Biology PhD Program

First Exam Assessment, Spring 2016

*Assessment of First Exams in the following four areas:*

Ecology, Evolutionary Biology, and Behavior (EEB)

Molecular, Cellular, and Developmental Biology (MCD)

Neuroscience (NS)

Plant Sciences (PS)
Periodic Review of the First Exam in Ecology, Evolutionary Biology, and Behavior — Spring 2016

Eligibility and Timing

The first exam for the PhD Program in Biology is specialized for each subprogram (Ecology, Evolutionary Biology, and Behavior (EEB); Molecular, Cellular, and Development Biology; Neuroscience; Plant Sciences). Students in all subprograms take the first exam following the completion of their first year.

Relationship to Learning Objectives

The first exam serves as an assessment related to the Learning Goal 1 for the program, which requires students to:

1. Demonstrate both broad and specialized knowledge in the chosen biology subprogram, including the ability to:
   A) read and critically evaluate the research literature
   B) explain the experimental, observational, and/or analytical bases for current theories
   C) design an approach to address a major unresolved research problem

For the exams currently under review, questions relate to four courses required of all students: behavior, ecology, evolution, and systematics.

Exam Design and Assessment

Students are provided with a reading list related to each of these areas that include recommended textbooks and primary research articles. For the exam, students answer 5 “short-answer” questions (1-2 paragraph responses) and 1 “longer-answer” (~4 page response) question from each area; students have a choice of questions within each of these areas. These questions are designed to assess both a breadth of knowledge in these areas and the ability to critically evaluate research statements and designs (related to the provided reading list). Questions are written by the faculty who have taught each of the required courses in that year, ensuring a close match between preparation and evaluation.

Exams are anonymized with aid from the central Program office. Grading is equally divided among the four areas and handled by doctoral faculty. A grade of over 70 represents “mastery” for each area. For the years 2013 – 2015, the average grade in each area has been 86.13 (Systematics), 86.31 (Behavior), 85.99 (Ecology), and 82.79 (Evolution), resulting in an average final grade of 85.30. Furthermore, no student has failed the total exam in the past seven years. This suggests that students are prepared for the exam. However, students earning a grade of below 70 in any area may be required to undertake a secondary assessment, usually as part of
their second exam (typically completed following the second year in the program). Though rare, remedial work has been required in systematics (1) and evolution (3) over the past three years.

Pending Changes

While the exam results indicate students have been prepared for the current version of assessments, feedback from faculty and students have been that some of these topics are more specialized and shouldn’t be required of all students (systematics, behavior) and that a focus on statistics would better prepare students to critically evaluate research papers and begin their own research. Reducing the overall number of classes, even while moving the required statistics course from the second to the first year curriculum, would also free up more time to be devoted to research the first year, when many students are developing initial research ideas or finalizing mentor selection. For these reasons the subprogram is recommending that future first year exams are based upon two required first year courses (ecology and evolution) and that students be encourage to take a statistics course their first year as well. These three courses are each taught on a yearly basis for students.

The decrease in topical sections on the First Exam will be compensated by a greater emphasis on the topical portion of the Second Exam (see below). Each section of the First Exam will be written and graded by a committee of 2-3 faculty members. The faculty members writing and grading an exam should either teach or have taught the respective required doctoral course, or consider themselves potentially interested and appropriate teachers of such a course. Exam writers/graders will not always be EEB Advisory Committee members; however, at least one exam writer/grader for each section should be present at the annual EEB Advisory Committee meeting where student results of the First Exam are discussed. The section format of the First Exam will remain largely unchanged, i.e. include a list of short answer topical questions for Part I and a short series of longer answer questions based on a professional journal article for Part II. Since the length of the exam as a whole has been cut in half, these individual sections can be longer, i.e. involve more questions.
Periodic Review of the First Exam in Molecular, Cellular, and Developmental Biology—Spring 2016

As part of the on-going assessment process, the MCD subprogram in Biology undertook a thorough review of the First Exam in the Spring Semester of 2016

The first exam in MCD assesses progress towards program learning goals #1 and a portion of goal #3:
Goal #1: Demonstrate both broad and specialized knowledge in Molecular, Cellular and Developmental Biology, including the ability to:
   A) read and critically evaluate the research literature
   B) explain the experimental, observational, and/or analytical bases for current theories
   C) design an approach to address a major unresolved research problem

The First Exam in each Biology subprogram tests students in each of the above areas.

Goal #3: Organize, format, and present data effectively in both written and oral form, display applicable computational and quantitative skills, and demonstrate excellence in teaching.

First year curriculum:
BIOL 700 Genetics
BIOL 710 Molecular Biology
BIOL 714 Cell Biology
BIOL 750 Developmental Biology

The four courses listed above provide the students with the background to navigate a set of 20 primary and review articles on topics within diverse MCD subdisciplines.

The reading list for the exam is provided in January of each year. The exam takes place in June. MCD faculty members provide both the questions and the reading list material for exams every year. The MCD subprogram advisory committee compiles the questions and crafts the exam. The Executive Committee of the Biology Program gives final approval of the exam and reading list.

For this special assessment effort, feedback was solicited from the advisory committee, as well as from a group of volunteer faculty and students. A meeting took place on May 20\textsuperscript{th}, 2016 to assess the exam, and to discuss several concerns raised by students or faculty regarding the exam. The student representatives on the committee had solicited information and concerns from other students and were able to report on these at the meeting.

The committee discussed the following points:
- We discussed potential explanations for why MCD has a lower grade average and a higher failure rate on the first level exam than do other Biology subprograms. Is it the preparation of the students, or is it the exam itself? As this is difficult to ascertain, we discussed each separately, as a starting point on what could be improved.
Courses should be coordinated and standardized among campuses to ensure that all First-year students are well prepared for the exam (the MCD first-year courses are each offered at ~4 different campuses). It was pointed out that a course geared only for PhD students could be taught at a higher level than the current courses which are also taken by Masters students at the campuses. Courses with Master students may dilute the intensity or the amount of knowledge covered in coursework. However, we have to consider how commuting to a centralized course at the GC could detract from lab time. A possibility is to offer the two courses for each semester in only one or two days/week.

If we cannot centralize the courses, curricula should be assessed in the courses, and they all should include reading primary literature and a writing component. VOTED on whether to centralize the 4 courses at the Graduate Center: 9 in favor, 3 against or abstained.

We considered a suggestion of limiting the choice of questions in the first part of the exam. The suggestion would have changed the first part of the exam to include only 4 essay questions, instead of the existing 6 questions from which students choose 4. VOTED on whether to eliminate the choice: unanimously against.

We discussed how the exam should be more representative of the content in the 4 courses that we require, but with 6 questions, it is difficult to require that the students choose questions that represent each of the 4 subjects.

We discussed whether to increase the time allowed to answer the exam questions. VOTED on whether to increase the time given for the examination: 12/13 against extending the time.

We discussed that as a learning exercise, it may be helpful for first year students to go over the previous year exam questions and be exposed to appropriate answers for examples of the essay questions. This could be included as part of the MCD Seminar Course. VOTED on whether to include this as part of the MCD Seminar Course: Unanimously in favor.

In conclusion, after significant deliberation, the committee agreed that the exams are reliable indicators of student progress toward program learning goals as well as helpful pedagogical tools. The modifications that were recommended were to consider whether the four courses provided in the curriculum adequately prepare first year students for the exam and for further research in MCD Biology. The program should consider centralization of the courses, and, if this is not possible, the program should assess the curricula at each campus to make sure that the same topics are covered, and that primary literature are covered. Courses should also include a writing component. The second recommendation was to go over examples from the previous exam to teach the students acceptable answers to the questions in the previous exam. Finally, the committee agreed that the list of primary literature should be provided with the understanding
that the first 12 in the list are to be tested in the essay questions, and that 13-16 are for experimental design, and 17-20 for data analysis. Several students had figured this out anyway, and telling them all makes it fair.

The following names attended the meeting:
Faculty: Luis Quadri, Nicolas Biais, Hualin Zhong, Linda Spatz, Shireen Saleque, Karen Hubbard, Alicia Meléndez
Students: Nicholas Palmisano, Jordana Lovett, Michael Cohen, Uday Madan, Dustin Zuelke
Periodic Review of the First Exam in Neuroscience – Spring 2016

Overview:
The First Exam in the Neuroscience Subprogram in Biology is designed to assess the following Learning Goals:

Demonstrate both broad and specialized knowledge in Neuroscience, including the ability to:
   A. read and critically evaluate the research literature
   B. explain the experimental, observational, and/or analytical bases for current theories
   C. design an approach to address a major unresolved research problem

Students enrolled in the Neuroscience Subprogram take the First Exam immediately following their first year, upon successful completion of the required first year Core Curriculum:

Neuroscience I (Fall) which covers: a) ion channels and cell intrinsic physiological mechanisms, b) synaptic transmission, and c) developmental neuroscience.

Neuroscience II (Spring) which covers: a) systems neuroscience, b) behavioral neuroscience, and c) cognitive neuroscience.

In 2014, the First Exam was significantly revised from a four session (two day) exam to a two session (one day) exam. Prior to 2014, Neuroscience students were the only Biology students that sat for a 2 day First Exam. This revision made the Neuroscience First Exam better aligned with the other Biology subprograms.

The content of the first exam was also revised significantly in 2014. Prior to the revision, there were typically over 12 multi-part questions and with the majority of them assessing general knowledge of basic mechanisms. Since 2014, questions are more designed to assess understanding of primary research articles in most of the content areas in Neuroscience I, and all of the content areas in Neuroscience II.

Typically, students answer 4-5 questions per 3 hour session, with essay answers typed on a computer in a proctored exam room. Students are allowed to bring unaltered articles from the reading list (which is posted in January) to the exam. Questions are designed to assess the students’ ability to understand and critically evaluate these primary research articles, which address all areas of the core curriculum and explain the experimental basis for current theories in Neuroscience.

Outcomes:
A total of eight students have taken the Neuroscience First Exam since the revision in 2014, and all have passed with an average grade of 78.55, although not every student has passed every question. When a student fails a question, or if the student fails the exam
altogether, the student and mentor are notified with a recommendation that the mentor focus on helping the student intensify training in the deficient area(s).

Our analysis of the First Exam modification in 2014 is that the revision was an improvement. Students performed as well as in the previous few years (78.17 average for 2011-2013), and better than 2009-2010, where the average grade was failing (<70). Therefore, reducing the exam to two sessions (one day) without significantly impacting the success rate appears to benefit the students.

**Assessment and further revision:**
Despite the successful performance on the exam, there is still room for improvement. Specifically, area C of the Biology Learning Goals (design an approach to address a major unresolved research problem) does not have a specific question in each First Exam for adequate assessment. Discussion of assessing this Learning Goal has been ongoing. For example, in the period from December 2014 – April 2015, revising the first exam to include an oral presentation was considered. The impetus for this consideration was to align better with the First Exam requirements of our CUNY Neuroscience Collaborative partner program Behavioral and Cognitive Neuroscience (BCN, in Psychology). The content of the oral portion was considered to include assigning the students to study a current problem in Neuroscience and to design an appropriate set of experiments to assess it. Following discussion at three Neuroscience Advisory Committee meetings, substantive discussion through email, and two meetings of a joint committee with BCN faculty, our committee ultimately decided to keep the First Exam in its current format (without an oral component). Moving forward, we will provide the Core Curriculum faculty, those tasked with crafting the First Exam, with the list of Learning Goals and the suggestion that their question address at least one of them. The Neuroscience Advisory Committee will also discuss developing a stand-alone written question to design a theoretical experiment incorporating their knowledge of the Core Curriculum material.

In Spring of 2016, following review of the First Exam materials, the Neuroscience Advisory Committee voted to incorporate Motor Systems into the Neuroscience II course curriculum effective 2017 (with at least one question on the 2017 First Exam reflecting this change). Similarly, a proposal is being considered by the Neuroscience Advisory Committee to formalize a “team teaching” aspect of Neuroscience I (similar to Neuroscience II). If approved, this will split Neuroscience I into three modules and will add at least one more question to the First Exam from the Neuroscience I curriculum.

Therefore, while the proposal to revise the format of the First Exam was rejected, decisions to provide a more comprehensive First Exam through content revisions are ongoing. Content revisions are driven by curricular changes in the Neuroscience I and II courses to ensure that the Learning Goals of our core curriculum and First Exam are congruent.

This assessment is based on the following documents: Biology learning goals 2011, 1st and 2nd exams and program learning goals, PS 1st exam reading lists and exams for years of 2008-2014, and 1st exam statistics for years of 2009-2015.

The 1st exam is designed to evaluate whether the students can meet the first biology learning goal: Demonstrate both broad and specialized knowledge in the chosen biology subprogram, including the ability to:
A) read and critically evaluate the research literature
B) explain the experimental, observational, and/or analytical bases for current theories
C) design an approach to address a major unresolved research problem

The assessment of the Plant Sciences 1st exam is organized into the following sessions:

Preparation: Students are provided with a clear and detailed reading list in advance of the exam.

Content/format: The 1st exam is divided into two parts: One part is an hypothesis-driven proposal that is required to be submitted prior to the written exam, and the second part is a one-day written exam. The one-day exam is composed of two sessions – questions on basic terms or concepts and critical reading/thinking questions based on the primary literature.

Process: The exam format as described above places an emphasis on the evaluation of students’ analytical skills, plus academic writing skills, which will help students succeed in their academic careers. Preparation and success in completing this exam readies students for the 2nd exam and also for their dissertational research projects thereafter.

Timing: The placement of the exam in the degree sequence allows for adequate preparation, and students are required to take the exam at the end of their first year in the program, which is appropriate. The policy also enables the students who fail the first time to re-take the exam one more time.

Grading: The exams are graded by the program faculty who prepare them. Grades and comments are provided.

Outcomes: Overall, the exams from the past few years had sufficient depth of content and their quality actually increased over the years. The PS exam requires understanding of primary research articles. To successfully write the required essays on these articles, students must fully understand the research questions posed, the approaches used to tackle the research questions, the results obtained and interpretations. Based on the grade statistics provided, except for the 1st year (2009) when two out of five students failed, in all other years all students passed the 1st exam. Given the increasing difficulty of the exams with years, this result strongly suggests that the PS subprogram has been very successful in preparing students for successful completion of the first level exam.
Overall: The PS subprogram 1st exam has been designed to help students successfully meet the biology learning goals. A particular strength is the strict requirement of students’ research proposal writing and analytical skill development, which is vital for the students’ future success. The exams have covered sufficient depth in the areas relevant to the field of plant biology.