spring.

4. At the beginning of each semester:

The student and the Research Supervisor must complete **PART 1** of the “**Supervisor's Report for Independent Research in Biophysics**”. (attached below) before the end of the second week of the semester (the Add deadline), and give the completed form to their research sponsor (usually their academic advisor in the Biophysics department).

5. At the end of each semester:

The student completes one of the course requirements as described below:

5A. If the student is completing their first semester of research (e.g. the student has a total of 3 or less research credits):

- The student is required to write a 2-3 page **Progress Report** and submit this to the Research Supervisor for grading.
- Upon receipt of the Progress Report, the Research Supervisor completes **PART 2 of “Supervisor's Report for Independent Research in Biophysics”** (attached below).
- The student delivers the Progress Report and the completed Supervisor's Report to the Faculty Sponsor. The Faculty Sponsor must receive ALL of this material by the end of the final exam period.
- Prior to submitting the grade and credits to the Registrar, the Faculty Sponsor may consult with the Research Supervisor to confirm that the assigned grade (S/U) matches the effort and accomplishments made by the student.
- Guidelines for how to write a Progress Report are provided on page 5 of this handout.

5B. If the student is completing their second (and all subsequent) semesters of research (for a total of six or more research credits):

- The student should prepare a poster or a series of powerpoint slides that provide a self-contained description of the research, including introduction and hypothesis, methods, results, conclusions, and literature cited, and submit this to both the Research Supervisor and Faculty Sponsor for grading, as described above.
- Upon receipt of the Poster, the Research Supervisor completes **PART 2 of “Supervisor's Report for Independent Research in Biophysics”** (attached below). The supervisor must meet with the student to discuss the report, including any deficiencies or areas that need

improvement, and plans for the upcoming semester of research, and also discuss the poster/powerpoint slides.

- The student then delivers the Poster and the completed Supervisor's Report to the Faculty Sponsor before the end of the final exam period. **Graduating seniors in their terminal semester should note that they risk losing their "graduating" status for that commencement period if they miss this deadline. This is a hard deadline established by the Registrar.**
- Prior to submitting the grade and credits to the Registrar, the Faculty Sponsor may consult with the Research Supervisor to confirm that the assigned grade (S/U or letter for AS250.521) matches the effort and accomplishments made by the student.
- Guidelines describing how to prepare a poster are provided on page 13 of this handout.

6. Grading:

Research done to fulfill AS.250.520 (year 1) is graded S/U, whereas research done to fulfill AS.250.521 (year 2+) is given a letter grade. The Faculty Sponsor will submit a research grade online upon receipt of the following:

The Progress Report or Poster; and

The "Supervisor's Report for Independent Research in Biophysics" Part 2

SUPERVISOR'S REPORT FOR INDEPENDENT RESEARCH IN BIOPHYSICS

PART 1. To be completed by the RESEARCH SUPERVISOR and STUDENT at the START of the semester.

Independent research is a key component of the Biophysics Major. Student research involves significant independent effort in the laboratory. Students must work ten hours per week in the lab (at a minimum) to receive three credits during a full (fall or spring) semester. As the summer period is shorter, summer research is expected to involve a proportionately greater effort per week, so that the total effort matches that for the fall / spring semester. By signing below, we (Student and Supervisor) agree to this effort level in the coming semester:

Student signature _____ Date: _____

Supervisor signature _____ Date: _____

Student: return a COPY of PART 2 this form (next page) to your Jenkins Faculty Sponsor in biophysics prior to the drop/add deadline of the current semester. Part 2, on the next page, must be filled out by your Supervisor and returned to your biophysics sponsor *before the end of finals, along with your written Progress Report or Poster (see above for details on the Progress Report or Poster).*

SUPERVISOR'S REPORT FOR INDEPENDENT RESEARCH IN BIOPHYSICS

PART 2. To be completed by the RESEARCH SUPERVISOR at the END of the SEMESTER.

Student/HopkinsID _____ / _____ Term _____

Biophysics Faculty Sponsor _____

Research Supervisor _____

Course number (circle one): AS.250.520 (year 1) AS.250.523 (year 2+)

Supervisor: In the space below and on the back, describe the research accomplishments made by the student in the last semester and its significance. Also, comment on level of effort made by the student, their proficiency level, and any areas where the student can make improvements. Then fill out the check boxes at the bottom

	EXCELLENT	VERY GOOD	SATISFACTORY	NEEDS IMPROVEMENT	UNSATISFACTORY
ATTENDANCE					
UNDERSTANDING SCIENTIFIC BACKGROUND					
TIME MANAGEMENT					
EXPERIMENTAL SKILLS					
PRODUCTIVITY					
RECORD KEEPING					
VERBAL SCIENTIFIC COMMUNICATION					
WRITTEN SCIENTIFIC COMMUNICATION					
DEMONSTRATE INITIATIVE					
OVERALL					

Significance of the research:

Progress made this semester:

Plans for the coming semester:

Areas that need improvement:

SUGGESTED GRADE _____ CREDITS _____

SUPERVISOR'S SIGNATURE _____

Student: return a COPY of PART 2 of this form to your research sponsor in biophysics prior to the end of finals week, along with the written component (i.e., your Research Report or Poster; see above).

Progress Report Guidelines

The Progress Report should include:

- The Student's name, the Research Supervisor's name, his/her title and affiliation, student's name, when accomplished e.g., Fall 2012, Spring 2013, Summer 2013.
- **Introduction:** Background rationale with reference/s; how the work fits into the overall objectives of the research program.
- **Methods:** Briefly give techniques used.
- **Results:** Give results obtained. If too early in the project for results, more on methodology might be appropriate.
- **Discussion:** Significance of results and their relation to future plans.

Poster Preparation Guidelines

Supervisors may have specific instructions or styles for laboratory posters, but a general guide for approaching this task is to prepare 9 OR 12 letter-sized (8.5 x 11 in) power point slides as following:

- **Title:** (1 slide) This slide contains the title of your study along with your name and the name of your Research Supervisor and when the work was accomplished, e.g. Fall 2012, Spring 2013, etc..
- **Abstract:** (1 Slide) This is essentially one paragraph that outlines the question that was addressed, summarizes the main results and states the conclusions. Do not use a font size smaller than 18.
- **Introduction:** (1 Slide) *This slide is optional.* You may choose to include it if you feel that your Abstract does not adequately describe the background for your project. Do not use a font size smaller than 18.
- **Results:** (5 or 8 Slides) Provide figures or graphs of data. Each result should have a scientific title that summarizes the main finding as well as a figure legend that briefly describes the methods. Do not use a font size smaller than 18.
- **Conclusions:** (1 Slide) A bullet point list of the main conclusions of the work. This section also contains a reference to the funding source for the work. A brief description of future experiments may also be appropriate in the Conclusions section. Do not use a font size smaller than 18.
- You must submit both paper and electronic copies of your poster to your Jenkins Faculty Advisor.

Frequently Asked Questions about Graded Research in Biophysics & the Biophysics Poster Session:

What time commitment is expected for research?

A general guideline is that 1 credit equals 3-4 hours laboratory work per week during the semester. An absolute minimum effort of 10 hours per week is expected for 3 credits of research. As the research progresses, students often find that they want to work more hours in the laboratory so that they can get more done. We encourage this, but cannot award more than three credits per semester, and six credits per academic year. Note that the level of effort should be evenly maintained throughout the semester.

Is research in year 2+ (AS.250.521) a guaranteed grade of "A"?

No. Research is a graded class, and "grades" necessarily have more than one value. Thus, you should take it seriously, like all your other classes. At a minimum, you should be committing 10-12 hours per week for 3 credits of research. However, simply showing up for this many hours will not guarantee a grade of "A". You want to show interest and initiative with your project; you want to ask lots of questions, and make progress in gaining technical skills, optimizing methods, acquiring knowledge, and making discoveries.

My Progress Report is longer than 3 pages. Is this a problem?

A Progress Report longer than 3 pages is generally not a problem. If you have questions about what to include, you should seek the advice of your Faculty Sponsor.

What is the Biophysics Undergraduate Research Festival (BURF)?

Biophysics Undergraduate Research Festival takes place in late April of each year. The event is usually held at Mudd hall lounge area. Every Biophysics majors and freshman who are interested in learning about Biophysics are invited. The first hour is a poster session in which all Biophysics undergraduate students who are engaged in research present a poster which are viewed by faculty and students in the department. The poster session is followed by a 45 min long research symposium (100 Mudd) in which we have presentations (10-15 minute talks) given by three to four selected graduating seniors on their research progress. Afterwards, we share food, drinks and fellowship in the Mudd lounge.

I have only completed 3 credits of research, but it went really well, and I was able to collect a lot of cool data. I want to make a poster and participate in the Biophysics Poster Session. Am I allowed?

Congratulations on your early success in the lab! During your first semester of research, you will still need to write your paper for your grade, but of course you are welcome to additionally prepare a poster and participate in the Biophysics Poster Session. You should have both your Research Supervisor and your Faculty Sponsor approve your poster.

I did research in the fall (or previous summer) but not in the spring. Can I still participate in the poster session?

Yes, even if you conducted your research in the fall (or previous summer) but did not continue through the spring, you are still invited to present your poster in the Biophysics Poster Session. In fact, we encourage you to participate. Keep in mind that you should have submitted both paper and electronic copies of your poster to your Jenkins Faculty Sponsor during the semester you conducted research for a grade. Thus, printing your submitted poster for the spring BPS should only require some file formatting.

Am I required to participate in the Biophysics Poster Session?

No, since our poster session will be annually, it is not a course requirement per se. Therefore, you are not required to participate, and your participation will not be graded. However, it is highly recommended that you participate in the BPS for as many years as you can. A poster session is a valuable opportunity for you to present your work to the faculty and to your peers. It will allow faculty to get to know you better, see what kind of researcher you have become, and in general, write stronger letters of recommendation on your behalf.

I will be seeking Honors in Biophysics. Does the poster take the place of the Honors Paper?

No, the requirements for Honors in Biophysics have not changed. These requirements can be found here:

http://biophysics.jhu.edu/undergraduate_awards_and_honors.html

In the future, participation in the Biophysics Poster Session will be a requirement (in addition to the Honors Paper) for majors seeking to earn Honors in Biophysics.