

Publication Expectations for Ph.D. Students Department of Microbiology & Immunology

Background

The UNC Graduate School conducted a formal review of the Department of Microbiology & Immunology Ph.D. program in 2010. The first two phases of the review were a self-study of our program, followed by a visit from a committee of outside experts. The overall evaluation of our program by the program review committee was:

"... the current students and faculty are judged to be outstanding, and the obvious commitment of the faculty to education is commendable. Because of its many strengths, the M&I educational program is evaluated as outstanding..."

Nevertheless, a primary concern of the program review committee was the publication record of Ph.D. students in our department:

"The Ph.D. is defined by many parameters, but most important among them is publications from the thesis studies. The program currently recommends that two first-authored papers should be the goal, although this is currently not a requirement. Both the program and the committee were surprised to learn from the self-study that this goal is far short of being met.

For at least 30 years, we have had an *expectation* (not a *requirement*) that MCRO Ph.D. students would generate at least two first-author research (not review) publications. However, our self-study of the publication record of students who earned their Ph.D. from 2005-06 through 2009-10 revealed that 11% had no first-author research publications, 89% had at least one first-author research publication, and only 44% had at least two. Thus, less than half the students in this sample met our publication goal at the time of graduation, although the proportion increased to 59% over the subsequent four years.

A strong Ph.D. program should be willing to regularly assess its educational practices to reveal weaknesses, seriously consider suggestions for improvement, implement appropriate changes, and later evaluate whether or not the changes were effective in achieving the desired results. We took this opportunity to change our approach to student publications.

Recommended & Required Strategies to Enhance Student Publications

It is to the benefit of all members and alumni of the Department of Microbiology & Immunology that our students achieve the strongest publication record possible. To that end, the Graduate Studies Advisory Committee (GSAC), which included three student representatives, considered multiple schemes to promote publication by students:

1. Recommended: Set a goal of early publication

The program review committee noted that between critical analysis of scientific literature in seminar/tutorial classes and extensive writing practice in MCRO795 and the preliminary examination, students in our program receive substantial training relevant to writing papers early in their graduate careers. The program review committee therefore suggested:

"... it might be possible to take advantage of the training in writing and critical review of literature that has been front-loaded in the curriculum to focus students on the goal of completing a research paper within at most one year after passing the preliminary examination."

Given the diversity of research that occurs in our department (e.g. the generation time of bacteria and mice are vastly different), the GSAC did not believe it is realistic or appropriate that all students share a goal of publishing their first paper by the same point in their graduate careers. Nevertheless, students should be aware that progress can be accelerated when they set goals for themselves to complete particular aspects of their individual research projects by specific dates.

2. Recommended: Regularly write detailed outlines or drafts of manuscripts

The program review committee made the following suggestion:

"Students and postdocs alike should be encouraged and taught to draft a manuscript based on their research preferably every six months and minimally every year – for students, perhaps in conjunction with committee meetings. This practice will focus trainees and their advisers on experiments needed to finish their paper(s). Experience suggests that students who write a paper early in their graduate training acquire important working knowledge about publishing and are motivated to write another. Encouraging manuscript outlines as soon as the research training begins may ultimately lead to an increase of the overall number of papers published by students."

The GSAC believed that decisions about when to write manuscript outlines and drafts are best left to students, their research mentors, and thesis committees. Nevertheless, students should be aware that writing a manuscript outline or draft is a valuable tool for visualizing the logical flow of a scientific story and highlighting what additional data are needed to complete a project. We encourage students to write such outlines at least once a semester, starting when they join the department.

3. Required: Discussion of publication plans at thesis committee meetings

The GSAC believed that annual thesis committee meetings are an appropriate place to encourage publication progress. Therefore, the instructions for preparation of progress reports in advance of thesis committee meetings were modified to state:

"Students will provide their committee with a progress report at least one week prior to each meeting following approval of the thesis topic. The document will consist of a Specific Aims page followed by a description of progress to date organized by Aim. The progress report should include any changes in Aims, a summary of key results, and

plans for future experiments. The report should also communicate the student's vision for how results could be organized into publications, and the current status of progress toward publications."

It is expected that publication plans will naturally be part of the discussion at all thesis committee meetings.

4. Required: Publication submission and acceptance requirements for Ph.D. degree

The program review committee recommended:

"...students be required to have at least one first-authored paper accepted for publication prior to defending the Ph.D...."

Instead, the GSAC recommended, and the faculty approved, a minimum publication requirement for the Ph.D. degree, which became effective beginning with Ph.D. defenses in Spring semester 2013. The requirement was revised based on practical experience in Spring 2013 and Spring 2023. The current version follows:

"The *expectation* of the Department of Microbiology & Immunology continues to be that all Ph.D. students will conduct sufficient research to result in at least two first-author publications describing original results in high quality, peer-reviewed journals. As a minimum standard, to earn the Ph.D. degree we *require* that (i) a student must make meaningful contributions to and be an author on at least two manuscripts intended for publication in respected, high-quality professional journals or books, (ii) at least one of the two manuscripts must be a first (or co-first) author primary research manuscript, (iii) at least one of the two manuscripts must be accepted for publication, and (iv) if the second manuscript is not accepted for publication, then peer reviews must be returned prior to the private Ph.D. defense. If a manuscript used to meet part iv is not accepted for publication by the time of the doctoral defense, then the peer reviews will be submitted to the dissertation committee for discussion at the defense along with the dissertation.

The student will submit to the dissertation committee a brief description of their specific contributions to the two manuscripts used to fulfill the publication requirement. Prior to the Ph.D. defense, the dissertation committee will decide (in consultation with the Director of Graduate Studies if necessary) whether the two manuscripts meet the part i standards of "meaningful contribution" and "respected, high-quality professional journals or books". The dissertation committee chair will inform the Director of Graduate Studies and the Student Services Manager when the publication requirement is met, as well as the basis for the committee's decision.

Each chapter in the dissertation other than the Introduction and Conclusion must list all actual or planned authors involved in the described research and include a statement specifying the contributions of the student to the project."

Ideally, the minimum publication requirement should be met before students start to write their dissertation, but this timing is not part of the actual requirement.

The reasoning that led to this specific publication requirement is as follows:

- Publications that are not completed before someone leaves a lab are often difficult to complete. The submission requirement ensures that at least one research project for which the student has primary responsibility is brought close to completion before a student leaves.
- Shepherding a manuscript through the publication process is an important part of learning to become a scientist and earn a Ph.D. Waiting to defend until peer reviews have been received ensures that a student has completed the bulk of the publication process and provides an opportunity for experts in the field to raise points that may be considered at the Ph.D. defense.
- We considered establishing a requirement of at least one first-author manuscript accepted for publication prior to graduation, as recommended by the program review team and utilized by some other Ph.D. programs on campus. However, ~90% of our students already publish at least one first-author paper (although perhaps not before graduation). With 90% compliance, imposing a first-author publication requirement that includes a mechanism allowing for rare exceptions would have little positive effect. In addition, a one-paper requirement might appear to lower our standards compared to our current two-paper goal.
- Requiring acceptance of a first-author publication prior to graduation would effectively cede the degree-granting decision to journal editors and reviewers in a process over which students and faculty have no control.
- Requiring acceptance of a first-author publication prior to graduation could increase a student's time to degree. Such a requirement could also cause authors to "aim low" and submit their manuscripts to a lower-tier journal with a fast review time and a higher probability of acceptance instead of enduring the lengthy and uncertain review process at a high impact journal. Requiring submission instead of acceptance avoids these negative unintended consequences.
- The requirement for authorship (doesn't have to be first author) on an accepted paper (could be a review article) establishes a minimum publication requirement that all Ph.D. students should be able to meet without exception. Students new to a lab typically engage in activities that could lead to such publications. They have the opportunity to read literature and contribute to a review article, or generate data for an unfinished project while learning new experimental techniques. The requirement also may encourage students to seek out opportunities to collaborate on multi-author publications and to complete a publication of some sort well before their defense instead of leaving everything to the end.
- Authorship practices vary between laboratories and should not be dictated by the department. However, the department does have an interest in whether authorship on a paper represents a sufficiently meaningful contribution to meet our minimum publication requirement. Examples of circumstances potentially meriting a closer look include: middle authorship on a paper with a large number of authors, co-first authorship on a revised manuscript when the student was not an author on the original submission, and first-authorship when the student did not take a primary role in writing the manuscript.

- The scientific publishing industry is undergoing significant changes and venues for publication exist that we would not consider acceptable for meeting the publication requirement.
- The dissertation committees, being most familiar with the student's research, should decide what constitutes a "meaningful contribution" and "respected, high-quality professional journals or books".

The consequences of our minimum publication requirement were evaluated in our 2019 self-study, with a sample of students who graduated between 2013-14 and 2017-18. The requirement was very successful in achieving the desired effects:

- Even though we do not require any first-author research publications, the fraction of student meeting our expectation of two first-author research publications increased by half at the time of initial sampling (i.e. at the end of the window, so some students had just graduated), from 44% to 64%.
- Similarly, the fraction of students who eventually meet our expectation when sampled later increased from 59% to >80%.
- The fraction of students with no first-author research publications decreased three-fold at the time of initial sampling, from 11% to 4%, and later declined to 1%.
- The average number of publications per student increased substantially, from 4.4 to 5.6 for Ph.D.-only students and from 2.5 to 4.6 for M.D./Ph.D. students.

5. Recommended: Complete publications before leaving UNC

The practical reality is that no one is more motivated to complete a publication, nor more familiar with the research, than the student. As a consequence, if a student leaves UNC without completing all publications, there is a substantial risk that an incomplete project or manuscript could languish for a long period of time, or perhaps never be completed, simply because no one else (including the research mentor) can devote the time necessary to finish the job. Most labs have horror stories about papers that took years to complete after someone left. Therefore, the ideal scenario is for students to at least submit all manuscripts for publication before leaving UNC.

If completion or submission is not possible, then we strongly recommend that students write up all available information (introduction, materials & methods, results, discussion, references, figures & tables) as a thesis chapter. This will make it as simple as possible for someone else to add the finishing touches and submit the manuscript - with the thesis chapter in hand there is no need to dig through lab notebooks to decipher methods or results, interpret data, etc. Writing as much as possible before leaving also protects the student's position as a potential author on the eventual manuscript.