

# PH.D. PROGRAM IN BIOLOGY-CELL AND MOLECULAR BIOLOGY TRACK

Department of Biological Sciences, Rutgers University-Newark

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## 1. Overview

The Ph.D. studies within the Cell and Molecular Biology (CMB) track of the joint Graduate Program in Biology at Rutgers-Newark and the New Jersey Institute of Technology (NJIT) provides students with opportunities to develop the knowledge and problem-solving skills needed to pursue a myriad of careers in biomedical sciences. The program is designed to foster understanding of foundational and advanced concepts in the biological sciences, and the analytical skills necessary to examine evidence critically.

Typical student progression through the program starts with coursework and two lab rotations. Laboratory rotations will help to identify a Thesis Advisor and are typically completed by the end of the first year. Subsequently, the student will commence dissertation research while still completing course work. Course work typically is completed at the end of the second year. At the start of the second year, the student will start preparing a preliminary research proposal as part of the Qualifying Exam, the oral part of which will be held in the summer (mid to late June). After passing the Qualifying Exam, the student will assemble a Dissertation Committee and defend the actual research proposal, the Dissertation Prospectus within a year. When the dissertation research is completed, the student will submit a written thesis and conduct a public Dissertation Defense.

## 2. Academic Advising

### 2.1. Pre-qualifying Students

Prior to passing the Qualifying Exam, students receive advice on course work, rotations, identifying a Dissertation Advisor, and all other academic matters from the **Pre-qualifying Student Advisor** in coordination with the Program Director, Faculty Mentors, and prospective Dissertation Advisors. The Pre-qualifying student advisor meets with students minimally once a semester. All student questions about academic matters should be directed to the Pre-qualifying Student Advisor. Currently **Dr. Nan Gao** serves as the Pre-Qualifying Student Advisor for the CMB track students at Rutgers-Newark.

### 2.2. Post-qualifying Students

Post-qualifying students receive advice from their Dissertation Advisor and the Program Director prior to forming a Dissertation Committee and passing their Thesis Prospectus. Afterwards, the Dissertation Committee is the main advising entity. All student questions beyond individual progress in their thesis work should be directed to the Program Director.

## 3. Course and Research Credit Requirements (Rutgers CMB Track)

### 3.1. Requirements (total 60 credits)

*Course Credits:* Students must complete **minimum 24 up to 30 course credits**, typically during the first two years. Course work may only be postponed past the first two years with permission from the Program Directors or the Standards Committee. Examples for good justification are that a specific elective course deemed very important for a student was not available, or that student had to take remedial or language courses which did not count towards the course credit requirement. Courses include 2 Laboratory Rotations (6 credits), 4 CMB Core Courses (12 credits), a course in Biostatistics (3 credits) and 1-3 Electives. Students entering with relevant graduate level course credits from a different program or institution may

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be considered for transfer of credits. The Program Directors, in consultation with the Standards Committee decide about the course credit transfer. Research or Thesis credits cannot be transferred.

*Research Credits:* Students must complete **minimum 30 up to 36 research credits** under the dissertation advisor.

### **3.2. Lab Rotations (6 credits)**

- *Advanced Problem in Biology* (26:120:509, Fall)
- *Advanced Problem in Biology* (26:120:510, Spring)

### **3.3. CMB Track Core Courses (15 credits)**

- *Molecular Biology of Eukaryotes* (26:120:515, Fall)
- *Cell, Molecular, and Developmental Biology* (26:120:524, Spring)\*
- *Topics in Cell Biology: Biochemistry of Eukaryotes* (26:120:526, Fall)\*\*
- Scientific Reasoning and Research Design in Biomedical Science (course number TBD, Fall) (only open to the second year students in the program or who have completed all three core courses)

\*Depending on background, students may first have to complete *Cell Biology Methods* (26:120:512) as a prerequisite.

\*\*Starting Fall 2023, the course will be listed as "Biochemistry of Eukaryotes (26:120:571)

### **3.4. Biostatistics (one of the two courses listed below, 3 credits)**

- *Approaches in Quantitative Analysis for the Life Sciences* (Spring, 48:120:615; NJIT MATH 615, Spring)
- *Introduction to Biostatistics* (NJIT MATH 663, Fall)

### **3.5. Electives (3-9 credits)**

All students have the opportunity to add to their knowledge base by properly selecting Elective Courses. Elective Courses may be taken from offerings within the program and in other graduate programs at NJIT and Rutgers (including RU Biomedical and Health Science and RU New Brunswick). Prior to enrolling in courses offered outside of the Graduate Program in Biological Sciences, students must receive permission from the Standards Committee if they are pre-qualifiers, or from the Program Directors if they are post-qualifiers. It is the student's responsibility to obtain the necessary paperwork to be signed by the Standards Committee or Program Directors (e.g., the Graduate Transfer Credit Form).

### **3.6. Grade Requirements**

Students are expected to successfully complete all of the Core and Elective credits taken within the Graduate Program. Course work provides the formal foundation upon which a successful research project and Dissertation Defense is built. To remain in good standing, students must maintain a GPA of 3.0 or better for all courses taken as part of the graduate course of study. Courses cannot be repeated in order to improve on poor performance. Furthermore, a student can receive grades of **C** or **C+** in a maximum of two courses, only one of which may be in the CMB Track Core Courses. Receipt of a grade of **F** in any course – Core or Elective – will under normal circumstances result in dismissal from the program.

### **3.7. Research Credits**

Students have to complete a minimum of 30 research credits under the dissertation advisor. It should be noted that the completion of this minimum requirement does not constitute the completion of the thesis work. The Dissertation Committee decides when the student's research projects have progressed sufficiently to earn the degree.

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### 4. Biology Colloquium

The Biology Colloquium is held weekly during the semester and consists of research presentations by invited speakers, students, and faculty, as well as professional development/career advice events and organizational meetings. All students, including post-qualifying students, are required to attend while being matriculated in the program.

### 5. Laboratory Rotations

Laboratory rotations (RU-N: *Advanced Problems in Biology* 120:509/510) provide opportunities for laboratory research and independent study with Graduate Faculty members. Students are required to complete two rotations, the first one typically in the Fall of the first year, and the second one in the Spring. The main objective of the lab rotations is to identify a lab in which to complete dissertation work. Additional anticipated outcomes of the rotations include the development of laboratory and/or computational research skills, development of analytical and critical thinking skills, and appreciation of a specific research field. It is expected that the Rotation Advisor is potentially willing to become the Dissertation Advisor and can provide space and funding, unless this decision has been made prior to the rotation. For students who have identified a “home” after the first rotation, the second one can be used to broaden their conceptual perspective and/or technical skills.

Rotation laboratories are selected in consultation with the Pre-qualifying Student Advisor, but it is up to the student to come to an agreement with a Rotation Advisor. The student and the Rotation Advisor have to agree on the scope of the project, and the student shall submit the ***Pre-qual Rotation Plan form*** no later than two weeks after the start of the semester. After completion of the rotation, the student shall write a project report. After approval by the rotation advisor, the ***Rotation Report*** should be submitted it to the Program Director and Ms Shandell Rivera no later than one month after the completion of the rotation semester. The Rotation Advisor decides upon the format, content, and anticipated outcome. The overall performance of the student during each rotation will be evaluated by the Rotation Advisor who will then decide on the course grade (A, B+, B, C+, C or F). The Rotation Advisor shall also complete the ***“Pre-qual Student Evaluation”*** form and submitted to the program. Under extraordinary circumstances, the Program Director may approve a student request to conduct a third rotation that must be completed in the Summer prior to start of the second Fall semester.

### 6. Selection of Dissertation Lab

#### 6.1. Advisor Declaration

Following completion of the laboratory rotations, students must select a Graduate Faculty member who will serve as their Dissertation Advisor during the research phase of the doctoral program. This process is expected to be completed by the beginning of the second year in the program, at which time the student will commence developing a project and accumulating preliminary data for the dissertation. The dissertation advisor and the student are expected to discuss the commitments laid out in the ***“Graduate Student and Mentor Compact”***, and submit the Advisor Declaration forms (***“Dissertation Advisor Declaration form”***).

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Finding a lab for dissertation work is a required milestone for a student in the program and a prerequisite for remaining in good standing. If a student cannot come to an agreement with either faculty member supervising the first two rotations, the Program Directors will review the case and determine if the student can do a third rotation. Otherwise, failure to find a Dissertation Advisor results in the dismissal from the program.

### **6.2. Graduate Student and Mentor Compact**

The program encourages a cooperative approach to graduate training. To this end, faculty and students have developed the "**Graduate Student and Mentor Compact**", approved by the student Body (11/01/2016) and the Graduate Faculty (01/24/2017). The Compact lists practices intended to establish a productive relationship between student and advisor(s), as well as expectations that each partner may have for the conduct of that relationship. It is required that a student and the Dissertation Advisor discuss the various issues set forth in the Compact prior to completing the "**Dissertation Advisor Declaration form**".

## **7. Qualifying Exam**

### **7.1. Purpose**

Following the successful completion of all course requirements, rotations, and identification of the Dissertation Advisor, each student must pass a Qualifying Exam to remain in the program. After successful completion of the Qualifying Exam, the student becomes a Ph.D. candidate. The exam is typically held in June of the second year. Postponing the exam or taking the exam earlier (June of the first year) requires permission by the Program Directors. The exam will be administered by a Qualifying Exam Committee of three Graduate Faculty members appointed by the Program Directors. The Dissertation Advisor cannot serve on the committee.

The overall purpose of the Qualifying Exam is to assess the student's preparation and ability to embark on the highly challenging task of successfully completing an original, scholarly scientific investigation. With proper course preparation and completion of rotation projects, it is expected that the majority of students should pass the Qualifying Exam.

The Qualifying Exam consists of a written research proposal and an oral exam, both of which should allow the Qualifying Exam Committee to determine if the student has acquired the following qualifications:

- A proper understanding of modern concepts and principles in the broadly defined areas of study and research
- A substantial understanding of the biological, mathematical, and physical principles applicable to the submitted proposal
- The ability to define an original and testable hypothesis and the ability to address it with a reasonable experimental or theoretical approach
- The ability to critically evaluate and review published, peer-reviewed literature pertinent to the question being posed
- The ability to interpret outcomes of the proposed experiments and an understanding of the limitations of the proposed approach
- The ability to effectively communicate scientific content both orally and in writing

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### 7.2. *Written Proposal*

While the student may write the proposal as an early version of the tentative dissertation project, there is no specific restriction on the subject of the Qualifying Exam proposal other than it must be the original work of the student. Preliminary data are not required. Following the NIH F31 fellowship application guidelines, the proposal should be limited to 7 pages that include one page *Specific Aims Page*; and six pages of *Research Strategies* that should include *Background and Significance*, *Preliminary Data* (if available) and *Research Plan*. The *Background and Significance* section should explain the importance of the problem or critical barrier to progress that the proposed project addresses and explain how the proposed project will improve scientific knowledge in the field. The *Research Plan* section should describe the overall strategy, methodology and analyses to be used to accomplish the specific aims. The section should also describe expected outcome and potential pitfalls/alternative strategy for each aim proposed. References are required and are not included in the seven-page limit.

Students must write the proposal themselves, but they are free to consult their mentors, other students and/or faculty members concerning methodologies, format and references. The students are also allowed to have mentors, other students and/or faculty members to read and critique the proposal.

*Submit Proposal Abstract:* Student should submit an abstract for the research proposal to the Program Director by **May 1st**. Abstract should briefly describes project goals and significance, specific aims and research design methods. The abstract should be limited to 30-lines of text. On the basis of the abstract, the Program Director assemble the Qualifying Exam Committee and the students will be notified of their committee composition in mid-May.

*Submit Research Proposal:* The full proposal must be submitted to the Qualifying Exam Committee by **June 10th**. The committee will evaluate the proposal based on the criteria (but are not limited to) below.

- Is it hypothesis-based, scientifically sound and logical?
- Is there sufficient background/review of field?
- Are the aims sufficiently independent?
- Is there an explanation of expected outcomes and consideration of alternative approaches?
- Is it well-organized and clearly written with proper grammar/spelling?

### 7.3. *Oral Exam*

Oral Exam portion of the Qualifying Exam should take place on the 3rd or the 4th week in June. It is the student's responsibility to contact the committee members to decided on the date/time/location of the oral exam. For the oral exam, the student should prepare a 20-minute presentation that serves as a defense of the proposed project. The examiners will interrupt and invite the student to discuss details of the proposal. In addition, the student will be examined on foundational knowledge in Molecular Biology, Biochemistry and Cell Biology. The topics may not directly related to the contents of the proposal, but covered during the course work the student has completed. How long the exam will take, and what portion of the time is spent on which topics is at the discretion of the committee.

### 7.4. *Pass/Fail*

If a student does not pass the written and/or oral component of the qualifying examination, the chance for a second attempt may be offered if the Qualifying Exam Committee identifies a clear path to remedying the prior shortcomings. This second attempt will typically take place within six weeks after the initial exam date. Ultimate failure to pass either the written or the oral part of the Qualifying Exam will

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result in dismissal from the program. Students can appeal a dismissal from the program using the established procedures of the Rutgers Graduate School-Newark (GSN).

The committee members will provide a detailed assessment of the student's performance, entered by the committee chair into the **"Qualifying Exam Report"** form that will be shared with the student and Dissertation Advisor for feedback purposes.

After successful completion, students must submit the **"Application for Admission to Candidacy for the Doctoral Degree"** to the Rutgers Graduate School-Newark (available on the GSN website). The form requires signatures from all Qualifying Exam Committee members, and the Program Director. Students should collect the signature of the Program Director last, so a copy with all signatures present can be kept for the program records.

### 8. Dissertation Committee and Thesis Prospectus

Within 6 months of the completion of the Qualifying Exam, the student shall assemble a Dissertation Committee, under the guidance of the Dissertation Advisor. The Dissertation Committee is the primary advisory group responsible for supervision and guidance of the student during the research phase of the dissertation. The Dissertation Committee also serves as the examination committee for the Dissertation Defense. Within a year of the Qualifying Exam, the student shall present and defend the Thesis Prospectus (the dissertation research proposal) to the Dissertation Committee.

#### 8.1. Committee Appointment

The Dissertation Committee will be composed of the student's Dissertation Advisor, minimum 2 additional members of the Biology Graduate Faculty and at least one external member from outside the Rutgers-Newark-NJIT scholarly community. External members should have demonstrated research expertise in the general area of the prospective dissertation project.

Each committee should have at least two members who are not vested in the student's research, defined as having no expectation of being a co-author on the work completed for the degree. One of these committee members should be external, as defined above; the others can be internal.

The chair of the committee cannot be the Dissertation Advisor and is selected at the time of the initial meeting leading up to the Thesis Prospectus exam. External members are only required to partake in the Dissertation Defense, but are encouraged to attend regular committee meetings, if necessary via videoconferencing. To establish a Dissertation Committee, the student must submit the **"Dissertation Committee Appointment Report"** form for approval from the Graduate Program Director.

#### 8.2. Committee Meetings

Beginning with the Thesis Prospectus and ending with the Dissertation Defense, the Dissertation Committee shall regularly meet with the student in about 6 month intervals to discuss research progress, experimental challenges, and potential changes to the original Thesis Prospectus. Meeting dates, recommendations, and outcomes shall be recorded by the committee chair on the **"Dissertation Committee Report"** form. The ultimate charge of the Dissertation Committee before the Dissertation Defense is to ensure that the student is making appropriate progress towards a timely and successful defense. Any major issues that indicate insufficient progress or the necessity to change approaches should be identified to the Program Director via the reporting forms.

Typically, each committee meeting should include the following:

- A discussion of what the student has done since the last meeting (according to the plan recorded on the previous report form).

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- A discussion of the plan of action for the time until the next meeting (to be specifically recorded on the report form).
- A discussion of the overall plans and timeline until completion. Special emphasis should be given to significant changes from the original Thesis Prospectus.
- A brief discussion among the committee about the student's performance, in the absence of the student.
- A brief discussion with the student about the interactions with the advisor(s), in the absence of the advisor(s), to ensure that there are no problems regarding mentorship. If there are, the committee chair shall not record those on the report form, but contact the Program Director.

### **8.3. Thesis Prospectus**

The written Thesis Prospectus should follow the same format as the Qualifying Exam. The Thesis Prospectus meeting will determine the student's ability to conceive, design, and conduct the proposed research project. It is a required milestone in the program, and approval by the Dissertation Committee should be viewed as a statement that the scope and originality of the proposal is sufficient to earn a Ph.D. degree upon successful completion. In the event a student does not successfully complete the Thesis Prospectus in a timely manner, the Program Director will convene a meeting with the student and Dissertation Advisor to review the student's progress and to prepare a plan of action for completion of the prospectus requirement. Failure to comply with the above timelines and procedures can result in loss of departmental financial support and dismissal from the program.

After the Thesis Prospectus meeting, the Committee Chair shall record the outcome of the meeting in a "**Dissertation Committee Report**" form. Student may not register for "Matriculation Continued" before completion of the Thesis Prospectus.

## **9. Dissertation Defense**

### **9.1. Minimum Requirements for Thesis Completion**

Following the completion of all course and research credits, it is the prerogative of the Dissertation Committee to determine when the student has made sufficient progress to write up the thesis and defend it. There is no requirement for the student to have published any of the work prior to the defense. However, the committee should be confident that the thesis work will yield at least one first author publication in a respected scientific journal, or the equivalent of such a publication. It should be noted that this is a minimum requirement, and satisfying it does not automatically mean that the committee deems the thesis work sufficient for the degree.

The thesis work should be completed within a reasonable time frame. If there are extenuating circumstances, they have to be clearly communicated to the Program Director, in a timely manner. Unless well-justified exceptions are granted, Rutgers Graduate School-Newark has a seven-year limit for full-time students for attaining a doctoral degree. Students who are not able to complete the thesis work within the time-limit should request for an extension of time to Rutgers Graduate School-Newark. The extension may not exceed one year.

### **9.2. Final Progress Report**

Approximately six months prior to the Dissertation Defense, the Dissertation Committee will convene a meeting with the Ph.D. candidate for a final progress report to the committee. The meeting should be attended by all members of the Dissertation Committee (internal and external), at which time the Committee will evaluate if sufficient progress has been made to warrant final preparation of a thesis and

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to establish an approximate timetable for the thesis public presentation and private defense. The committee chair shall report the outcome of this meeting on the "*Dissertation Committee Report*" form.

### **9.3. Thesis Submission and Formatting**

It is the student's responsibility to consult with Rutgers Graduate School-Newark well in advance of the anticipated completion date regarding submission deadlines for the Diploma Application, submission and formatting requirements for the Dissertation, payment of the microfilming fee, and other matters.

The completed dissertation must be submitted to all members of the Dissertation Committee at least two weeks prior to the scheduled Dissertation Defense. If this deadline is not met, any of the Dissertation Committee members can demand that the Dissertation Defense be postponed.

### **9.4. Presentation and Oral Exam**

The Dissertation presentation must be advertised in advance, with a minimum of 10 days' notice, and open to anyone wishing to attend. Announcements should be distributed by email to the whole Federated Department (via the department administrators). Students must also send an invitation to the Dean of the Rutgers Graduate School-Newark. The format should follow a typical research presentation, i.e. a 45 min to 1 h talk followed by discussion and questions from the audience. The talk does not have to cover all chapters of the written thesis. The Dissertation Committee can opt not to take part in the discussion and reserve questions for the oral examination.

The public presentation is followed by a non-public oral examination conducted by the Dissertation Committee. There is no fixed format or time limit for this examination. The Committee will discuss the work and interpretations with the student. The aim is to determine if the student's work withstands a detailed critical review and if the student has the appropriate expertise to defend the thesis and the conclusions therein.

### **9.5. Reporting, Pass/Fail**

Upon successful Dissertation Defense, students must present the "*Dissertation Defense Report*" form (available on the Graduate School website) to the chair of the Dissertation Committee to collect all necessary signatures. In the event that the student fails to successfully defend the dissertation, one additional Dissertation Defense may be attempted. Reasons for the failure will be provided on the "*Dissertation Defense Report*". Failure on the second attempt will result in dismissal from the program. Appeals by the student should be directed through Rutgers Graduate School-Newark.

## **10. Teaching**

The program considers teaching experience an integral part of the academic training provided to the students. Therefore, all students are expected to assist in undergraduate teaching at some point during their progression through the program, independent of their funding source. Students awarded explicit teaching assistantships generally are given teaching assignments each Fall and Spring semester. Students who wish to supplement their stipends can also apply for Summer semester teaching assignments. Failure to perform adequately as a teaching assistant will result in revocation of the assistantship. Students awarded other departmental, University, or external assistantships or fellowships are expected to complete a minimum of two semesters of teaching, for a total of six to nine contact hours before they graduate. Exempt are only students whose funding award explicitly prohibits them from teaching. The program shall make every effort to give priority to the students' own course curriculum over their specific teaching assignments. Therefore, scheduling conflicts between course work and teaching should be resolved in favor of the course work.

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### **11. Effort Expectations**

Full-time students awarded assistantships or fellowships are expected to dedicate 100% of their professional efforts to their course work, research, and teaching activities. Additional professional activities have to be well-justified and require approval by the academic advisors (Thesis Advisor and Dissertation or Standards Committee) and the Program Director. Examples for such activities are limited part-time outside employment to cover legitimate financial needs, or the pursuit of professional development opportunities that are outside of the scope of the program but complementary to the student's career plans.

### **12. Exceptions to Regulations**

Exceptions to the regulations described in this document may be granted by the Program Director, after consultation with the appropriate faculty members and/or committees. Although the joint Graduate Program Biology has three tracks and most students are likely to choose one track in which to concentrate, the program recognizes that some students may wish to establish an individualized course of study intermediate between the tracks. The individualized course of study must be developed in consultation with the student's major advisor and the Pre-qualifying student advisor with approval from the Program Director.

### **13. Academic Integrity and Scholarly Ethics**

All students, faculty and staff associated with the Ph.D. Program in Biology are expected to adhere to the highest standards of academic integrity and scholarly ethics. As a guide to academic integrity and scholarly ethics please refer to the following sites: