

Self-Study of Graduate and Postdoctoral Education

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PREFACE

Key recent departmental changes. This is a particularly opportune time for a program review because numerous changes during the past several years have significantly affected graduate and postdoctoral education in the Department of Microbiology & Immunology. The changes and their impacts will be described in detail at the appropriate places in this self-study, but highlights are mentioned here to alert the reader:

- Direct admission of graduate students to the department ceased with the creation of the Biological & Biomedical Sciences Program (BBSP) in 2008. Graduate students spend their first year in BBSP, rather than individual departments, and are financially supported by BBSP during that year. Overall, BBSP has been very positive for the Department of Microbiology & Immunology. The number and diversity of students entering our department have increased substantially as a direct result of BBSP. However, adjustments to our program have been necessary to cope with the increased numbers of students and the fact that they do not join our department until the end of their first year.
- Jeff Frelinger stepped down as Department Chair in 2007 after 16 years during which he guided the department through substantial growth and revitalization. Interim Chair Ron Swanstrom then oversaw the department for a year. As an outside hire, incoming Chair Bill Goldman was able to negotiate significant resources for the department and also introduced many new ideas about departmental operations. The change in department leadership also resulted in a longer than usual interval since the last external review of our program in 1999.
- Beginning with the arrival of our new Chair in 2008, the department has added eight new primary faculty and ten new joint faculty members, who together constitute nearly a third of the 60 faculty members active in graduate and postdoctoral education. With only three faculty retirements or departures in the same period, the new appointments represent substantial net growth.
- Janne Cannon retired at the end of 2008 after many years as Prelim Exam Advisor. Glenn Matsushima stepped down in 2009 after serving almost five years as Director of Graduate Studies and overseeing the transition to BBSP. Bob Bourret assumed both roles as the new Director of Graduate Studies and implemented numerous changes to the graduate program following faculty and student input.
- In 2009, the department began to comprehensively consider its program of postdoctoral education for the first time and implement some new activities for postdoctoral scholars.

Self-study overview. Our self-study formally began in October 2009, with our commitment to a Fall 2010 site visit date, and involves three intertwined types of activities:

- First, we looked comprehensively at our department's educational activities, which are represented by Section I - Program Overview, Section II - Curriculum, and Section V - Leadership & Support of this document. Although the descriptions provided should help the site visit committee understand what we do and why we do it, an important aspect of this activity was that it gave us an opportunity to assess

whether our program features are logically consistent with each other and with our goals, and how well the parts fit together as a coherent whole. This endeavor actually began with the arrival of the new department Chair and predates the formal self-study period. A Graduate Studies Advisory Committee was created in early 2009. The committee met in February 2009, June 2009, October 2009, March 2010, and April 2010 to broadly consider our graduate program. Committee recommendations were then discussed at full faculty meetings in February 2009, June 2009, November 2009, and May 2010. As a result, our department implemented numerous improvements to our graduate curriculum and procedures, although all could be considered relatively modest adjustments built on the foundation of our well-established program. Finally, given the practical reality that an outstanding educational plan is useless if it is not executed, the new Director of Graduate Studies began aggressively enforcing policies (such as deadlines for assembling thesis committees or seeking thesis project approval). As a result, all students are now in compliance with our expectations for progress toward their degree.

- Second, we gathered objective data about our graduate students, postdoctoral scholars, faculty, and their accomplishments, which are described in Section III - Graduate Students & Postdoctoral Scholars and Section IV - Faculty. This material provides one view of how well our department is actually accomplishing our educational mission. Some of these data has to our knowledge never previously been collected by the department or analyzed as thoroughly.
- Third, we asked the three departmental constituencies (graduate students, postdoctoral scholars, faculty) to complete subjective surveys asking how well we are currently performing our educational mission and solicited suggestions for future improvements. We then held separate discussions with the three groups to further develop ideas. Section VI - Future includes the survey and discussion results, as well as a summary/synthesis of suggestions arising from both the objective and subjective aspects of our self-study.

We anticipate continuing departmental discussions and actions both in response to feedback from the site visit committee and with regard to unresolved issues raised in this self study.

Section I - Program Overview

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I. PROGRAM OVERVIEW

This section provides context by describing the purpose of our department, the scale of our graduate and postdoctoral educational activities, our connections to other scientists both on and off the UNC Chapel Hill campus, how we compare to Departments of Microbiology & Immunology at other institutions, and a historical perspective of changes in our department over the past decade.

A. Mission of the Department of Microbiology & Immunology

Mission statement. The three intertwined missions of the Department of Microbiology & Immunology are to:

- Conduct research that significantly advances the science of microbiology and immunology, broadly defined and with emphasis on topics that could contribute to improved human health;
- Educate diverse graduate, professional, and pre-professional students as well as postdoctoral scholars in the aspects of microbiology and immunology appropriate for their careers; and
- Serve the people of North Carolina and the United States, whose support enables our research and teaching missions, as well as the international community of scholars, who provide the framework in which to conduct high-quality peer-reviewed microbiology and immunology research.

Scope of program review. This program review will focus on education of graduate students and postdoctoral scholars, and will touch on other aspects of our department's mission only to the extent relevant to this focus. The Department of Microbiology & Immunology is part of the School of Medicine and therefore has minimal responsibility for training undergraduate students. The time period covered by our self-study is the five academic years from 2005-06 through 2009-10, with occasional reference to current (Fall 2010) information.

B. Need/Demand for Microbiology & Immunology Graduate & Postdoctoral Programs

The UNC Department of Microbiology & Immunology offers Ph.D. and M.S. degrees, as well as postdoctoral training. Our department primarily offers a Ph.D. degree, which can be pursued either alone or as part of an M.D./Ph.D. program. Our Ph.D. program is described in detail in Section II - Curriculum. To quickly orient the reader at the beginning of this self study, Microbiology & Immunology Ph.D. program summaries intended for prospective students are reproduced in Appendices A1 and A2. Under specific limited circumstances, the department also awards a M.S. degree. There are two tracks to the M.S. degree, one for Ph.D. students who decide on a different career path, as well as a special part-time program for laboratory technicians. Finally, our department trains postdoctoral scholars. There is substantial objective and anecdotal evidence of strong need/demand for each of these programs, as described below.

Admissions data show extraordinary demand for the Microbiology & Immunology Ph.D.-only program. In 2007-08 and prior academic years, Ph.D.-only students entered our department via either direct admission or through the relatively small Interdisciplinary Biomedical Sciences (IBMS) umbrella program. The number of students directly admitted to our department was limited by our ability to financially support students during their first year, before joining a thesis laboratory. (Note that for simplicity, the word "thesis" is used in this document to mean either Ph.D. dissertation or M.S. thesis). Since 2008-09, Ph.D.-only students enter our department exclusively through the Biological & Biomedical Sciences Program (BBSP). Recruiting costs as well as first-year stipends are covered by BBSP, which is funded jointly by all of the departments and centers that participate in graduate student training as well as contributions from the School of Medicine administration and other sources. The increased resources and cost sharing approach alleviated some of the first-year financial support bottleneck and immediately resulted in substantial growth of our Ph.D. program, as seen by admissions data for the past five years (Table I-1).

Table I-1. Ph.D.-only students entering the Department of Microbiology & Immunology, 2005-10

Academic Year	Admissions Route				Total
	Direct Admission	IBMS	BBSP	Transfer with new faculty	
2005-06	6	4	-	-	10
2006-07	8	1	-	-	9
2007-08	11	2	-	-	13
2008-09	-	-	19	7	26
2009-10	-	-	15	-	15

BBSP (<http://www.med.unc.edu/bbsp>) is a large umbrella program comprised of 14 Ph.D. programs:

- The Departments of Biochemistry & Biophysics, Biology, Cell & Developmental Biology, Cell & Molecular Physiology, Chemistry, Microbiology & Immunology, Pathology & Laboratory Medicine, and Pharmacology;
- The Curricula in Bioinformatics & Computational Biology, Genetics & Molecular Biology, Neurobiology, and Toxicology;
- The School of Pharmacy;
- The Oral Biology Ph.D. Program (added in 2010).

In each year that BBSP has existed, more students chose Microbiology & Immunology than any other Ph.D. program within BBSP. In 2009, $19/118 = 16\%$ of BBSP students chose Microbiology & Immunology for their Ph.D. program. In 2010, $15/84 = 18\%$ of BBSP students chose Microbiology & Immunology for their Ph.D. program. In addition, $4/118 = 3\%$ of BBSP students in 2009 and $2/84 = 2\%$ of BBSP students in 2010 joined the laboratories of faculty with primary appointments in Microbiology & Immunology, but as part of a different Ph.D. program.

Sixty-three Ph.D.-only students are currently enrolled in our department. Ph.D.-only students in the Department of Microbiology & Immunology earned 55 Ph.D. degrees during the 2005-06 through 2009-10 academic years.

Admissions data show strong demand for the Microbiology & Immunology Ph.D. program among M.D./Ph.D. students. From 2005 to present, 45 UNC M.D./Ph.D. students began the Ph.D. phase of their program. Seven of 45 = 16% of M.D./Ph.D. students entered the Department of Microbiology & Immunology, the second highest number (after Pharmacology) of the 12 Ph.D. programs chosen by M.D./Ph.D. students. Four M.D./Ph.D. students are currently enrolled in our department. M.D./Ph.D. students earned 10 Ph.D. degrees from the Department of Microbiology & Immunology during the 2005-06 through 2009-10 academic years.

Total Ph.D. program enrollment is increasing. There are currently 63 Ph.D.-only and four M.D./Ph.D. students in our department. In terms of progress towards the Ph.D., a first-year M.D./Ph.D. student has completed lab rotations and most classes and therefore is roughly equivalent to a second-year Ph.D.-only student. Using this definition to align students on different tracks, the distribution of current students by year in our Ph.D. program (Table I-2) shows both timely degree completion and the recent influx of BBSP students that is likely to result in continued program growth for another two to three years before reaching steady state.

Table I-2. Program year distribution of current Microbiology & Immunology Ph.D. students

Program year	Number of students
1st year	0 (first-year students are in BBSP)
2nd year	16
3rd year	24
4th year	16
5th year	9
6th year	2
≥ 7th year	0

The M.S. program is small but fulfills two important needs. The M.S. program in the Department of Microbiology & Immunology is quite small, but the faculty consider it to be worthwhile. The M.S. program consumes little in the way of faculty time or other departmental resources. There are two distinct tracks to the M.S. One track is for students who enter intending to earn a Ph.D. but change their mind. Five M.S. degrees were awarded in this category during 2005-06 to 2009-10, and there is one current student on this track. The other track is to offer sufficiently motivated laboratory technicians the opportunity for career advancement by conducting thesis research outside of their normal job responsibilities. Three M.S. degrees were awarded in this category during 2005-06 to 2009-10. There are currently no students on the lab tech M.S. track.

There are more than 100 postdoctoral scholars in laboratories affiliated with the Department of Microbiology & Immunology. Unlike graduate students, postdoctoral scholars are primarily affiliated with a specific laboratory and not officially affiliated with a particular department. For the purposes of this self-study, the postdoctoral scholar population of the Department of Microbiology & Immunology is defined to be postdocs in the labs of primary faculty, plus Virginia Miller's lab. Dr. Miller

is a special case; she would have a primary appointment in our department except her husband cannot be her department chair. There are currently 56 postdoctoral scholars in the laboratories of faculty with primary appointments in Microbiology & Immunology and three postdoctoral scholars in Virginia Miller's lab, for a total of 59. In addition, there are 56 postdoctoral scholars in the laboratories of faculty with secondary appointments in our department.

C. Interdisciplinary Activities

Progress in scientific research is increasingly the result of collaborations between scientists from different fields. Thus an important aspect of graduate and postdoctoral education is exposure to and participation in interdisciplinary endeavors. There are extensive opportunities for interaction between students, postdoctoral scholars, and faculty from different scientific disciplines at UNC Chapel Hill. This section summarizes the most obvious and quantifiable interdisciplinary interactions involving members of the Department of Microbiology & Immunology, but cannot hope to be a complete list.

Building collegiality and collaboration. A culture of open cooperation is a fundamental, long-standing strength of the Department of Microbiology & Immunology that was effectively fostered by former chair Dr. Frelinger, continues to be strengthened by current chair Dr. Goldman, and is universally treasured by department members. In general, faculty members cheerfully share the burdens that arise from our joint commitment to our chosen curriculum of graduate education. There are many examples of joint publications and joint group meetings between different research groups, as well as a few students with joint research advisors. Department members freely share ideas, equipment, and materials on a daily basis. To help promote communication and interaction, a Friday afternoon social hour is funded by the department and hosted by a different lab each week during the academic year. To increase awareness of research in various labs and build bridges between disciplines, non-Microbiology & Immunology students who are members of departmental laboratories are invited to speak in our weekly student seminar series. Students are required, and faculty are encouraged, to attend departmental seminars outside their specialties of immunology, microbial pathogenesis, or virology.

Numerous seminar series and social events also facilitate interactions between our department and colleagues in the Research Triangle area. Departmental faculty take a leadership role in organizing many of these events:

- Nancy Raab-Traub organizes weekly virology in progress talks
- Miriam Braunstein organizes the monthly research in progress talks on bacterial and eukaryotic pathogens, which brings together scientists from across the UNC Chapel Hill campus and occasionally nearby universities.
- Virginia Miller organizes the monthly Bacterial Select Agent Club meetings. This is an outgrowth of the Southeast Regional Center of Excellence for Emerging Infections and Biodefense and brings together multiple labs from UNC Chapel Hill and Duke University to talk about research in progress on *Burkholderia*, *Francisella*, and *Yersinia*.

- Matt Wolfgang and Tony Richardson organize the quarterly Triangle Microbial Interactions meetings, which are held at various area restaurants for a social hour and talks by faculty from UNC Chapel Hill, Duke University, and North Carolina State University.
- The Triangle Immunology Interest Group has monthly meetings at the North Carolina Biotechnology Center and brings together scientists from UNC Chapel Hill, North Carolina State University, Duke University, and biotechnology/pharmaceutical companies in Research Triangle Park. Lishan Su is on the steering committee.
- The Triangle Virology Association serves the same local institutions as the Triangle Immunology Interest Group but meets once per semester and also includes national speakers. Nancy Davis is on the steering committee.
- Tony Richardson, Rita Tamayo, and Matt Wolfgang have organized the first annual Bacterial and Eukaryotic Pathogens Graduate Symposium. The symposium will be held in November 2010 and will include two national speakers as well as graduate student speakers and poster presentations from our department.

As a creative means of encouraging interactions, Bill Goldman (Chair of the UNC Chapel Hill Department of Microbiology & Immunology) and Joe Heitman (Chair of the Duke University Department of Molecular Genetics & Microbiology) each use personal funds to buy a pair of season tickets to the Durham Bulls Triple A minor league baseball team. The seats are located together behind home plate. Tickets to individual games are then distributed to department members, so that two people from UNC and two from Duke can attend each game together.

Joint faculty appointments. One measure of interdisciplinary interactions is joint faculty appointments. There are 33 faculty members active in graduate and postdoctoral education who have primary appointments in the Department of Microbiology & Immunology. Among our primary faculty, three have joint appointments in the Department of Biochemistry & Biophysics, and one has joint appointments in the Departments of Biomedical Engineering and Computer Science. There are 27 faculty members with joint appointments in the Department of Microbiology & Immunology. Our joint faculty have primary appointments in the School of Medicine Departments of Biochemistry & Biophysics (1), Cell & Developmental Biology (1), Cell & Molecular Physiology (1), Dermatology (1), Genetics (3), Medicine (9), Neurology (1), Pediatrics (1), Pharmacology (1), and Surgery (1); in the School of Dentistry Departments of Dental Ecology (1) and Periodontology (1); in the School of Public Health Department of Epidemiology (2); and in the College of Arts & Sciences Departments of Biology (2) and Chemistry (1). About half (13/27) of our joint faculty active in graduate and postdoctoral education have primary appointments in clinical departments of the School of Medicine and would not have access to graduate students without a joint appointment in an appropriate basic science department. Conversely, having clinical researchers among our faculty provides students with opportunities to conduct translational research.

Ph.D. programs represented in Microbiology & Immunology laboratories. A large fraction of graduate and postdoctoral training occurs in the context of conducting laboratory research. Department of Microbiology & Immunology faculty supervise the research of students from many different Ph.D. programs, often in the same laboratory,

thus providing extensive opportunities for interdisciplinary interactions. Almost half ($31/67 = 46\%$) of current Microbiology & Immunology students have joint faculty members as their research advisors. In the laboratories of our primary faculty, non-Microbiology & Immunology students make up $18/54 = 33\%$ of current Ph.D. students (Table I-3). Similarly, during the 2005-06 through 2009-10 fiscal years, non-Microbiology & Immunology students earned $23/70 = 33\%$ of the Ph.D. degrees in laboratories of our primary faculty. In the laboratories of our joint faculty, non-Microbiology & Immunology students make up $37/68 = 54\%$ of current Ph.D. students.

Table I-3. Ph.D. students of Microbiology & Immunology faculty

Ph.D. Program	Ph.D. Degrees Awarded	Current Ph.D. Students of	
	Last 5 Years In Primary Faculty Labs	Primary Faculty	Joint Faculty
Microbiology & Immunology	47	36	31
Biochemistry & Biophysics	3	5	5
Biology	0	0	8
Biomedical Engineering	1	0	0
Cell & Developmental Biology	0	0	1
Cell & Molecular Physiology	1	0	1
Chemistry	0	0	3
Epidemiology	0	0	6
Genetics & Molecular Biology	12	8	6
Neurobiology	2	0	1
Oral Biology	3	4	0
Pharmacology	0	0	6
Physiology	1	0	0
Toxicology	0	1	0
Totals	70	54	68

Microbiology & Immunology faculty participation in training curricula. In addition to departments, which can provide formal faculty appointments, there are several degree- or certificate-granting training curricula that draw faculty from various departments. The programs with substantial involvement from our departmental faculty include:

- The Curriculum in Genetics & Molecular Biology grants a Ph.D. degree and includes 17 of our faculty members.
- The Oral Biology Ph.D. Program grants a Ph.D. degree and incorporates 11 of our faculty, including program director Pat Flood.
- The Curriculum in Bioinformatics & Computational Biology grants a Ph.D. degree and includes five of our faculty members.
- The Curriculum in Neurobiology grants a Ph.D. degree and includes three of our faculty members.
- The Curriculum in Toxicology grants a Ph.D. degree and includes two of our faculty members.

- The Graduate Training Program in Translational Medicine is funded by the Howard Hughes Medical Institute and offers a certificate upon completion. Thirteen of our departmental faculty participate, including program director Virginia Miller.
- The Molecular & Cellular Biophysics Program offers a "minor" and is funded by the National Institutes of Health. Five of our departmental faculty participate.

Open access to courses in other departments. Our students can take courses in any department. The Department of Microbiology & Immunology requires completion of six semester-long classes for the Ph.D. (described in more detail in Section II - Curriculum). Our course requirements are very flexible and give credit for almost any graduate level biomedical classes. Thus our students have the freedom to select courses based on their individual interests and needs. Students typically complete four of their required six classes while in BBSP, before joining our department.

Joint degree program. The only joint degree program in which the Department of Microbiology & Immunology participates is the M.D./Ph.D. program within the School of Medicine.

Microbiology & Immunology faculty involvement in UNC research centers and institutes. Faculty members from various UNC departments often organize together to focus interdisciplinary efforts on specific human health issues. The centers and institutes in which Microbiology & Immunology faculty active in graduate and postdoctoral education are extensively involved include:

- More than half (34/60) of our faculty are members of the Lineberger Comprehensive Cancer Center. Nancy Raab-Traub is the program leader for virology, Jenny Ting and Jon Serody are co-program leaders for immunology, and Blossom Damania is head of the AIDS-associated malignancies focus group.
- The Center for Infectious Diseases includes 25 of our faculty.
- The Center for AIDS Research is directed by Ron Swanstrom and includes 21 of our faculty.
- The Carolina Vaccine Institute is headed by Stan Lemon as Interim Director, with Mark Heise as interim Associate Director, and houses five of our faculty. An additional 19 departmental faculty are associated with CVI.
- The Center for Translational Immunology is directed by Jenny Ting and includes seven of our faculty.
- The Center for Gastrointestinal Biology & Disease includes seven of our faculty.
- The Comprehensive Center for Inflammatory Disorders is directed by Pat Flood and includes six of our faculty.
- The Thurston Arthritis Research Center includes six of our faculty.
- The Cystic Fibrosis Research Center includes four of our faculty.

Microbiology & Immunology faculty involvement in multi-institutional consortia. Many Department of Microbiology & Immunology faculty participate in a wide variety of multi-institutional research consortia. The consortia with most involvement by our faculty members are:

- The Southeast Regional Center of Excellence for Emerging Infections and Biodefense includes 12 departmental faculty. Jenny Ting acts as Co-Director and a

member of the Steering Committee. Aravinda de Silva, Mark Heise, Tom Kawula, Virginia Miller, and Jenny Ting all act as program leaders.

- The Center for HIV AIDS Vaccine Immunology includes three of our faculty.

D. Inter-institutional Perspective

It is difficult to obtain reliable, objective information comparing the quality of graduate education at different universities. Available information is summarized in this section.

NIH grant funding. Because NIH grants are awarded on a competitive, peer-reviewed basis, success in obtaining NIH funds is one quantifiable metric for ranking the quality of scientific research conducted in different departments. However, there are obvious limits to the utility of this information. For example, the data is at best an indirect measure of the quality of graduate and postdoctoral education, is not normalized to department size, and the grouping of particular scientific disciplines into departments varies at different schools. NIH stopped publishing department rankings after 2005 in part because multi-investigator awards make fair comparisons impractical. Nevertheless, the raw data necessary to compile rankings is still available (<http://report.nih.gov/award/trends/FindOrg.cfm>) and others have done so. Over the past five years, our department was ranked between 12th and 16th nationally in NIH funding among medical school microbiology departments (Table I-4).

Table I-4. UNC Department of Microbiology & Immunology rank among medical school microbiology departments by total NIH funding

Fiscal Year	Rank	Awards Total	Source
2005	12 of 99	\$14,483,554	NIH ^a
2006	15 of 97	\$11,596,836	BRIMR.org
2007	16 of 97	\$12,156,582	BRIMR.org
2008	14 of 98	\$11,702,495	BRIMR.org
2009	12 of 95	\$12,707,492	BRIMR.org

^ahttp://report.nih.gov/award/Rank/MedSchool_Departments.cfm?Department=MICROBIOLOGY,%20IMMUN,%20VIROLOGY

National Research Council data-based assessment of research doctorate programs in the United States. The National Research Council evaluates the quality of graduate programs across the country about every 10 years. Analysis of data collected in 2005-06 on over 5,000 doctoral programs at 212 universities was released in September 2010 and is summarized here. Data was collected for twenty different characteristics covering various aspects of research activity, student support and outcomes, and diversity of the academic environment. Two methods were used to combine the twenty characteristics into a single ranking. The survey-based (S) ranking used relative weights for each characteristic based on asking faculty in each field how important each characteristic is in determining program quality. The regression-based (R) ranking asked faculty to rank the quality of a sample of programs in their field and then worked backwards to determine what weights should be applied to each characteristic to reproduce the ranked list. Applying the weights to the characteristics then allowed programs in the same field to be ranked with respect to one another. The

process was repeated 500 times, with the weights regenerated using a random sample of half the responses in the S or R method and the characteristics randomly varied within 10% of their reported value. The top and bottom 5% of the resulting rankings were discarded, leaving a 90% confidence interval of where a particular program ranks in its field.

Seventy-four microbiology programs were rated (note there was a separate category of 78 immunology and infectious diseases program into which some departments of microbiology and immunology were placed). The 90% confidence interval for ranking of the UNC Department of Microbiology & Immunology was between 9th and 35th by S ranking, and between 14th and 33rd by R rating. If microbiology programs are sorted based on whether both their 5th and 95th percentile rankings are better (or worse) than the 5th and 95th percentile rankings of our department, then it is possible to deduce an approximate ranking (Table I-5). By this analysis, our department ranks in the range of 18th to 21st among 74 programs based on S ratings and 25th to 29th based on R ratings. Programs that rated more highly than our department in this analysis are listed in Appendix A3.

Table I-5. Comparison of 5th & 95th percentile rankings for microbiology programs in 2005-06 NRC assessment vs. UNC Department of Microbiology & Immunology

Category	<u>Number of programs with</u>	
	S-rankings	R-rankings
Both rankings better than UNC	17	24
Not clearly distinguishable	3	4
Both rankings worse than UNC	53	45

Within the three subcategories for the 20 measured characteristics, the Department of Microbiology & Immunology had 90% confidence interval rankings of 12th to 49th for research activity, 7th to 42nd for student support and outcomes, and 35th to 65th for diversity of the academic environment. Using the method of Table I-5 to identify programs likely ranked above or below our department, we are probably ranked in the range of 22nd to 29th in research activity, 14th to 22nd in student support and outcomes, and 51st to 57th in diversity of the academic environment.

The rankings described in this section cannot fully reflect a graduate program and research environment that has undergone considerable change since the 2005-06 NRC surveys were conducted. Our department has been heavily influenced by creation of the BBSP umbrella admissions strategy, the addition of 18 faculty members (including the department Chair and 11 other faculty newly recruited to UNC), and changes to a wide variety of program requirements and activities as described elsewhere in this self-study. It is particularly worth noting that BBSP recruitment of graduate students has dramatically increased the diversity of our department since the data for the NRC study was collected, as documented in Section IIIA.

US News & World Report science doctoral program rankings. *US News & World Report* sends questionnaires to all department chairs and directors of graduate studies at schools that awarded at least five doctoral degrees in the discipline over a

five-year period. Participants are asked to give their opinion of the quality of each program on a scale from 1 to 5 or "don't know". Scores are then averaged and ranked. In the biological sciences as a whole, UNC Chapel Hill was ranked 24th out of 257 schools in 2010 with a score of 4.0, based on a 15% survey response rate. In the same survey, department chairs and directors of graduate studies were asked to nominate up to 10 programs in each specialty. The nine programs receiving the most votes were published. The UNC Department of Microbiology & Immunology does not appear in the top nine rankings in either Microbiology or Immunology/Infectious Disease in 2010. Information is from <http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools>.

E. Previous Program Evaluation

The Department of Microbiology & Immunology, 1999 vs. 2010. The last external review of our department was conducted in 1999. To put the previous review in perspective and appreciate the growth and changes of the Department of Microbiology & Immunology over the past decade, it may be useful to compare some features of the department then and now (Table I-6, next page):

Department of Microbiology & Immunology strengths identified in 1999. The report of the December 1999 site visit is reproduced in Appendix A4. The report identifies the following strengths of the department:

- Extensive interactive environment
- Excellent training environment
- Excellent faculty research funding
- Excellent faculty publishing
- Exceptionally high faculty morale
- Equitable distribution of teaching load
- Equitable access to departmental resources
- Outstanding training program
- Flexible course requirements
- Generally high teaching quality
- Heavy faculty involvement in preliminary exams

It is the responsibility of the site visit committee to evaluate the current state of our department. However, we believe that each of the strengths noted in 1999 has been maintained or improved.

Current status of departmental weaknesses identified in 1999. The 1999 program review identified eight weaknesses in the Department of Microbiology & Immunology. The weaknesses and how they have been addressed in the intervening years are outlined below:

- *Insufficient dollars for first-year graduate students.* We originally shortened rotations to get students into their thesis labs and off of department funds by February of their first year, thus allowing a given amount of departmental money to support more first-year students than if students were supported until June. However, BBSP solved this problem by providing all first-year students with stipend support from August through June. Our department is assessed annually to help fund BBSP, but the

Table I-6. Department of Microbiology & Immunology selected statistics, 1999 vs. 2010

Category	1999	2010
<i>Total faculty & staff</i>		
Primary tenure track faculty	26	35
Primary research track faculty	6	9
Joint tenure track faculty	18	33
Joint research track faculty	1	2
Lecturer	1	1
Teaching lab coordinator	1	1
Office staff	10	8
<i>Faculty active in training graduate students & postdoctoral scholars</i>		
Primary tenure track faculty	23	32
Primary research track faculty	0	1
Joint tenure track faculty	16	26
Joint research track faculty	0	1
% Female faculty	18%	28%
% Underrepresented minority faculty	0%	5%
% International faculty	Unknown	23%
% Assistant professor	18%	18%
% Associate professor	21%	33%
% Full professor	61%	49%
% Primary faculty trained at UNC	17%	18%
% Joint faculty trained at UNC	44%	26%
<i>Ph.D. students</i>		
Ph.D. students	43 ^a	67 ^a
5-year average of entering class GPA	3.6	3.5
5-year average of entering class GRE	1246	1252
Average time to Ph.D.	5-6 years	5.8 years
Attrition rate	~20%	~7%
% Female students	49%	73%
% Underrepresented minority students	7%	12%
% International students	Unknown	7%
Annual stipend	\$16,500	\$26,000
<i>M.S. students</i>		
M.S. students	5	1
<i>Postdoctoral scholars (in primary faculty labs)</i>		
Postdoctoral scholars	29	59
% Female postdocs	41%	29%
% Underrepresented minority postdocs	Unknown	5%
% International postdocs	Unknown	44%

^aThe 1999 number includes first-year students, whereas the 2010 value does not (BBSP students do not affiliate with specific graduate programs until the end of the first year).

financial burden of BBSP is now shared by all departments and centers, based on the number of students who perform their thesis research in each unit's space. BBSP also receives substantial funding from other sources (e.g. Dean's office of the School of Medicine), which further reduces the financial burden of first-year students on our department.

- *Too few students enter department.* Again, this problem was solved by BBSP, which has also helped us recruit a more diverse student population.
- *Top-heavy faculty.* Extensive faculty hiring and turnover during the past decade have revamped the department faculty. For more details, see Section IVA - Faculty Composition and Figure IV-1.
- *"Inbreeding" of department faculty (too many faculty trained at UNC Chapel Hill).* According to our last self-study, $11/39 = 28\%$ of faculty active in graduate training in 1999 had received previous training at UNC Chapel Hill. However, most (7/11) UNC-trained faculty were joint appointees, about whom the Department of Microbiology & Immunology did not make a hiring decision. "Inbreeding" has been reduced somewhat over the past decade, largely through turnover and expansion of the joint faculty. In 2010, six of 33 = 18% of primary faculty involved in graduate and postdoctoral education had trained at UNC (three as graduate students and three as postdoctoral scholars). In addition, seven of 27 = 26% of joint faculty involved in graduate and postdoctoral education had trained at UNC (five as postdoctoral scholars and two as interns/residents/fellows). Thus the current overall fraction of UNC-trained departmental faculty is $13/60 = 22\%$, down from 28% in 1999.

In both 1999 and 2010, additional department faculty members not active in graduate student and postdoctoral scholar training (e.g. tenure track faculty with primarily clinical responsibilities and research track faculty) included multiple individuals with previous UNC training.

- *Confusion about rotation report format.* This is no longer applicable, because rotations occur while students are part of BBSP, before joining our department.
- *Poor communication about preliminary examination expectations.* This problem was fixed long ago (e.g. see Appendices B6-B11).
- *Poor seminar and dissertation defense attendance.* Departmental seminars are now heavily attended, in part because students are required to attend at least two-thirds of seminars (see Section IIA - Ph.D. Curriculum) and partly due to a changing department culture in which more faculty lead by example in attending seminars.
- *Need better cohesion among focus groups within department.* The previous site visit team suggested department retreats to meet this need. We held faculty retreats for many years, but have stopped the practice both due to cost and because the retreats did not include the entire department. However, multiple activities have been instituted in the past two years to foster frequent interactions among research groups and across scientific disciplines. These include a weekly TGIF social hour, mandatory (at least two-thirds) seminar attendance for students, a symposium for postdoctoral scholars in the department, and inclusion in the student seminar series of non-departmental students who work in departmental labs.

Section II - Curriculum

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II. CURRICULUM

This section describes how the Department of Microbiology & Immunology educates Ph.D. students, the modifications we make to that training for M.D./Ph.D. and M.S. students, and our initial departmental efforts to contribute to postdoctoral training, which has traditionally been considered the responsibility of individual laboratories.

A. Ph.D. Curriculum

Educational goals. Our goal is to train our Ph.D. students to become first-rate scientists. The skills that we aim to impart include:

- Acquisition of broad background knowledge in modern microbiology and immunology.
- The ability to critically evaluate the scientific literature.
- Strong written and oral communication skills.
- Facility in experimental design and execution, from concept through interpretation of results to publication.
- Fostering collaboration and comfort with interdisciplinary science.
- Teaching experience.
- Appropriate professional conduct, including the responsible conduct of research.

Over the years, our department faculty has spent a lot of time thinking about and debating how to best educate graduate students. Each aspect of our curriculum is designed to foster one or more of the skills listed above. Our department has collectively developed and fine-tuned a coherent and comprehensive plan for graduate education. An obvious measure of our commitment to education is the willingness with which faculty devote an exceptional amount of time to implementing our plan.

Professional development during the first year in BBSP. Ph.D. students spend their first year in BBSP, outside of the control of our department. BBSP students who eventually join the Microbiology & Immunology program nevertheless interact with departmental faculty in classes and laboratory rotations during their first year. In addition, students meet weekly for 90 minutes in First Year Groups consisting of ~15 BBSP students, a faculty leader, three faculty co-mentors, and four student peer mentors. Microbiology & Immunology faculty and students are extensively involved in leadership of First Year Groups (Table II-1, Appendix B1). The First Year Groups work to develop professional skills such as logical/critical thinking, familiarity with various experimental methods, and scientific communication, and also provide mentoring for course and rotation selections. Social activities help develop a sense of community and give students a "home" in their First Year Group prior to joining a Ph.D. program. Following each of the three first-year rotations, students report on their project through a poster presentation, a written report, or a talk.

Outside of the First Year Groups, BBSP students attend a series of six seminars on the responsible conduct of research, which cover mentorship and social responsibility; plagiarism; experimental design and statistics; animal and human subject use; authorship and peer review; and intellectual property and conflict of interest. Students also attend four lectures about quantitative skills and biostatistics.

Table II-1. Fraction of BBSP First Year Group leaders^a from the Department of Microbiology & Immunology

Academic Year	Faculty Group Leaders	Faculty Co-Mentors	Student Peer Mentors
2008-09	2 of 8	6 of 25	Peer mentors not used
2009-10	2 of 6	6 of 19	5 of 31
2010-11	3 of 6	4 of 18	4 of 23

^aListed by name in Appendix B1.

Ph.D. requirements of the UNC Graduate School. UNC Chapel Hill imposes the following minimum requirements on all Ph.D. degrees:

- Minimum residence of four full semesters of at least nine credit hours.
- A doctoral written examination and a doctoral oral examination, which together constitute a comprehensive assessment of the student's command of their field.
- Annual progress report to the student's thesis committee.
- Committee approval of the thesis project.
- A final oral examination on the thesis research.

Each academic program specifies additional requirements.

Microbiology & Immunology Ph.D. timeline. A timeline of the key steps in the typical progression to a Ph.D. degree in our department is shown in Appendix B2. The timeline also provides an overview of our department-specific degree requirements, which are described in detail below.

Classroom course requirement. The Department of Microbiology & Immunology requires our Ph.D. students to take at least six semester-long courses, including at least two seminar/tutorial classes. One of the seminar/tutorials must be MCRO710, MCRO711, or MCRO712; the other can be from outside the department, in which case the class must be 700 level or higher on a relevant topic, must be based on discussion of the primary literature, and must be approved for credit by the Director of Graduate Studies. Our course requirements represent a long-standing compromise (students must take classes, but particular classes are not specified) between faculty who believe the Ph.D. is best earned in the laboratory rather than the classroom and faculty who believe the Ph.D. should reflect comprehensive understanding of a specified body of knowledge. It is a fortunate coincidence that our flexible course requirements work very well in the context of the BBSP umbrella program, in which students typically complete four courses before deciding which Ph.D. program to join. In other words, a student's course selection during their first year does not prevent them from completing Microbiology & Immunology course requirements in their second year. An astute observer will note that it is technically possible for a student to meet our course requirements while taking only one of our courses, although this has not happened and most students take at least half their courses in Microbiology & Immunology.

Microbiology & Immunology graduate courses. The Department of Microbiology & Immunology offers four lecture courses, three seminar/tutorials based entirely on discussion of the primary literature, and a writing class. Each course is described below. Note that the content of the seminar/tutorials change each year, so students can

take the same course number for credit more than once. Enrollment in our graduate classes for the past five years is given in Appendix B3. Additional students and other department members often join the literature discussions in seminar/tutorial classes.

MCRO614/MCRO615 Immunobiology (course director Ed Collins, Fall semester). MCRO614 consists of lectures designed to introduce students to the cellular, molecular, and biochemical aspects of the immune system and the immune response. The course closely follows a textbook chosen yearly to be current and accessible to a broad range of students. Although a graduate level course, senior level undergraduates are allowed to register. The graduate students that register are from many departments and schools at UNC (e.g. Public Health, Medicinal Chemistry, Biology, Biochemistry & Biophysics). MCRO614 is a popular course and has the largest enrollment of departmental graduate classes. MCRO615 is a recitation companion to MCRO614 designed for students interested in research in immunology. The once weekly MCRO615 meeting involves reading and presenting primary literature that follows closely the lecture material in MCRO614. The goal is to show the experimental approaches that led to the conclusions discussed in the lectures.

MCRO630 Virology (course directors Steve Bachenheimer & Ray Pickles, Fall semester). MCRO630 is designed to provide students with a comparative framework for understanding the broad molecular, biochemical, and cell biological concepts in virus replication. Thus rather than focus in a vertical fashion on the replication of representative virus families, much of the course involves a horizontal exploration of a particular step in virus replication across the diversity of animal viruses. To that end, the approach and organization taken in the text "Principles of Virology" (eds. Flint, Enquist, Racaniello, & Skalka) is emphasized. Because all the material cannot be covered in one semester, some aspects of viral replication are assigned as outside reading. With a target audience of graduate students, reading of additional primary literature to supplement the lecture topics is suggested, and course time is devoted to discussion of papers that illustrate a particular concept or an emerging issue in virus replication. Finally, discussion of lecture material and making connections with other topics presented in the course is always encouraged.

MCRO635 Microbial Pathogenesis I (course director Peggy Cotter, Fall semester). MCRO635 is a graduate level course that focuses on bacterial and fungal pathogens. The course covers basic aspects of bacteriology and also discusses individual bacterial and fungal pathogens in detail. MCRO635 is designed for first- or second-year graduate students in microbiology or related disciplines, but is open to others upon instructor approval. Basic knowledge of genetics and molecular biology is required. MCRO635 meets twice per week for 75 minutes and is team-taught by Microbiology & Immunology faculty members who run active research laboratories in areas directly related to their lecture/discussion topics. Although some classes are entirely lecture, most also include the discussion of one or more primary research articles. Enrollment is typically ≤ 10 , so students are expected to be active participants. There is no required textbook. Instead primary research articles and relevant reviews are posted on the Blackboard website at least 48 hours prior to each class. Students

are expected to read these papers before class and to be prepared to discuss research articles during class.

MCRO635 also includes a writing assignment. In consultation with a relevant faculty member, students choose a topic on which to write a research proposal that is roughly equivalent to one Specific Aim of an NIH R01-type research proposal. Students obtain topic approval by mid-way through the course and submit a draft by week 12. Students then revise their proposals in response to faculty critiques. A written exam mid-way through the course is based on the "basic bacteriology" lectures. For the final exam, students present to the rest of the class an assigned figure from a research article, giving relevant background, the purpose of the experiment, general experimental details, a description and interpretation of the data, and the relevance of the conclusions. The final grade is based on the score of the written exam, the research proposal, the final exam presentation, and overall class participation.

MCRO640 Microbial Pathogenesis II (course directors Steve Bachenheimer & Mark Heise, Spring semester). Micro 640 is designed to introduce graduate students to fundamental concepts in understanding virus-induced disease. At the end of this course, students are expected to have a basic understanding of the types of virus/host interactions that drive virus-induced disease, be exposed to key unresolved questions within the field, and have a firm grasp of the types of experimental approaches that can be used to study viral pathogenesis from the standpoint of both the host response and the virus.

The course, which includes a mix of lectures and primary literature review, consists of two units. The first unit introduces students to key aspects of the virus/host interaction that lead to virus-induced disease. This includes several lectures on the host immune response, with an emphasis on understanding how the host immune response limits viral infection, how viruses evade host immunity, and how overactive immune responses can exacerbate disease and cause immune pathology. A second emphasis within Unit 1 concerns the impact of host genetic variation on disease susceptibility. This area includes introduction to basic concepts in systems genetics, an overview of research tools for studying viral interactions with genetically complex populations, and discussion of real world examples of host genetic variation affecting susceptibility to virus-induced disease. The third emphasis area within Unit 1 is focused on viral genetic variation and its impact on viral virulence, immune escape, and viral fitness, where these concepts are linked back to human disease.

The second module within MCRO640 provides an overview of several viral pathogens, where the lectures are grouped either by virus class (e.g. herpesviruses or lentiviruses) or by the organ system that is affected (e.g. respiratory viruses, enteric viruses). These lectures, delivered by faculty within the Department of Microbiology & Immunology who have expertise with the specific classes of pathogens under discussion, provide the students with an opportunity to apply the basic concepts discussed in Unit 1 to specific types of viral pathogens. At the end of the course, a capstone lecture/discussion is delivered with the goal of summarizing the key concepts in viral pathogenesis covered in the course. This final activity focuses on a single virus

of the students' choosing, and is designed to allow the students to ask the key questions and design the experiments needed to understand the mechanisms leading to virus-induced disease.

The final course grade is based upon two exams, administered at the end of each unit, with each exam making up one third of the final grade, as well as a writing project, which comprises the final third of the grade. The writing component consists of a five-page research proposal on a topic related to viral pathogenesis, where the students are expected to develop a single Specific Aim. This component is designed to provide the students with an opportunity to further develop their proposal writing skills while integrating concepts in viral pathogenesis from the lecture/literature discussion segments of the course.

Additional lecture classes. The classes outside Microbiology & Immunology that are most commonly taken by our students are the two semester sequences MCRO631/632 Advanced Molecular Biology I & II or MCRO643/644 Cell Structure, Function & Growth Control I & II. MCRO631/632 is cross-listed with the Departments of Biology, Biochemistry & Biophysics, Genetics, and Pharmacology. MCRO631 focuses on DNA structure, replication, recombination, and repair whereas MCRO632 focuses on RNA structure, gene regulation, transcription, and translation. Jack Griffith is a teacher for MCRO631. MCRO643/644 (also termed "Super Cell") is cross-listed with the Departments of Biochemistry & Biophysics, Cell Biology, and Pharmacology. MCRO643 covers membranes, cytoskeleton, extracellular matrix, and ion channels, whereas MCRO644 covers various aspects of signal transduction, growth control, and transformation.

MCRO710 Seminar/Tutorial in Prokaryotic Molecular Biology (Course director Miriam Braunstein, Spring semester). Prior to 2010, MCRO710 was taught by a single faculty member on a topic of their choosing. Course offerings for 2005-09 are shown in Table II-2.

Table II-2. MCRO710 Seminar/tutorial in prokaryotic molecular biology topics

Semester	Topic	Instructor
Fall 2005	Polarity in bacteria	Braunstein
Fall 2006	Bacterial interactions with host cells	Kawula
Spring 2007	Global regulation/stress responses/bacterial communities	Cannon
Spring 2008	Molecular mechanisms of bacterial adherence	Wolfgang
Spring 2009	Antibodies: Double-edged swords that can control or exacerbate infections	de Silva

Beginning in 2010, MCRO710 switched to a format in which several specific topics are each covered over a four-week block within a semester. The change was made in support of a training grant application in microbial pathogenesis. Even numbered years will include regulation of virulence factors (Bourret), localization of virulence factors (Braunstein), and host-pathogen interactions (Kawula). Odd numbered years will cover metabolism of pathogens (Richardson), eukaryotic pathogens (Goldman), biodefense pathogens (Cotter), and cutting-edge techniques for studying pathogens (Wolfgang).

Under both the old and new versions, MCRO710 includes a writing component as described for MCRO635. Students choose a topic related to the course subject, write a single Specific Aim research proposal (10-pages, double-spaced), and then revise the proposal in response to detailed faculty feedback.

MCRO711 Seminar/Tutorial in Animal Virology (Course director Dirk Dittmer, Fall semester). MCRO711 is the most advanced Virology class offered by the Department of Microbiology & Immunology. One goal of MCRO711 is to help students transition from structured, class-based knowledge acquisition into the less structured reality of research where knowledge is obtained from original sources such as the primary research literature. MCRO711 starts with a one-week refresher in statistics, in particular those concepts that are applicable to virology and systems biology. Quantitative analyses are increasingly important in modern virology and MCRO711 provides one resource for our students to acquire those skills.

MCRO711 is team-taught and organized around two to three themes per semester. The specific content changes based on faculty interest, availability, and recent discoveries, but from 2005 to 2009 included some aspect of advances in HIV research, innate immune response to viral infection, and viruses and human cancer each year. Two to six primary research publications are discussed during each class. The papers are provided one week in advance and every student is expected to understand, present and critically evaluate any aspect, e.g. a particular figure, of all assignments. Textbooks suggested for background reading include Kaufman, Medzhitow, Gordon "The Innate Response to Infection", ASM Press 2004; Flint, Enquist "Principles in Virology", ASM Press 2008; Fields "Virology, 4th", Lippincott, Williams, & Wilkins 2001; and Damania, Pipas "DNA Tumor Viruses", Springer 2008.

MCRO711 has a midterm and a final exam. The exams are take-home writing assignments, either reviews of primary literature or a short proposal following the new NIH R21 format. Half of the course grade is based on both exams, with the remaining 50% on class participation. MCRO711 was held three times in the past five years (Appendix B3), and was cancelled twice due to lack of student interest.

MCRO712 Seminar/Tutorial in Immunology (Fall & Spring semesters). MCRO712 is taught each semester, with the topic chosen by the instructor (Table II-3, next page). The primary and joint immunology faculty meet periodically to schedule teaching assignments into the future, with everyone expected to take a turn. Inclusion of a writing assignment is at the discretion of the instructor.

Table II-3. MCRO712 Seminar/tutorial in immunology topics

Semester	Topic	Instructor
Fall 2005	Immunoregulatory effector cells	Tisch
Spring 2006	Immune responses to chronic infections	Su
Fall 2006	Post-translational modification of proteins	Klapper
Spring 2007	Autoimmunity	Markovic-Plese
Fall 2007	Immune responses to bacterial infection	Frelinger
Spring 2008	Innate immunity: infection and inflammation	Ting
Fall 2008	B and T cell tolerance	Clarke
Spring 2009	Effector T cells and immune diseases	Wan
Fall 2009	Type I Interferon and innate immune response mediated regulation of adaptive immune response in the context of autoimmune diseases	Markovic-Plese
Spring 2010	Immune responses to persistent virus infection	Su

MCRO795 Research Concepts (Course Director Marshall Edgell, Fall semester). MCRO795 is an intensive class in writing research proposals, with a focus on achieving clarity through relentless logical consistency. The course is only open to Microbiology & Immunology students and is typically taken in the Fall semester of the second year, just prior to beginning preliminary examinations. The central philosophies of MCRO795 are:

- Improvement in writing is best achieved through frequent practice with extensive, detailed feedback.
- A short writing assignment is sufficient to reveal writing deficiencies. Furthermore, brevity facilitates extensive feedback.
- The Specific Aims page contains the essential logical elements of a research proposal, so once the Specific Aims page is satisfactory it is relatively easy to write the rest of the proposal.
- A "fill-in-the-blanks" template forces the author to confront the logically difficult parts of their proposal and make changes that usually improve the project.

Students submit a writing assignment of about one page by email each Thursday. Two faculty members then critique/edit each assignment by writing detailed changes and comments directly into the electronic file. All corrected assignments are distributed to everyone, so students can benefit from inspection of writing other than their own. The class meets for an hour and a half each Monday afternoon to answer student questions, discuss examples of good and bad writing from the week, and talk about the next step in the proposal. The cycle then repeats, with the next week's assignment to revise previous text in response to critiques as well as add new material. During the first half of the course, all students write a proposal of their own creation building off of a published journal article chosen by the faculty. Starting from a common point facilitates discussion as students wrestle with similar issues. In the second half of the semester, students think and write about their own research.

MCRO795 is team taught and requires substantial faculty time commitment to write 24 detailed reviews per student per semester (course faculty collectively wrote over 500 reviews in Fall 2009). There is faculty consensus that the effort is worth it, because

both student and faculty writing clearly improves due to participation in the course. Because the amount of "red ink" typically does not diminish even though writing improves, students receive a "word grade" (Poor, Fair, Good, Very Good, Excellent, Outstanding) each week to help track the quality of their writing. However, students are not graded on writing quality, but only on whether or not assignments are submitted on time and follow the format rules, which change each week. Three late or incorrectly formatted assignments results in a grade of Low Pass for the semester, which is serious because nine units of Low Pass make a student academically ineligible to continue in the UNC Graduate School. The grading scheme is designed to give students the freedom to experiment with different writing styles while making the point that failure to properly format or submit grant applications on time has painful consequences in the real world (e.g. proposal returned without review).

The last assignment is for the students to critically evaluate the course and the instructors. Students may love the course or hate it, but since MCRO795 began in 2002 only one student has said that their writing did not improve as a result. Every year, some aspect of the course has been modified in direct response to student feedback from the previous year.

MCRO701 (Fall)/MCRO702 (Spring) Seminar in Microbiology. All students in Microbiology & Immunology are enrolled in MCRO701 and MCRO702 each year and are required to attend at least two-thirds of the weekly departmental and student seminars for as long as they are in our department. Required seminar attendance was instituted in 2009-10 as a way to ensure that all students receive a broad exposure to modern microbiology and immunology research within the constraints of the BBSP timetable. Because BBSP students do not join a department until after their first year, it is difficult to impose common course requirements on all students without pushing courses into the third year and interfering with thesis research. The hope is that all students (and faculty) try to attend all seminars; the two-thirds requirement makes allowances for absences due to travel, illness, etc. and ensures that students are exposed to seminars outside their area of expertise. Seminars also provide an opportunity to build department community.

Faculty speakers give seminars on Tuesday mornings, with breakfast pastries and coffee/juice provided. A seminar committee divides up the available slots among the four research areas of the department (immunology; microbial pathogenesis; virology; molecular, structural, and computational biology) to ensure balance. Most speakers are from outside the area, with a few from local institutions or UNC. Appendix B4 lists all departmental seminars for the past five years. We are fortunate to have in our department two Burroughs Wellcome Fund Investigators (Miriam Braunstein, Blossom Damania) as well as two faculty who advise the Burroughs Wellcome Fund (Bill Goldman, Virginia Miller). Each faculty member with a Burroughs Wellcome Fund connection can host one seminar by a Fund award winner each year with the costs subsidized by the Fund. Our seminar series also includes the annual Bassford Memorial Lecture (Appendix B5), which is organized and hosted by the graduate students in honor of former department faculty member Phil Bassford. In addition, the postdoctoral scientists invite and host one seminar speaker each year.

Student seminars are held at noon on Thursdays with pizza and sodas provided. All Microbiology & Immunology students in the third year and above are required to speak each year. To help build community, non-departmental students working in departmental laboratories were offered the opportunity to speak in the series beginning in 2009. In 2009-10, the seminar series had 32 Microbiology & Immunology students, six non-departmental students from UNC (in Genetics & Molecular Biology, Oral Biology, and Toxicology), and three Washington University students completing their degrees with UNC faculty. In 2010-11, the seminar series will include 49 Microbiology & Immunology students, five non-departmental students from UNC (in Biochemistry & Biophysics, Genetics & Molecular Biology, and Toxicology), and three Washington University students. Appendix B6 lists all student seminars for the past five years.

Students who do not meet the minimum attendance requirement are given a grade of Incomplete, which can be converted to Pass by extra attendance in the following semester. If course work (i.e. attendance) is not made up within one year, then the UNC Registrar automatically converts grades of Incomplete to Fail. A single grade of Fail makes a student academically ineligible to continue in the UNC Graduate School.

Teaching Assistant requirement. Ph.D. students are required to act as teaching assistants for two semesters, typically for one semester in each of the second and third years. Although the Department of Microbiology & Immunology is part of the School of Medicine, for historical reasons it is a department responsibility to provide microbiology courses for large numbers of pre-nursing and pre-pharmacy undergraduates (MCRO251/MCRO255) as well as dental students (MCRO515). Course enrollments are shown in Appendix B7. Microbiology & Immunology students typically act as laboratory TAs and give short lectures prior to each laboratory session, assist during the laboratory, grade lab reports, compose and grade quizzes and lab practical exams, etc. The TAs primarily work under the direction of Teaching Lab Coordinator Bruce Alexander, but also to some extent with MCRO251/MCRO255 Lecturer Lorraine Cramer.

Prior to BBSP, it was sometimes difficult to find enough students to staff all three courses. We now have the opposite problem. Roughly speaking, to meet our two Teaching Assistantship requirement, we need as many Teaching Assistant slots as the sum of the number of second- and third-year students. In 2010-11, however, the sum of second- and third-year students is 40 (Table I-2), but we have only 30 teaching positions. We now use more Teaching Assistants per class than in the past, which diminishes the teaching experience for each student. MCRO251/MCRO255 uses 12 laboratory Teaching Assistants (four per lab section of up to 80 students) and two lecture TAs per semester, for a total of 28 per year. In addition, for the first time in 2010-11, two Microbiology & Immunology students are acting as Teaching Assistants for the lecture and laboratory portions of the undergraduate BIOL422 Microbiology course offered by the Biology Department. This provides an opportunity for Microbiology & Immunology students who want a much more extensive teaching experience, with stipend, tuition, and fees for the semester paid by the Biology Department. However, we have not yet fully resolved how to reconcile our two

semester Teaching Assistant requirement with the increased number of graduate students from BBSP.

Doctoral preliminary examinations. The UNC Graduate School specifies that Ph.D. students must take both written and oral preliminary examinations, but leaves the format to the discretion of the degree-granting unit. Generally speaking, common written examination formats fall into three categories: testing comprehension of a specific body of knowledge and/or critical evaluation of scientific papers, thesis proposals, or non-thesis research proposals. The first category has the advantage that all students take the same examination, but offers little training benefit. For thesis proposals, the time invested directly benefits the thesis project, but the initial ideas typically arise from the faculty mentor rather than the student. We wish to evaluate student ideas and therefore employ a non-thesis proposal.

It has long been the practice of the Department of Microbiology & Immunology to use the preliminary examinations as an opportunity for a significant educational experience. The process starts in mid-February, when students begin to formulate ideas for two original research proposals. Students choose two faculty members to help develop each topic, but are free to talk to anyone about their ideas. Topic selection meetings are held by late April to ascertain whether or not a student has thought of two viable research topics. If so, the committee chooses the topic about which the student will write, but does not tell the student. Until 2009, students were not allowed to propose topics in any way related to actual or proposed research in their lab. In an attempt to capture some of the investment of exam time for the benefit of thesis research, the rules on topic selection changed in 2010. Students are still prohibited from topics that involve actual, planned, or discontinued research in their labs (because the ideas for such projects came from other people), but are required to have at least one topic that is plausibly related to the research in their laboratory (e.g. involves the same bacterium, virus, immune cell type, disease, etc.). As expected, there was some confusion as we sought to define how a potential topic could be close enough to satisfy the new requirement but not too close to research in a student's laboratory to be derivative. We anticipate the boundary will become clearer with experience.

The chosen topics are revealed to the students on the first day of the five-week writing period, which begins after Spring semester final exams are complete. Not knowing the topic in advance ensures all students write their proposal (12 pages in the format of a NIH R01 application) during the same time. Students are free to discuss their ideas with anyone, and frequently correspond with the authors of the papers that serve as the foundation for their proposals. The only artificial aspect of the process is an absolute ban on receiving any help with the actual writing. Guidelines and advice for topic selection and the written exam are reproduced in Appendices B8-B10.

Faculty hold a Study Section meeting in July to assign grades to each proposal. In addition to the two faculty reviewers chosen by the student during the topic selection process, each proposal is assigned a common reader to ensure equitable treatment across multiple proposals. If an initial reading raises doubt among any of the three reviewers that a proposal might not Pass, then two extra readers as well as the Prelim

Exam Advisor also read the proposal prior to the Study Section meeting. Thus, no student should receive a non-passing grade unless at least six faculty members have read the proposal and can offer their informed opinions. Four grades are possible. Honors is not awarded every year and is generally reserved for proposals of sufficient quality to be discussed (i.e. not triaged) at a real NIH Study Section. Pass is a very broad category ranging from excellent to barely acceptable. Incomplete means the science is basically sound but there is a limited deficiency in the proposal, which the student attempts to correct during a month long rewrite period, after which the proposal can be given a final grade of Pass or Fail. However, no proposal initially designated as Incomplete has received a final grade of Fail in at least the past 15 years. Proposals with pervasive weaknesses earn a grade of Fail. Students who fail the written preliminary exam typically take the exam again the following year, although in 2010 we created an option for a "fast track" retake in limited circumstances (Appendix B11). If a student fails either the written or the oral preliminary examination twice, then he or she is academically ineligible to continue in the UNC Graduate School.

After passing the written examination, students take the oral examination, which centers on the written proposal. The oral exam committee consists of the two original reviewers of the written exam, a common reviewer assigned to multiple exams to ensure fair treatment, and two additional members who typically may be under consideration for inclusion on the student's thesis committee. The oral examination usually lasts about 90 minutes and primarily explores student understanding of the experimental methods employed in the written proposal. Student responses to problems identified during the review of the written exam, experimental design, data interpretation, and recent developments in the field are also covered. Guidelines and advice for the oral preliminary examination are given in Appendices B12 and B13. Failure on the oral exam is much rarer than for the written exam, and no student in living memory has failed the oral exam twice.

Preliminary examinations in the Department of Microbiology & Immunology consume a large amount of student and faculty time. Although strenuous, students generally look back on the experience with a feeling of accomplishment. Faculty, having carefully considered how they wish to structure the exam, generally support the process with a generous commitment of their time, which is substantial. For example, 116 faculty topic selection assignments for 29 students who began the written preliminary examination in 2010 were handled by 43 departmental faculty (27 primary and 16 joint), as well as nine non-departmental faculty. The 28 students who completed the exam ultimately required 141 reviews of written proposals, which were completed by 38 departmental (28 primary and 10 joint) and four non-departmental faculty. The 25 students taking their oral examinations in Fall 2010 will need 125 oral exam committee members. It is typical of our department that the Prelim Exam Advisor had no difficulty finding faculty volunteers to promptly fill all common and extra reviewer assignments for written and oral exams.

Thesis committee. Students must choose a thesis committee and a chair by the end of the fall semester of the third year. An important change made in 2009 was to explicitly uncouple forming and meeting with a thesis committee from passing preliminary examinations. Previously, students who had not passed their preliminary

exams (even if the exam was delayed for a year due to health issues, childbirth, etc.) were effectively denied outside advice on their research, which was counterproductive. The roles of research advisor and thesis committee chair were separated in 2010 as a proactive measure to protect the student in the rare cases of conflict between student and research advisor. Complete rules for thesis committee composition and chair duties are given in Appendix B14. Students must meet with their committee to approve their thesis project by March 31st of their third year, a date chosen to avoid conflict with faculty scheduling of topic selection meetings for students taking preliminary examinations. Students are required to meet at least annually with their thesis committees and provide brief written progress reports at each meeting.

Doctoral final examination. Our stated goal (not requirement) is that Ph.D. students will conduct sufficient research for at least two first author papers in high-quality refereed journals, either published or submitted. The Ph.D. thesis usually consists of a student's papers, preceded by a substantial introductory chapter that provides a scholarly introduction to the field and followed by a brief concluding chapter to put the results in perspective and suggest future directions. After the thesis is written, the Department of Microbiology & Immunology requires both a private oral defense and a public seminar. The historical practice of our department has been for the candidate to give a public seminar, followed immediately by a private defense in front of the thesis committee, and a subsequent public celebration. However, beginning in Fall semester 2010, we reversed the order and separated the two phases of the doctoral final examination out of concern that having the public seminar first, which is often attended by out-of-town family and friends, could negatively impact the professionalism of the oral defense and make it difficult for the thesis committee to fail or delay a student who is not ready to graduate. The private oral defense now must occur at least two weeks prior to the public seminar.

B. M.D./Ph.D. Curriculum

M.D./Ph.D. students have a curriculum similar to Ph.D.-only students, with two notable differences. First, M.D./Ph.D. students do their rotations during the summers before and after their first year of medical school. They then join their thesis laboratory in the summer after their second year of medical school, following completion of their board exams. Second, the degree requirements are modified slightly to reflect medical school course work and a goal of Ph.D. degree completion in four years. M.D./Ph.D. students are required to complete three classes, one of which must be a seminar/tutorial (instead of six classes, including two seminar/tutorials). Furthermore, M.D./Ph.D. students complete one semester as a Teaching Assistant rather than two, and their teaching is done in the MCRO515 dental microbiology course, rather than the undergraduate microbiology courses.

Students who enter the department with a M.D. degree are expected to fulfill the same requirements as M.D./Ph.D. students.

C. M.S. Curriculum

M.S. requirements of the UNC Graduate School. UNC Chapel Hill imposes the following minimum requirements on all M.S. degrees:

- Minimum residence of two full semesters of at least nine hours credit, by either full or part-time registration
- A written or an oral comprehensive examination
- If a thesis is required, then a final oral examination on the thesis may be required

Each academic program specifies additional requirements.

Department of Microbiology & Immunology M.S. degree requirements.

Requirements for the M.S. degree in our department overlap with Ph.D. requirements. For example, class, seminar attendance, student seminar presentation, and final defense requirements are the same. The three key differences are:

- There is no Teaching Assistant requirement for the M.S. degree.
- A written, but no oral, preliminary examination is required. The written examination (Appendix B15) consists of questions about course work and the student's area of research, and is completed over a 48-hour period. Questions are written by members of the thesis committee and go beyond factual recall to involve experimental design, interpretation of the literature, etc. Alternatively, passing the Ph.D. written preliminary examination fulfills this requirement.
- The scope (but not the quality) of research expected is reduced, with a goal of one first-author publication.

Two tracks to the Microbiology & Immunology M.S. degree. The M.S. is a terminal degree in our department and does not lead to a Ph.D. There are two tracks to our M.S. degree. One path, described in Appendix B16, is for students admitted to the Ph.D. program who do not complete the predoctoral requirements and decide to earn a M.S. instead. Ph.D. students can easily switch onto this track at any time, although it is infrequently done.

The second track is intended for full-time laboratory technicians in the department. The special Master's program (Appendix B17) was created in about 1990 to provide graduate training for well-qualified technicians who were unable to be full-time students. The program provides technicians with an opportunity for career and educational advancement. From the perspective of the employing laboratory, the M.S. program likely enhances the intellectual and scientific engagement of technicians in their daily work and also retains valuable and productive employees while they complete their degree. Before applying for the special Master's program, a technician must be employed full-time for at least one year in the laboratory of a departmental faculty member and complete a graduate level class in our department with a grade of Pass or higher. Thesis research projects are expected to be independent graduate level work distinct from technician duties and carried out in addition to the regular 40-hour work week. Miriam Braunstein acts as advisor for students in the special Master's program.

D. Postdoctoral Training

The Department of Microbiology & Immunology has traditionally considered postdoctoral training to primarily be the responsibility of individual laboratories rather than the department, although some postdoctoral scholars are supported by training grants. Initial efforts to improve the departmental contribution to postdoctoral training began at a faculty meeting in February 2009 and are ongoing. However, we have not yet invested anywhere close to the same amount of thought and discussion in consideration of how best to train postdoctoral scholars as we have in our approach to graduate student education.

The first challenge was to identify all postdoctoral scientists associated with our department. As a result, pictures of postdoctoral scholars are now included on our department website and bulletin board, along with faculty and student photographs. However, we still do not have a satisfactory system to accurately keep track of postdoctoral scholars in our department.

Microbiology & Immunology Postdoc Association activities. Virginia Miller volunteered to act as our first postdoctoral advisor and encouraged postdoctoral scholars in the department to form a Postdoc Association (Appendix B18). Eric Weening (Miller lab) is the current president and is assisted by Corrine Williams (Goldman lab). The Postdoc Association organizes various activities to benefit postdoctoral scholars in our department, as described below:

The postdoctoral association holds monthly meetings with guest speakers. Meeting topics in 2009-10 included:

- "Jobs outside of academia", with speakers Rob Fulcher and Jennifer Kuhns. Both are graduates of our department who now work for Becton-Dickinson.
- "The job interview process from a candidate's perspective", with new faculty member Rita Tamayo and postdoc Matt Lawrenz (Miller lab), who had just accepted a faculty position at another university.
- "The job interview process from the perspective of the Chair and search committee", with department Chair Bill Goldman and search committee chair Tom Kawula.
- "The manuscript review and editorial process" with Peggy Cotter (editor, *Molecular Microbiology*) and Ron Swanstrom (editor, *Journal of Virology*).

The first meeting in 2010-11 will feature Lecturer Lorrie Cramer and discuss teaching.

The Postdoc Association organized and held the first annual departmental Postdoc Research Symposium in November 2009 (Appendix B19), which included corporate sponsors (scientific supply companies and local restaurants) for refreshments and prizes. The prize winners for the best talks were Chelsea Lane (Miller lab) and Sun Ah Kang (Vilen lab). Plans are well underway for the second annual symposium to be held November 12, 2010.

The association invited and hosted a departmental seminar in 2009-10 by bacteriologist Ralph Isberg from the Department of Molecular Biology & Microbiology at Tufts University. Immunologist Michael Starnbach from the Department of Microbiology

& Molecular Genetics at Harvard Medical School has accepted an invitation from departmental postdoctoral scholars to speak in 2010-11.

Postdoctoral scholars at UNC Chapel Hill. Historically, postdoctoral scholars have "fallen through the cracks" at many institutions, being considered neither faculty, students, nor staff. UNC Chapel Hill has been proactive in establishing policies and support systems for postdoctoral scholars and in 2005 was named by *The Scientist* magazine as the best place for postdocs to work among U.S. academic institutions. Two key UNC policies are designed to prevent exploitation of postdoctoral scholars. One is a five-year limit on postdoctoral employment, after which scholars must either be promoted to a permanent position or leave UNC. The second policy is a minimum stipend of \$36,282, with a strong recommendation to follow the NIH postdoctoral stipend scale.

The UNC Office of Postdoctoral Affairs (<http://postdocs.unc.edu/>) offers a variety of services for postdoctoral scholars. For example, the office presents professional development workshops throughout the year on topics such as Interviewing & Negotiating; Networking 101: Getting to the Next Level in Your Career; Legal Issues for International Postdocs; and Marketing Your Credentials: Writing CVs and Cover Letters. In addition, the office provides individual career counseling and career assessments to facilitate career and professional development. There is also a campus wide Postdoctoral Association. Microbiology & Immunology postdoc Jim Fuller (Richardson lab) served on the Postdoctoral Association leadership team.

Section III - Graduate Students & Postdoctoral Scholars

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III. GRADUATE STUDENTS & POSTDOCTORAL SCHOLARS

This section describes who our graduate students and postdoctoral scholars are, where they come from, how they are financially supported, what they accomplish while they are in our department, and where they go after they complete their training at UNC.

A. Who Are UNC Microbiology & Immunology Graduate Students?

Admission to the Department of Microbiology & Immunology. Graduate student admissions to UNC are not under the control of the Department of Microbiology & Immunology. Rather, students are admitted through either the BBSP umbrella program for Ph.D.-only students or the School of Medicine M.D./Ph.D. program. Department members serve on admissions committees and actively participate in the recruiting process. Following three laboratory rotations in their first year, BBSP students wishing to join the Microbiology & Immunology Ph.D. program are considered by the Director of Graduate Studies on a case-by-case basis. Students whose chosen research advisors have Microbiology & Immunology faculty appointments are automatically approved, whereas students without departmental research advisors are rarely allowed to join our Ph.D. program. Currently, two of 67 Microbiology & Immunology Ph.D. students have research advisors who are not department members. One student joined our program with a non-departmental advisor whereas the other switched to a non-departmental lab two years after joining our department.

Undergraduate characteristics of Microbiology & Immunology students. Almost all (60/67) current Microbiology & Immunology students earned their bachelor's degree in a biological science, with Biology being the most common major (Appendix C1). Current students came to our department from 57 different colleges and universities, mostly in the United States (Appendix C2). Students graduated from institutions located all over the United States, with the most frequent states being Pennsylvania (nine students), California (eight students), Maryland (seven students), North Carolina (six students), and Virginia (four students). The California contribution is an aberration largely attributable to six students transferring from UC Davis and UC Santa Barbara with newly recruited faculty members. Average GPA and GRE scores (verbal plus quantitative) of incoming students for the past five years are given in Table III-1 (next page). There does not appear to be any consistent trends in these scores over time, nor are there significant differences between direct departmental admissions and the BBSP route. However, BBSP has had other substantial impacts on our graduate student population, as described in the following paragraphs.

Table III-1. Average scores of incoming graduate students

Entering Year	Admissions Route	<u>Applicant Pool</u>		<u>Microbiology & Immunology Students</u>	
		GPA	GRE	GPA	GRE
2005	MCRO	3.5	1235	3.7	1235
2006	MCRO	3.5	1242	3.4	1291
2007	MCRO	3.4	1236	3.5	1232
2008	BBSP	3.5	1254	3.4	1224
2009	BBSP	3.5	1257	3.5	1277

Racial diversity of Microbiology & Immunology students. At the time of the 1999 self-study, among 43 Microbiology & Immunology students, there was one (= 2%) African-American student, two (= 5%) Hispanic students, and five (= 12%) Asian students. Similarly, the combined Ph.D. programs that now make up BBSP had about 6% underrepresented minority students in 2007. The BBSP umbrella admissions route dramatically increased the proportion of underrepresented minorities entering biomedical Ph.D. programs at UNC, with 17% in the 2008 BBSP class, 22% in 2009, and 22% in 2010. As a result, the diversity of Microbiology & Immunology students has increased substantially and is likely to continue to do so as BBSP students replace students who had been admitted directly to the department. The current population of 67 Microbiology & Immunology Ph.D. students includes six (= 9%) African-American students (6/6 from BBSP), two (= 3%) Hispanic students (1/2 from BBSP), and five (= 7%) Asian students (1/5 from BBSP). Our current second- and third-year students, who mostly entered via BBSP, are considerably more diverse (7/40 = 18% underrepresented minorities) than our fourth-year and above students (1/27 = 4%), who mostly came via direct admission to the department.

Gender diversity of Microbiology & Immunology students. At the time of the 1999 self-study, graduate students in the Department of Microbiology & Immunology were evenly split between genders (21/43 = 49% female). Since then, our student population shifted to a preponderance of females and is currently 49/67 = 73% female. BBSP students entering UNC are enriched for females (65% in 2008, 55% in 2009, 59% in 2010) and the BBSP students who chose Microbiology & Immunology (13/19 = 68% in 2008, 10/15 = 67% in 2009) have been more female than the BBSP first-year class as a whole. Nevertheless, the umbrella BBSP program is once again shifting our student population to be more reflective of society as a whole. Leaving out seven transfer and four M.D./Ph.D. students to make a direct comparison, our current second- and third-year students who entered via BBSP are 23/34 = 68% female whereas our fourth-year and above students who came via direct admission are 18/22 = 82% female.

International Microbiology & Immunology students. Historically, the number of international students in the Department of Microbiology & Immunology has been very limited due to restricted sources of financial support, although tuition remissions are available for international students. BBSP has a target of 10% international students and has been successful in meeting their goal (13% in 2008, 10% in 2009, 12% in 2010). Currently, our department has 5/67 = 7% international students, with four of our five international students entering via BBSP. Our current second- and third-year students, who mostly entered via BBSP, are 4/40 = 10% international whereas than our

fourth-year and above students, who mostly came via direct admission to the department, are $1/27 = 4\%$ international. We therefore expect that the proportion of international students will continue to increase as directly admitted students graduate and students admitted through BBSP take over the department.

B. The UNC Microbiology & Immunology Graduate Student Experience

Academic support. UNC offers a variety of resources to help graduate students succeed academically. The Office of Biomedical Graduate Education runs the Training Initiative in Biological and Biomedical Sciences (TIBBS) program (tibbs.unc.edu), which is available to all graduate students (as well as postdoctoral scholars and staff). The same office also runs an Initiative for Maximizing Student Diversity (IMSD) NIH training grant that focuses on support for underrepresented minorities. The UNC Graduate School offers a variety of professional development programs open to all students (gradschool.unc.edu/student/profdev/).

UNC Graduate School policy is that students who receive a grade of F in any course, or L grades in nine or more credit hours of classes, become academically ineligible. However, no student in living memory has failed out of the Microbiology & Immunology Ph.D. program due to poor classroom performance. Instead, the major academic barrier to staying in our program is the written preliminary examination. Historically, about 20% of students fail the Department of Microbiology & Immunology written exam on their first attempt, and about one third of those who retake the exam fail on their second attempt. UNC Graduate School policy is that students who fail the exam twice are not academically eligible to continue. Therefore, we have multiple strategies at the departmental level to help students adequately prepare and succeed in their preliminary examinations. First, most of our classes have a writing component, as described in the Curriculum section. Second, almost all students take the MCRO795 proposal writing class in the Fall semester of their second year, which is exclusively intended for students preparing to take our preliminary examinations. At the end of MCRO795, the few students whose quality of writing remains problematic are alerted to their situation and specifically encouraged to obtain additional writing practice prior to the exam. Third, the preliminary exam is delayed on a case-by-case basis for students in difficult circumstances (e.g. health issues, recent parenthood, weak academic preparation) until their individual situation improves. Finally, any students who fail a preliminary examination meet with the Prelim Exam Advisor and jointly devise a plan to enhance the chance of passing the second attempt. As described below in the paragraphs on graduation statistics, attrition in our program is rare and there is no evidence that any graduate student subpopulation (e.g. underrepresented minorities, females, international students, M.D./Ph.D. students) is overrepresented among students who fail a preliminary examination or leave our program without earning a Ph.D.

Graduate student financial support. A key prerequisite for successful umbrella admission programs is that all students in all participating departments are paid equally. Equal pay has been the case in the biological sciences at UNC since the inception of the IBMS program and continues under BBSP. Graduate student stipend amounts are

shown in Table III-2. In addition to a stipend, tuition, fees, and health insurance are covered for all Microbiology & Immunology graduate students.

Table III-2. UNC Chapel Hill biomedical sciences graduate student stipend amounts

Academic Year	Stipend Amount
2005-06	\$22,000
2006-07	\$23,000
2007-08	\$24,000
2008-09	\$25,000
2009-10	\$26,000
2010-11	\$26,000
2011-12	\$27,500 (planned)

BBSP pays for first-year students from August until June. About one-third of BBSP funding comes from payments by the various departments and centers that house students, based on a running average of the laboratories joined by past BBSP students. The remainder of BBSP funding comes from the Dean's office of the School of Medicine, the University Cancer Research Fund, Graduate School fellowships, training grants, etc. Student support after leaving BBSP is guaranteed by the head of the administrative unit (e.g. department or center) that administers the funds supporting the student's laboratory. For example, the Department of Microbiology & Immunology guarantees support for all graduate students in department labs in the Mary Ellen Jones Building regardless of whether or not those students are part of our Ph.D. program. Similarly, Microbiology & Immunology students housed in the Lineberger Comprehensive Cancer Center or the Center for AIDS Research have support guaranteed by their centers, not our department.

After joining their thesis laboratories, most ($45/67 = 67\%$) current Microbiology & Immunology students are supported by research grants awarded to their advisors. Most of the rest ($16/67 = 24\%$) are funded by training grants (summarized in Table III-3 on the next page and described in following paragraphs). Three students are sustained by start-up funds to new faculty, one is funded by her administrative unit (UNC Kidney Center), and two have individual fellowships. After joining our department, all non-international students are strongly encouraged to apply for North Carolina residency to become eligible for in-state tuition, and to continue applying for residency until successful. In recent years, the UNC Graduate School has been able to provide sufficient tuition remissions to cover the extra cost of out-of-state tuition for all of our non-resident students.

Table III-3. Current training grant support for Microbiology & Immunology students

Grant Topic	Principal Investigator	Department /Center	# Students Supported
Arthritis & Immunology	Joanne Jordan	Thurston Arthritis Research Center	1
Basic Immunology	Jenny Ting	Microbiology & Immunology	2
Cancer Cell Biology	Channing Der	Lineberger Comprehensive Cancer Center	1
Gastroenterology	Balfour Sartor	Medicine	1
Immunology	Luis Diaz	Dermatology	2
Sexually Transmitted Disease/AIDS	Fred Sparling	Medicine	1
Translational Medicine	Virginia Miller	BBSP	3
Virology	Ron Swanstrom	Center for AIDS Research	5

Basic immunology training grant. Jeff Frelinger initiated our "Basic Immune Mechanisms" training grant (T32AI007273) and was the Principal Investigator for 25 years, with the assistance of Barb Vilen as co-Principal Investigator for the last five years. With Dr. Frelinger's departure from UNC, Jenny Ting has taken over as Principal Investigator and the training grant was recently renewed. There are currently four slots for Ph.D. students and two slots for postdoctoral scholars. There are also two slots for M.S. students at North Carolina Agricultural & Technical State University, a historically black institution in nearby Greensboro, as part of a collaborative effort to increase minority students in science. Of the 22 faculty on the basic immunology training grant, nine have primary and 10 have joint appointments in our department.

Virology training grant. The "Molecular Biology of Viral Disease" training grant (T32AI007419) was initiated by Bob Johnston. Ron Swanstrom took over as Principal Investigator after the first five years, and Jennifer Webster-Cyriaque became co-Principal Investigator in 2008. The training grant is now in its 18th year, and has expanded from two to seven predoctoral slots, with one slot supported by UNC matching funds for cancer virology. Twenty of the 22 training faculty have primary or joint appointments in our department.

Bacterial and eukaryotic pathogens training grant application. We recently submitted a revised application to NIH for a T32 predoctoral training program in bacterial and eukaryotic pathogens, with Bill Goldman as Principal Investigator/Director and Miriam Braunstein as Associate Director. Of the 16 faculty affiliated with the proposed training program, nine have primary appointments and five have joint appointments in the Department of Microbiology & Immunology. Support was requested for six slots. The proposed training program will include laboratory research, a core classroom curriculum, engagement in the scientific community, and professional development activities. Critical thinking and communication skills will be emphasized in all aspects of the program.

Translational medicine. The Howard Hughes Medical Institute Med-into-Grad Initiative supports the UNC Graduate Training Program in Translational Medicine. The program matches students with clinical co-mentors and leads to a certificate. The program began in 2006 and recently renewed funding. Virginia Miller directs the program. At least six Microbiology & Immunology students have participated.

Individual fellowships. Lauren Neighbours (Heise lab) was one of 200 students nationally awarded a three year National Defense Science & Engineering Graduate Fellowship in 2010. This is a highly competitive award, as only ~5% of NDSEG applications in the biosciences are successful. M.D./Ph.D. student Erin Steinbach (Plevy lab) received a five-year F30 fellowship from NIH in 2010. Tabb Sullivan (Braunstein lab) is the recipient of a five-year Morehead Fellowship from UNC that paid a substantial amount of support in his first year. Three students who graduated in the past five years had individual NIH support while in our program. Cathy Cruz was awarded a F31 fellowship and Shehzad Sheikh, who entered our program with a M.D., won a F32 fellowship. Meg Scull earned a R36 dissertation research grant.

Ph.D. degrees earned. In this self-study, we chose to track Ph.D. degrees based on the date of the final defense, rather than actual graduation date. The defense date marks completion of virtually all degree work (only submission of a corrected thesis remains), and provides much greater temporal resolution than the three (May, August, December) yearly graduation dates. Over the five-year period from 2005-06 to 2009-10, 65 Ph.D. degrees were earned by Ph.D.-only and M.D./Ph.D. students in the Department of Microbiology & Immunology. Annual totals are given in Table III-4 and individual degrees are listed in Appendix C3.

Table III-4. Department of Microbiology & Immunology Ph.D. degrees, past five years

Fiscal Year of Defense Date	Number of Degrees
2005-06	4
2006-07	16
2007-08	15
2008-09	12
2009-10	18

Publication record of Ph.D. students. Our stated goal is that Ph.D. students will conduct sufficient research for two first-author papers in high-quality, peer-reviewed journals. Actual publication statistics are given in Tables III-5 and III-6 (next page) for Ph.D.-only and M.D./Ph.D. students respectively. (Note that these numbers represent a lower bound, as recently graduated students may have additional manuscripts in the publication pipeline.) The two tracks of students are indistinguishable with regard to first-author publications (Figure III-1, next page). Twenty-four of 55 = 44% of the Ph.D.-only and 4/10 = 40% of the M.D./Ph.D. graduates met the goal of at least two first-author papers. Six of 55 = 11% of Ph.D.-only and 1/10 = 10% of M.D./Ph.D. graduates had no first-author publications (Figure III-1). Ph.D.-only students published substantially more middle author primary research papers than M.D./Ph.D. students, presumably because the Ph.D.-only students stayed in the department longer (see next

section on time to Ph.D. degree). M.D./Ph.D. students did not author any review articles, presumably due to a focus on rapid degree completion to rejoin medical school.

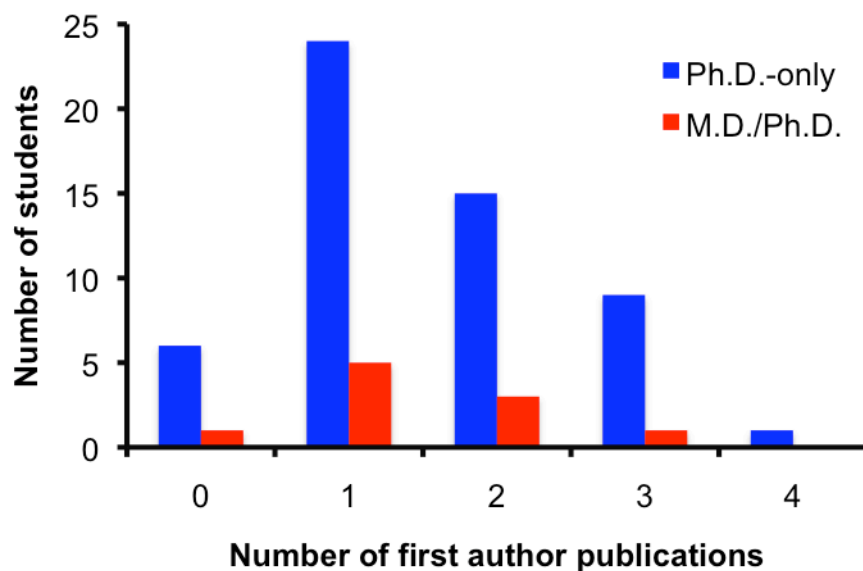
Table III-5. Publications per Department of Microbiology & Immunology Ph.D.-only graduate (n=55), 2005-06 through 2009-10

Publication Type	Mean	Standard Deviation	Minimum	Maximum
First author primary	1.5	0.9	0	4
Middle author primary	2.5	2.3	0	11
First author review	0.3	0.5	0	2
Middle author review	0.1	0.4	0	2
Total publications	4.4	3.0	1	16

Table III-6. Publications per Department of Microbiology & Immunology M.D./Ph.D. graduate (n=10), 2005-06 through 2009-10

Publication Type	Mean	Standard Deviation	Minimum	Maximum
First author primary	1.4	0.8	0	3
Middle author primary	1.1	1.1	0	3
First author review	0	0	0	0
Middle author review	0	0	0	0
Total publications	2.5	1.2	1	4

Figure III-1. First Author Publications



Manire Award. The G. Philip Manire award is given annually in honor of former department Chair Phil Manire to the senior student who conducted the most impressive and significant thesis project (Appendix C4). Recent winners are listed in Table III-7.

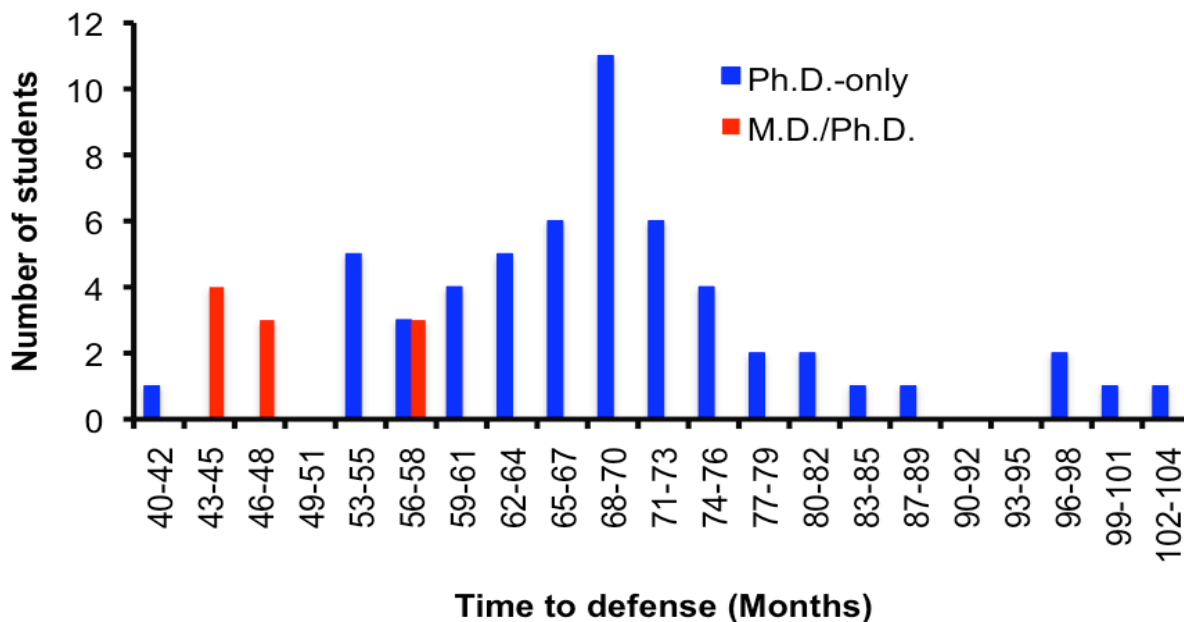
Table III-7. G. Philip Manire Graduate Student Excellence in Research Award winners

Year	Graduate Student	Research Advisor
2005	Mark Wallet	Roland Tisch
2006	Joseph Thompson	Bob Johnston
2007	No award (interim Chair)	
2008	No award (interim Chair)	
2009	Gretja Schnell	Ron Swanstrom
2010	Kwun Wah Wen	Blossom Damania

Time to Ph.D. degree. The time from entering our department until the Ph.D. defense for all students who graduated in the past five years is shown in Figure III-2 (next page). For Ph.D.-only students, statistical calculations do not include one student who entered the department with a M.D. degree and earned a Ph.D. degree in 42 months. For the other 54 Ph.D.-only students, the mean time to degree (defense) was 70 months (5 years, 10 months), the median time was 68 months, and the range was 55 to 103 months. Forty of 54 = 74% of students completed their degree in less than or equal to six years, another 9/54 = 17% were done in less than or equal to seven years, and 5/54 = 9% took more than seven years. Note that UNC has an eight-year (96 month) limit on earning a Ph.D. degree, although a student may apply for an extension due to extenuating circumstances. Changes to our program implemented in the past year (earlier dates for selection of thesis committee and thesis project approval, more vigorous enforcement of these checkpoints), coupled with our current class structure in which only 2/67 = 3% of students are in their sixth-year or above (Table I-2), suggest that it should be possible going forward to reduce the number of students who take an exceptionally long time to graduate, and perhaps modestly decrease the median time to degree as well.

M.D./Ph.D. students enter the program with more experience and typically complete their degree in shorter time than Ph.D.-only students (Figure III-2). For the ten M.D./Ph.D. students who completed their Ph.D. in the past five years, the mean time to degree (defense) was 49 months, the median was 47/48 months, and the range was 44 to 58 months. Because M.D./Ph.D. students coordinate completion of their Ph.D. degree with re-entry into the medical school curriculum, the distribution was bimodal. Seven students finished in just under four years and three students finished in just under five years.

Figure III-2. Time to Ph.D. defense



Attrition. There are several reasonable ways to estimate attrition from our Ph.D. program:

- If attrition is based on the types of advanced degrees earned in our department over the past five years, then the five students who began intending to earn a Ph.D. yet completed a M.S. represent $5/70 = 7\%$ of the total Ph.D. and M.S. degrees earned.
- If attrition is based on the fraction of students who entered our department in the past five years intending to earn a Ph.D. and are still on track, then $5/82 = 6\%$ of students have been lost (two earned a M.S., one is currently in the M.S. program, and two students left the department - one for veterinary school and one M.D./Ph.D. student who changed departments).
- The historical average is that about one-fifth of students fail the written preliminary exam on the first try, and about one-third of those who retake the exam fail on their second attempt, which would suggest a dismissal rate of about one-fifteenth $= 7\%$. This represents an estimated lower bound on attrition, because some students voluntarily leave the program without failing their preliminary exam twice.

In any case, losses from our Ph.D. program are quite low, and appear to have improved in the past decade. The 1999 departmental self-study did not report attrition statistics, but the report of the site visit team indicates a rate of about 20%.

Going back to the start of the M.D./Ph.D. program, $5/22 = 23\%$ of M.D./Ph.D. students and $22/128 = 17\%$ of Ph.D.-only students failed their written preliminary exam on the first try (from 1998 through 2010). Given the relatively small number of M.D./Ph.D. students, these failure rates are likely indistinguishable.

C. Where Do UNC Microbiology & Immunology Graduate Students Go?

Initial occupations of Ph.D. graduates. After graduation, Microbiology & Immunology Ph.D. degree recipients from the past five years engaged in a range of occupations (Table III-8). Most ($39/65 = 60\%$) pursued postdoctoral training. A significant fraction ($11/39 = 28\%$) stayed at UNC Chapel Hill, but most went elsewhere for their postdoctoral experience. The laboratories chosen for postdoctoral training (Appendix C6) were of high quality and many are located at high-profile institutions such as Harvard University, Princeton University, Rockefeller University, Stanford University, University of Washington, and Yale University. The next largest group of occupations ($14/65 = 22\%$) involved medical training. All ten of the M.D./Ph.D. students returned to medical school and two Ph.D. students went to veterinary school. Finally, $12/65 = 18\%$ of students found permanent employment in industry, government, higher education, and at a research institute. Non-postdoctoral occupations are described in more detail in Appendix C7.

Table III-8. Initial occupations of Department of Microbiology & Immunology Ph.D. recipients, 2005-06 through 2009-10

Type of position	Sector	Number
Postdoctoral training	Other academic institutions	23
	UNC Chapel Hill, different lab	7
	UNC Chapel Hill, same lab	4
	Government (NIH)	3
	Industry	1
	Research institute	1
Medical training	Medical school	10
	Medical training	2
	Veterinary school	2
Permanent	Industry	7
	Government	2
	Higher education	2
	Research institute	1

NIH postdoctoral fellowships. Of the Ph.D. graduates who moved into postdoctoral positions at other academic institutions in the past five years, $8/23 = 35\%$ have been awarded NIH postdoctoral fellowships so far (Appendix C8). This represents a lower bound for success, because some students in this cohort graduated too recently to have yet been successful in obtaining a postdoctoral fellowship.

D. UNC Microbiology & Immunology M.S. Students

M.S. degrees earned. Over the five-year period from 2005-06 to 2009-10, eight M.S. degrees were earned by students in the Department of Microbiology & Immunology. Annual totals are given in Table III-8 and individual degrees are listed in Appendix C5.

Table III-8. Department of Microbiology & Immunology M.S. degrees, 2005-06 through 2009-10

Fiscal Year of Defense Date	Number of Degrees
2005-06	2
2006-07	1
2007-08	2
2008-09	2
2009-10	1

Publication record of M.S. students. Our stated goal is that M.S. students will accomplish enough research for the publication of one first-author paper in a high-quality, peer-reviewed journal. Actual publication statistics are given in Table III-9. Four of 8 = 50% of the M.S. graduates met the goal of one first-author paper, a success rate similar to that of Ph.D. students in meeting their publication goal. Middle author contributions were more common than first-author papers and review authorship was rare. One of eight = 13% of the M.S. students graduated with no publications.

Table III-9. Publications per Department of Microbiology & Immunology M.S. graduate (n=8), 2005-06 through 2009-10

Publication Type	Mean	Standard Deviation	Minimum	Maximum
First author primary	0.5	0.5	0	1
Middle author primary	1.6	1.6	0	4
First author review	0.1	0.3	0	1
Middle author review	0.1	0.3	0	1
Total publications	2.4	2.1	0	7

Time to M.S. degree. For the five students who switched from the Ph.D. to the M.S. program, the range in time to defense was 30 to 56 months, reflecting a variety of individual circumstances. The number of students in the M.S. program is too small to make reliable conclusions, but not surprisingly it appears that switching to the M.S. program prior to attempting Ph.D. preliminary exams shortens the time to the M.S. degree, whereas beginning fulltime employment prior to writing and defending the M.S. thesis lengthens the time to degree. For the three technicians in the special M.S. program, the time to defense was 24, 25, and 42 months.

Job placement following M.S. degree. Of the eight students who earned a Microbiology & Immunology M.S. degree in the past five years, three work in the biotechnology/pharmaceutical industry (Indenix Pharmaceutical, Novartis, Syngenta), three conduct research in academic laboratories (UC San Diego, UNC Chapel Hill,

University of Pennsylvania), one is at the Food & Drug Administration, and one is a middle school science teacher.

E. Who Are UNC Microbiology & Immunology Postdoctoral Scholars?

Graduate characteristics of Microbiology & Immunology postdoctoral scholars. Most of our current postdoctoral scholars earned their doctoral degree in microbiology, immunology, or a closely related field (Appendix C9). About 20% earned a Ph.D. in biochemistry. Two postdoctoral scientists are trained in bioinformatics and one in biomedical engineering.

Current postdoctoral scholars came to our department from 39 different colleges and universities (Appendix C10). The single largest contingent (11) is from UNC Chapel Hill, and another 10 postdoctoral scientists came from Duke University, North Carolina State University, and Wake Forest University. Thus, about one-third of our postdoctoral scholars earned their Ph.D. degree at a North Carolina university. About one-quarter of our postdoctoral scholars earned their doctorate at a foreign institution. In conjunction with the overall two-fifths frequency of foreign postdocs (next paragraph), this indicates that almost half of our foreign postdoctoral scholars earned their Ph.D. at American universities. The data also suggests there is room to improve recruitment of American postdoctoral scholars to our department from outside North Carolina.

Diversity of Microbiology & Immunology postdoctoral scholars. The postdoctoral scholars in our department have a dramatically different demographic composition than the graduate student population. Only $17/59 = 29\%$ of our postdoctoral scholars are female, but $26/59 = 44\%$ are international. This is consistent with the 45% international composition of all postdoctoral scholars at UNC Chapel Hill. There are two Hispanic and one African American postdoctoral scholars, so under-represented minorities comprise $3/59 = 5\%$ of the overall postdoctoral population or $3/33 = 9\%$ of the American postdoctoral population in our department.

F. The UNC Microbiology & Immunology Postdoctoral Experience

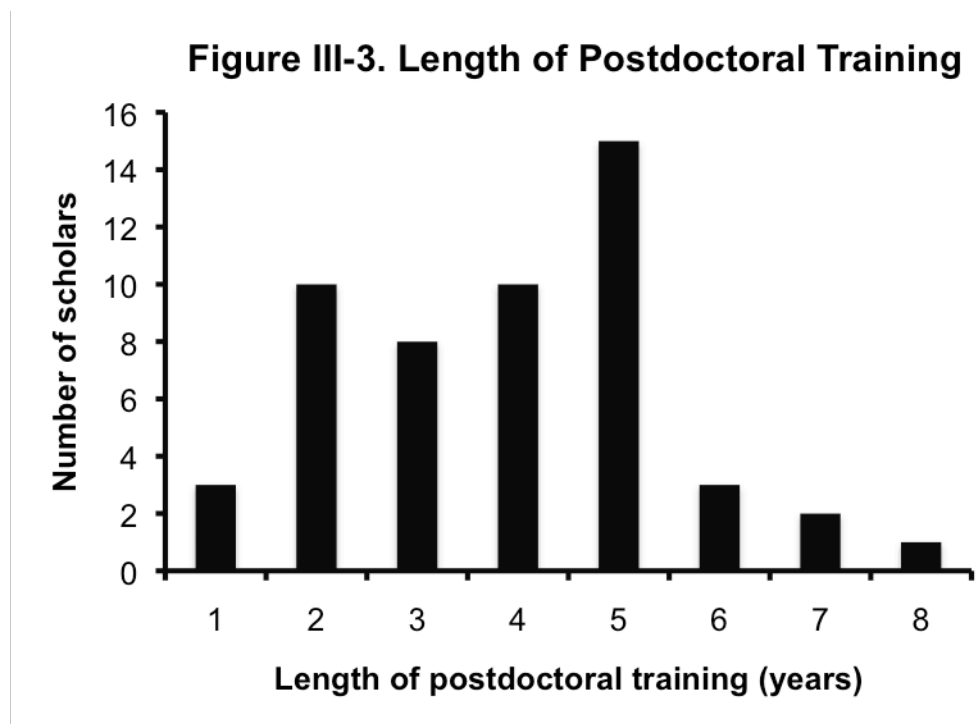
Postdoctoral scholar financial support. The sources of support of current postdoctoral scholars for whom we have data are shown in Table III-10. Individual fellowships come from the American Cancer Society, the Canadian Multiple Sclerosis Society, the Cancer Research Institute, the Juvenile Diabetes Research Foundation, the Leukemia & Lymphoma Society, and five F32 fellowships from NIH.

Table III-10. Sources of support for current postdoctoral scholars

Source	Number
Research grants to mentors	30
Training grants	11
Individual postdoctoral fellowships	10
Faculty start-up funds	4
Program project grants	2
Total	57

Individual fellowships to support postdoctoral scholars who passed through our department in the past five years came from the American Cancer Society (2), the American Foundation for AIDS Research (1), the Arthritis Foundation (2), the Burroughs-Wellcome Fund (1), the Cancer Research Institute (1), the Heiser Program for Research in Leprosy and Tuberculosis, Irving Fellowships (2), the Juvenile Diabetes Foundation (2), the Kidney Foundation (1), the National Multiple Sclerosis Society (2), NIH K (2) and F32 (6) awards, an ORISE Fellowship (1), and a Pfizer Award (1).

Length of postdoctoral training. Fifty-two postdoctoral scholars have passed through laboratories of Microbiology & Immunology primary faculty in the past five years. Their length of training in our department (to a resolution of one year) is shown in Figure III-3. The distribution is asymmetrical, due to the UNC policy of a five-year limit on postdoctoral training. It is possible to get a one-time extension to the limit in exceptional circumstances (e.g. due to maternity leave), which presumably accounts for the few longer cases. The average stay was 3.9 years, with a standard deviation of 1.6 years.

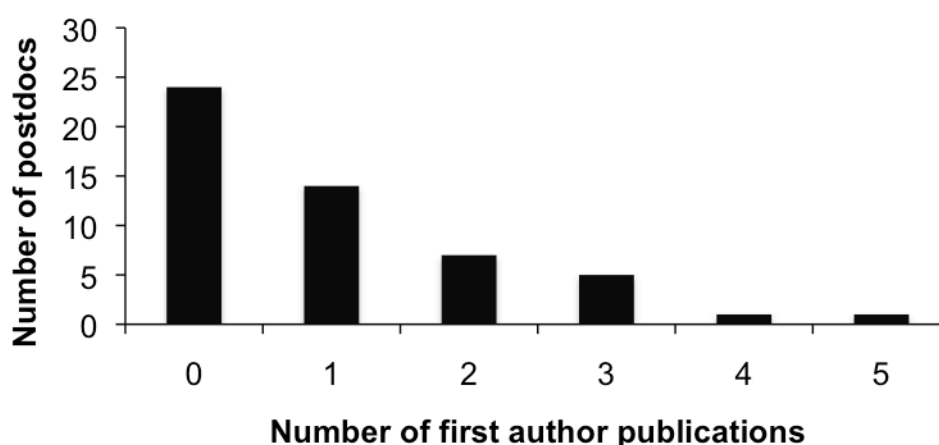


Publication record of postdoctoral scholars. Publication statistics for postdoctoral scholars who left the Department of Microbiology & Immunology during the last five years are given in Table III-11 (next page). On average, these scholars published one first-author primary research paper, two middle-author primary research papers, and no review articles. However, $24/52 = 46\%$ of our postdoctoral scholars left without any first-author publications (Figure III-4, next page). This modest publication rate cannot be attributed to a short duration of training; $39/52 = 75\%$ of postdoctoral scholars remained in the department for three or more years (Figure III-3).

Table III-11. Publications per Department of Microbiology & Immunology postdoctoral scholar (n=52), 2005-06 through 2009-10.

Publication Type	Mean	Standard Deviation	Minimum	Maximum
First author primary	1.0	1.2	0	5
Middle author primary	2.0	2.4	0	8
First author review	0.0	0.2	0	1
Middle author review	0.1	0.3	0	1
Total publications	3.1	3.2	0	12

Figure III-4. First Author Postdoc Publications



G. Where Do UNC Microbiology & Immunology Postdoctoral Scholars Go?

Job placement of postdoctoral scholars. After leaving the Department of Microbiology & Immunology, most ($33/51 = 65\%$) postdoctoral scholars found academic jobs (Table III-12). Seventeen of $51 = 33\%$ were faculty positions, but $9/51 = 18\%$ were again as a postdoctoral scholar. Postdocs from our department also found jobs in industry, government, and research institutes. Appendix C11 gives available details.

Table III-12. Job placement of Department of Microbiology & Immunology postdoctoral scholars, 2005-06 through 2009-10

Sector	Type of position	Number
Academic	Faculty position, UNC Chapel Hill	6
	Faculty position, other institutions	11
	Non-faculty position	7
	Postdoctoral	9
	Total	33
Industry		11
Government		3
Research Institute		3
Homemaker		1

Section IV - Faculty
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IV. FACULTY

This short section summarizes who our departmental faculty are and some highlights of their research and teaching activities.

A. Faculty Composition

Microbiology & Immunology faculty overview. The Department of Microbiology & Immunology has 81 faculty members. Because this program review is focused on graduate and postdoctoral education, this self-study limits faculty descriptions to the 60 members who are active in training graduate students and/or postdoctoral scholars. Of the 60 training active faculty, 56 have laboratories with graduate students and/or postdoctoral scholars. Four faculty who are no longer training students or postdocs in the laboratory are included due to their significant contributions to other aspects of graduate education (particularly classroom teaching and preliminary examinations). Two of the four continue laboratory operations without graduate students or postdoctoral scholars.

Among 46 faculty with primary appointments in our department, the members excluded from this analysis include three tenure track faculty with primarily clinical responsibilities, eight research track faculty, the teaching lab coordinator, and a lecturer who teaches undergraduate courses. Although the research track faculty obviously interact with graduate students and postdoctoral scholars and make important contributions, education is not a major responsibility. Among 35 faculty with joint appointments in our department, seven tenure track faculty who either no longer have active laboratories or primarily have a clinical focus, as well as one research track faculty, are not included.

Microbiology & Immunology faculty distribution by research discipline. Faculty research expertise is fairly evenly distributed across immunology, microbial pathogenesis, and virology (Table IV-1). A smaller group engaged in molecular, structural, and computational biology research is united by an emphasis on biophysical methods. Assignment of faculty to one particular research category is somewhat artificial, particularly given the large number of laboratories that study host-pathogen interactions or vaccines and thus could be considered to focus on both immunology and microorganisms or viruses. Most of the molecular, structural, and computational biology faculty could also fit comfortably in one of the other three categories.

Microbiology & Immunology faculty distribution by appointment. Our faculty active in graduate and postdoctoral education are fairly evenly balanced between those with primary (33) or joint (27) appointments. Similarly, primary faculty act as research advisors for 36 Microbiology & Immunology students, whereas joint faculty are mentors for 31 of our students. There are 56 postdoctoral scientists in the laboratories of primary faculty and 59 postdocs in joint labs.

Table IV-1. Department of Microbiology & Immunology faculty active in training graduate students and/or postdoctoral scholars, listed by research area^a

Immunology (20)	Microbial Pathogenesis (14)	Virology (20)	Molecular, Structural, & Computational Biology (6)
Abel, Kristina	Beckers, Cornelis	Bachenheimer, Steve ^b	Bourret, Robert
Cairns, Bruce	Braunstein, Miriam	Baric, Ralph	Collins, Edward
Clarke, Stephen	Cotter, Peggy	Burch, Christina	Edgell, Marshall ^b
Flood, Patrick	Dangl, Jeff	Damania, Blossom	Giddings, Morgan
Jobin, Christian	Goldman, William	de Silva, Aravinda	Griffith, Jack
Klapper, David ^b	Hobbs, Marcia	Dittmer, Dirk	Redinbo, Matt
Liu, Zhi	Kawula, Tom	Garcia-Martinez, Victor	
Markovic-Plese, Silva	Meshnick, Steve	Heise, Mark	
Matsushima, Glenn	Miller, Virginia	Johnston, Robert	
Peden, David	Nicholas, Robert	Kafri, Tal	
Plevy, Scott	Rawls, John	Lemon, Stanley	
Sarantopoulos, Stefanie	Richardson, Anthony	Margolis, David	
Sartor, Balfour	Tamayo, Rita	Moorman, Nathaniel	
Serody, Jonathan	Wolfgang, Matthew	Moody, Cary	
Su, Lishan		Newbold, John ^b	
Ting, Jenny		Pickles, Ray	
Tisch, Roland		Raab-Traub, Nancy	
Vilen, Barb		Swanstrom, Ron	
Wan, Yisong		White, Laura	
Whitmire, Jason		Webster-Cyriaque, Jennifer	

^aEach faculty member is listed only once, although several could reasonably be listed in more than one area.

^bThe four indicated faculty members do not offer laboratory training for graduate students or postdoctoral scholars but nevertheless are active in other aspects of graduate education.

Microbiology & Immunology faculty distribution by rank. In 2010, 18% of departmental faculty active in graduate and postdoctoral education were Assistant Professors, 33% were Associate Professors, and 49% were Full Professors (Table IV-2). This is a more balanced distribution than at the last departmental program review in 1999, when there were 18% Assistant Professors, 21% Associate Professors, and 61% Full Professors.

Microbiology & Immunology faculty age distribution. The age distribution of Department of Microbiology & Immunology faculty active in graduate and postdoctoral education is broad (Figure IV-1). The primary faculty has a reasonably flat distribution, with three to five members in six out of seven five-year age bins from 35-39 to 65-69. The age distribution of the joint faculty is narrower, with most in the 40-59 range. Both primary and joint faculty have a peak in the 50-54 age group. The overall distribution suggests our department is unlikely to suffer disproportionate effects of retirement for at least another decade, leaving plenty of time to continue to regenerate faculty ranks through hiring of new Assistant Professors. The practice of our department over the past two decades has been to hire primary faculty almost exclusively at the Assistant Professor level.

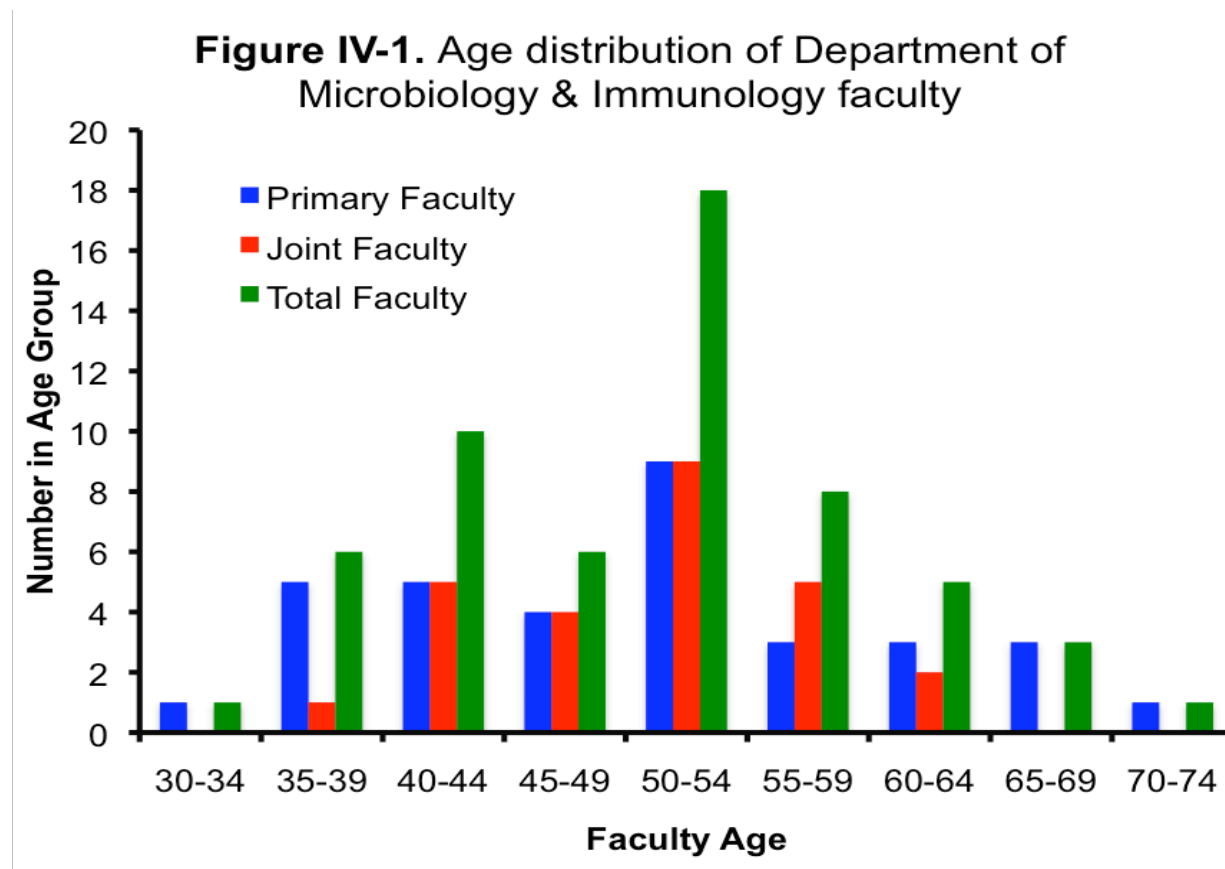


Table IV-2. Department of Microbiology & Immunology faculty active in training graduate students and/or postdoctoral scholars, listed by rank

Rank	Primary Faculty	Joint Faculty
Assistant Professor	Abel, Kristina Moody, Cary Moorman, Nathaniel Richardson, Anthony Tamayo, Rita Wan, Yisong Wolfgang, Matthew ^a	Rawls, John Sarantopoulos, Stefanie Whitmire, Jason
Associate Professor	Braunstein, Miriam Collins, Edward Cotter, Peggy Damania, Blossom ^a de Silva, Aravinda Dittmer, Dirk Giddings, Morgan Kafri, Tal Matsushima, Glenn Pickles, Ray Vilen, Barb	Beckers, Cornelis Burch, Christina Cairns, Bruce Flood, Patrick Heise, Mark Jobin, Christian Markovic-Plese, Silva Plevy, Scott Webster-Cyriaque, Jennifer
Full Professor	Bachenheimer, Steve Bourret, Robert Clarke, Stephen Edgell, Marshall Goldman, William Griffith, Jack Johnston, Robert Kawula, Tom Klapper, David Newbold, John Raab-Traub, Nancy Su, Lishan Ting, Jenny Tisch, Roland	Baric, Ralph Dangl, Jeff Garcia-Martinez, Victor Lemon, Stanley Liu, Zhi Margolis, David Meshnick, Steve Miller, Virginia Nichols, Robert Peden, David Redinbo, Matt Sartor, Balfour Serody, Jonathan Swanstrom, Ron
Research Asst. Professor	White, Laura	
Research Full Professor		Hobbs, Marcia

^aPromotion to next rank pending.

Racial diversity of Microbiology & Immunology faculty. The Department of Microbiology & Immunology primary faculty active in training graduate students and postdoctoral scholars includes $2/33 = 6\%$ under-represented minorities. Joint faculty active in training students and postdocs includes $1/27 = 4\%$ under-represented minority. All together, under-represented minorities (one African American, two Hispanic/Latino) make up $3/60 = 5\%$ of the total departmental faculty. Note that under-represented minorities are only counted among American citizens, with international scholars placed in a separate category. Under-represented minorities constitute $3/46 = 7\%$ of Americans in the Microbiology & Immunology faculty.

Gender diversity of Microbiology & Immunology faculty. Among primary Department of Microbiology & Immunology faculty active in graduate and postdoctoral education, $11/33 = 33\%$ are female. Women constitute $6/27 = 22\%$ of joint faculty. Overall, $17/60 = 28\%$ of our training faculty are female. This proportion is very similar to the 29% of departmental postdoctoral scholars who are female, but strikingly different from the 73% women among departmental graduate students.

International Microbiology & Immunology faculty. Almost one-third ($10/33 = 30\%$) of the primary departmental faculty members active in graduate and postdoctoral education are international. International scholars make up $4/27 = 15\%$ of joint faculty and $14/60 = 23\%$ of overall departmental faculty.

Department of Microbiology & Immunology faculty recruitment. Of the seven primary tenure track faculty hires made by Chair Bill Goldman since his arrival at UNC, four are female and one is an under-represented minority. Six were hired as Assistant Professors and one as an Associate Professor with tenure. A search is currently underway for an immunologist.

B. Faculty Research

UNC Chapel Hill is a major research university that received over \$800 million in research grants and contracts in fiscal year 2010, with more than half of the total going to the School of Medicine. The National Institutes of Health is the largest single source of research funding at UNC Chapel Hill. The Department of Microbiology & Immunology is part of the UNC School of Medicine and is heavily involved in research activities. As previously noted (Table I-4), our department ranked about 12th to 16th in NIH funding among medical school microbiology departments over the past five years.

Faculty publication and research funding. Original research and publishing of discoveries in peer-reviewed journals are integral parts of graduate and postdoctoral education in microbiology and immunology. Details of faculty publications and research funding are contained in 60 abbreviated curricula vitae covering 2005 to 2010 (Appendix G, available in electronic form only). Almost all faculty publish actively and even two faculty who no longer have laboratories of their own have published within the past five years. Only three of 33 primary faculty do not have external funding - the two faculty who no longer operate laboratories but contribute heavily to teaching, and one new

Assistant Professor who has been on campus only a few months. Among 27 joint faculty, only one is currently unfunded.

Faculty salary compensation plan. UNC Chapel Hill School of Medicine faculty are paid a salary consisting of a base component, which is typically adjusted for cost-of-living or promotions, and a variable component, which can increase or decrease each year. To encourage faculty to seek external funding, the Department of Microbiology & Immunology recently instituted a faculty salary compensation plan (Appendix D1) that indexes the variable component to the amount of salary coverage from non-departmental sources (grants, core facility income, endowed professorships, etc.). The variable salary component is activated once this outsource salary coverage exceeds 50%, and is also accompanied by a similarly indexed "variable lab component" that is allocated to a non-expiring unrestricted laboratory fund for each investigator. Although the amount of the variable salary component (from \$3,000 to \$15,000 annually) might be considered modest, the increments in variable salary make up a larger fraction of a small base salary than of a large base salary. Thus, the plan is designed to particularly encourage junior faculty to establish the habit of seeking multiple grants.

Department of Microbiology & Immunology faculty honors and distinctions. Competitively earned honors and distinctions bestowed by external organizations based on scholarly accomplishments are one indicator of faculty quality. Such honors earned in the past five years by department faculty active in graduate and postdoctoral education are listed in Appendix D2.

C. Faculty Teaching

Distribution of teaching load. As part of a medical school department, faculty in the UNC Department of Microbiology & Immunology generally do not have a heavy teaching load. Our departmental tradition is that new faculty are exempted from teaching for a year after their arrival on campus to allow time to establish their research laboratories, while senior faculty without laboratories are utilized in courses with heavy teaching demands. Most graduate courses are team taught. The department has four Group Leaders (Steve Bachenheimer, Bob Bourret, Steve Clarke, Tom Kawula), each representing a major research area, who work with course directors to ensure an equitable overall distribution of teaching responsibilities. Appendix D3 shows participation of faculty active in graduate and postdoctoral education in each MCRO graduate course taught for the past five academic years. Because not all teaching duties of our faculty (in particular, dental and medical microbiology) are included, Appendix D3 cannot be used to comprehensively assess all departmental teaching activity. However, Appendix D3 shows extensive involvement of our departmental faculty ($30/33 = 91\%$ of primary and $11/27 = 41\%$ of joint faculty) in graduate classroom teaching across all professorial ranks and scientific disciplines. The only primary Microbiology & Immunology faculty who did not participate are the three newest Assistant Professors, two of whom arrived after the end of the 2009-10 academic year. An opinion survey of the faculty (Appendix F3, questions 2 & 3) indicates generally high satisfaction with teaching assignments.

Teaching undergraduate and professional students. A few department faculty members have heavy teaching loads in non-graduate courses, which allow the remainder of the faculty to focus on graduate and postdoctoral education. Teaching Lab Coordinator Bruce Alexander, who holds a Master of Arts in Teaching degree, coordinates the microbiology course for first-year medical students; runs the laboratories for the dental student, medical student, and pre-professional student courses; and supervises our Teaching Assistants. Lorraine Cramer, Ph.D. teaches the MCRO251/MCRO255 undergraduate pre-professional microbiology courses, which have enrollments of up to 200 students per semester (Appendix B7). Lorrie earned the 2009 Johnston Teaching Excellence Award. In addition to participating in graduate courses, John Newbold is course director and Steve Bachenheimer teaches in the MCRO515 dental microbiology course.

Teaching evaluations. Our collection of student evaluations is currently transitioning from a single end-of-course paper survey to a new electronic survey system that will be administered every five weeks during the course. Basic questions are consistent from course-to-course and instructor-to-instructor forms, with the flexibility to also use course-specific questions. Multiple surveys will be collected so that performance by earlier instructors is not forgotten prior to completing the evaluation. The new survey system is only intended for courses that are primarily lecture based. Dixie Flannery, the Student Services Manager, will compile the results. Course directors will distribute the student evaluations to faculty who participated in the course, as well as a summary to the department Chair. Although the survey results are anonymous, student compliance will be monitored and completion of surveys will be part of the "participation" portion of their grade in each course. Our past experience is that department faculty take student feedback seriously and various aspects of a course are sometimes changed in response to student feedback.

Course directors are also responsible for peer evaluation of faculty teaching effectiveness, focusing primarily on faculty who are new to the course or who have needed improvement based on previous assessments. A summary of the peer evaluations is relayed to the Chair, who discusses teaching performance with faculty members during their annual meetings. Peer and student evaluations are also incorporated into the information compiled for consideration of faculty promotion and tenure.

Thesis supervision. An essential part of graduate student education is design and execution of an independent laboratory research project with faculty guidance. Appendix D4 lists the number of degrees earned and membership on Microbiology & Immunology thesis committees for each primary faculty member during the past five academic years. Among the 33 primary faculty active in graduate and postdoctoral education, eight have arrived too recently for a student to complete a degree and four no longer supervise students in the laboratory. Microbiology & Immunology Ph.D. degrees were earned in 14/21 = 67% of the remaining laboratories. Students in two of the seven laboratories that did not produce Microbiology & Immunology Ph.D. degrees during the past five years switched to the M.S. track and earned M.S. degrees.

Students in four of the five laboratories that did not produce any Microbiology & Immunology degrees earned Ph.D.'s in other programs.

Twenty-two of 33 = 67% of our primary faculty have served on Ph.D. thesis committees for Microbiology & Immunology students during the past five academic years. Among the 11 faculty who have not recently been on departmental thesis committees are three faculty without active labs and three new Assistant Professors.

Section V - Leadership & Support

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V. LEADERSHIP & SUPPORT

This section describes the governance and administration of the Department of Microbiology and Immunology with respect to our mission of graduate and postdoctoral education, as well as relevant facilities and equipment.

A. Leadership

Department Chair. The Chair of the Department of Microbiology & Immunology is Bill Goldman. Bill was an outside hire and began his five-year term on September 1, 2008. The Chair is chosen by, and serves at the discretion of, the Dean of the School of Medicine.

Group Leaders. Four Group Leaders, chosen by the Chair and serving at his discretion, represent the major research areas of our department, assist in department governance, and provide advice as needed. The Group Leaders are:

- Steve Bachenheimer - Virology
- Bob Bourret - Molecular, Structural, & Computational Biology/Director of Graduate Studies
- Steve Clarke - Immunology
- Tom Kawula - Microbial Pathogenesis

The Chair consults with the Group Leaders for advice as matters arise. The Group Leaders organize teaching assignments and oversee mentoring arrangements for junior faculty within their respective areas. In addition, the group leaders provide institutional memory.

Faculty meetings. To facilitate communication and gather input, the Chair has a standing schedule of faculty meetings from 12:00 - 1:30 pm on the first Monday of the month. Faculty members can suggest agenda items and lunch is provided. To keep attendance to a manageable size, and because many issues are specific to laboratories located in the department's core space in the Mary Ellen Jones Building, the primary faculty alone meets in even-numbered months (except August). Meetings in odd-numbered months are held as needed and typically include joint faculty for consideration of graduate student matters.

Director of Graduate Studies. The Director of Graduate Studies is chosen by the Chair and serves at his discretion. The current Director is Bob Bourret. Responsibilities of the Director include:

- Introduce new students to our department.
- Oversee student progress in thesis committee and chair selection, thesis project approval, regular thesis committee meetings, and timely graduation (see Appendix E1 for a timeline of annual tasks).
- Coordinate preliminary written and oral examinations (see Appendix E2 for a timeline of annual tasks).
- Work with the Student Services Manager to ensure smooth functioning of the graduate program.
- Interpret and enforce rules.

- Handle problems as they arise.
- Initiate changes in the graduate program as the need arises. Depending on the situation, the Director can act alone, in consultation with the Chair, in consultation with the Graduate Studies Advisory Committee, or with approval of the departmental faculty.

Graduate Studies Advisory Committee. The Graduate Studies Advisory Committee was created in 2009 at the request of the Chair. The former Director of Graduate Studies, Glenn Matsushima, selected committee members based on their experience, interest, and commitment to graduate education. The current committee consists of:

- Bob Bourret, Director of Graduate Studies
- Dixie Flannery, Student Services Manager
- Glenn Matsushima, past Director of Graduate Studies
- Bill Goldman, Department Chair and former Director of Graduate Studies at Washington University
- Tom Kawula, Microbial Pathogenesis Group Leader and former Director of Graduate Studies
- Barbara Vilen, BBSP First Year Group leader
- Aravinda de Silva, former BBSP First Year Group co-mentor
- Mark Heise, former BBSP First Year Group co-mentor
- Steve Bachenheimer, Virology Group Leader
- Bonnie Gunn, graduate student representative (2009-2011)
- Kate Arrildt, graduate student representative (2010-2012)

The Graduate Studies Advisory Committee is large enough to offer diverse opinions, but small enough to engage in focused discussion. The committee advises the Director of Graduate Studies on how to best resolve some issues that the Director cannot handle alone. In other situations, the committee deliberates and then forwards recommendations to the department faculty for amendment and approval. The committee has been active since its inception in making or recommending numerous modifications to the graduate program.

Graduate & Professional Student Federation. There is no formal student government within the Department of Microbiology & Immunology. However, our department sends a representative to the Senate of the campus-wide UNC Graduate & Professional Student Federation (studentorgs.unc.edu/gpsf/index.php/home). Our current senator is Rachael Liesman. GPSF is a volunteer organization and allows each department to decide how to choose their representative. Our department senator serves one-year terms until he/she no longer wishes to do so and then is responsible for finding a new volunteer to serve in the position. Former Microbiology & Immunology senator Monika Schneider now serves as GPSF Vice President of Internal Affairs.

Microbiology & Immunology Postdoc Association. The leaders of our departmental postdoc association are Eric Weening and Corinne Williams. The faculty advisor is Virginia Miller.

UNC Postdoctoral Association. Microbiology & Immunology postdoc Jim Fuller served as one of the volunteer leaders for the campus-wide postdoctoral association until he left recently for a permanent position.

B. Administrative Support

Department administrative staff. The Department of Microbiology & Immunology is extremely fortunate to have a highly experienced and remarkably effective administrative staff that has consistently figured out how to do more with less over the years as our department has grown and the administrative staff has shrunk. Current personnel and their responsibilities are as follows:

- Director of Research Administration, Sarah Van Heusen. Sarah is in charge of the department administrative staff and assists the Chair in managing the department budget, space, and other resources.
- Student Services Manager & Seminar Program Coordinator, Dixie Flannery. As Student Services Manager, Dixie registers students for classes, collects course evaluations, enters course grades, keeps all student records, notifies the Graduate School of student progress, supports the admissions process, interacts with the campus bureaucracy on behalf of our students, etc. Dixie interacts frequently with our students and generally is knowledgeable about how each is doing. She brings matters to the attention of the Director of Graduate Studies as appropriate.

In her role as Seminar Program Coordinator, Dixie schedules both the departmental and student seminar series. For the departmental seminar speakers, she handles the logistics of travel and hotel arrangements, publicity, payment of honoraria, etc.

- Executive Assistant to the Chair, Brandy Dykhuizen. Brandy helps manage the Chair's calendar and organize his meetings; handles departmental scheduling, correspondence, and announcements; coordinates all interviews, visits, and travel arrangements for faculty recruitments; arranges special events (luncheons, symposia, etc.); and has an ever-changing portfolio of additional tasks, such as collecting and analyzing data for this self-study.
- Grants Specialist, Sharon Rone. Sharon provides a critical and invaluable service by assisting department faculty in assembling and submitting grant applications.
- Human Resources Facilitator, Paula Harrington. Paula oversees hiring, promotion, and other human resources tasks.
- Business/Accounting, Mike Loy, Lisa Best, and Theresa Duffy. Mike, Lisa, and Theresa handle accounting of department and grant funds for laboratories and core facilities housed in the Mary Ellen Jones Building, as well as a wide variety of business functions including shipping and receiving, overseeing equipment and building maintenance, travel arrangements and reimbursement, etc.

Other support staff. The department employs a handyman on an as needed basis. We no longer can afford dedicated personnel for glassware washing or information technology support. Glassware washing, computer network support, and repair of old equipment are ongoing needs that could benefit from a dedicated group of personnel. It would be most efficient if such people could be shared with other departments/centers in the same building, but such a stable situation is years away.

Financial base for administrative support. The current administrative staff is barely sufficient to meet our department needs and is performing a truly heroic task to keep up with the workload. The financial base of support for our administrative staff is precarious, because the department's allocation of state funds (the primary means of support for administrative personnel) has been cut three times in the past two years. The School of Medicine is currently contemplating another 10% reduction in funds for all departments. Retention is also a concern because UNC has frozen staff salaries for the last two years. A particularly urgent need, as well as a wise investment, would be a new staff member to assist Sharon Rone in the burden of grant submissions/revisions, which have increased as NIH paylines have dropped and new departmental faculty have been hired.

C. Facilities & Equipment

Teaching space. Appropriate spaces to teach classes, hold seminars, or meet in groups of various sizes are severely limited in the buildings that house the Department of Microbiology & Immunology and nearby. Functions are typically scheduled based on room availability rather than what makes the most sense for a particular activity.

Research space. The Department of Microbiology & Immunology has historically been housed primarily on floors 6-8 of the Mary Ellen Jones Building. As part of his recruitment, Chair Bill Goldman negotiated a promise from the School of Medicine for a complete interior renovation/modernization of the entire building (a \$100M project). This would result in more efficient lab design and space utilization. The department would relocate to floors 9-11 and gain 10,000 square feet of space. The plan also includes moving other research centers related to our department (e.g. the Center for AIDS Research, the Division of Infectious Diseases, the Center for Translational Immunology) into other adjacent floors of the Mary Ellen Jones Building. Such an arrangement would go a long way toward addressing one of our major departmental weaknesses, which is that we are scattered across multiple buildings. Substantial progress has been made in designing the renovations, but the project is on hold due to the economic collapse. Renovation of the Mary Ellen Jones Building remains a high priority for the School of Medicine, but the timetable for completion is uncertain. However, planning for renovation of the upper floors showed a need to vacate the 8th floor. Therefore, the 5th floor of Mary Ellen Jones was modestly updated in 2009 and now houses seven of our research groups (including four who moved from the 8th floor) on a presumably temporary basis.

Administrative space. The space for department headquarters staff is cramped and cannot easily accommodate any new staff additions without overcrowding. Offices for teaching intensive faculty are adequate.

Teaching equipment. Most departmental classes are taught in 802 Mary Ellen Jones (location of the site visit meetings for this program review), which is equipped with a whiteboard, LCD projector, and an overhead projector. The tables are on wheels and there is a large supply of chairs so the room can be easily configured for a variety of functions, including classes, joint group meetings, small seminars, and our weekly

TGIF social hour. Maximum seating capacity without tables is about 50. UNC provides Blackboard software for electronic distribution of class materials to students.

Research equipment. We are fortunate that access to equipment is rarely if ever a barrier to research progress in our department. In addition to the equipment in individual laboratories and larger pieces of shared departmental equipment (e.g. ultracentrifuges, phosphorimager, autoclaves), UNC Chapel Hill maintains an extensive set of about 80 core facilities for oligonucleotide synthesis, DNA sequencing, microarrays, transgenic mice, mass spectrometry, NMR, X-ray crystallography, etc. (See Appendix E3 for a comprehensive list of core facilities and links to their websites.) The core facilities are unquestionably a major research asset. Each core facility is typically led by a faculty director, as well as a Ph.D. level scientist who can assist with experimental design, use of the specialized equipment or services, and data interpretation. Fees are typically reasonable. Core facilities led by primary faculty in the Department of Microbiology & Immunology include Electron Microscopy (Jack Griffith), Flow Cytometry (Nancy Fisher), Microprotein Sequencing & Peptide Synthesis (David Klapper), and Retrovirology (Susan Fiscus).

Libraries. UNC Chapel Hill has extensive library holdings befitting a major research university. Access to electronic journals has revolutionized library use over the past decade, as the university pays for electronic subscriptions to thousands of journals. There is financial pressure to cut some campus subscriptions each year, but in general people in our department can get everything they need online and rarely set foot in an actual library anymore.

Computers. High-speed Internet access, both wired and wireless, is excellent throughout campus. Computer resources are generally adequate, although the responsibility of individual labs. The UNC Office of Information Systems provides servers and data backup for the department, as well as general computer support. However, relying on this off-site service has made it difficult to obtain timely and effective information technology support for individual laboratory computers.

Section VI - The Future

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VI. THE FUTURE

This section first describes the results of opinion surveys and follow-up discussions about our educational activities as one way to identify what we are doing well and where to focus our efforts for future improvement. The latter part of this section then attempts to synthesize and summarize unresolved issues arising from the three strands of our self-study outlined in the Preface - the descriptive information of Sections I - Program Overview, II - Curriculum, and V - Leadership & Support; the objective data of Sections III - Graduate Students & Postdoctoral Scholars and IV - Faculty; and the subjective data at the beginning of this section (Section VI - The Future).

A. Opinion Surveys

A Survey Committee was appointed to solicit opinions and ideas from the Department of Microbiology & Immunology. The committee members were:

- Peggy Cotter, committee chair & microbial pathogenesis faculty representative
- Steve Bachenheimer, virology faculty representative
- Yisong Wan, immunology faculty representative
- Eric Weening, postdoctoral scholar representative
- Brittany Mortensen, graduate student representative

The survey committee designed three different surveys to ask students, postdocs, and faculty to assess how well the Department of Microbiology & Immunology currently carries out various educational functions, what can be improved, and to suggest ideas for change. The surveys were administered using SurveyMonkey.com and the results are described below. The overwhelming majority of responses to virtually every question from all three constituencies were positive. The graduate students and postdoctoral scholars (at least those who responded to the opinion surveys) generally appear to be satisfied with their training, and the faculty believe training programs in the Department of Microbiology & Immunology are working well.

Graduate student survey. The graduate student survey response rate was 37/67 = 55%. All results received are included in Appendix F1 and are summarized here. A majority of respondents entered the program between 2006 and 2009. Fifty-four percent plan to pursue a career in academics (37% large university, 17% small university or college), 30% plan to pursue a career in a national lab or government agency and 17% plan to pursue a career in industry. Eighty percent plan to do post-doctoral training, which is somewhat higher than the 60% of students who have actually done so in the past five years.

The students were queried about their satisfaction with course requirements, course availability, and the quality of instruction they received. Responses were overwhelmingly positive, with a majority of answers being “satisfied”, some “very satisfied”, and only a few “unsatisfied”. About 45% of respondents wanted additional course offerings, but the open-ended responses did not provide a clear consensus on specific topics (see Appendix F, Student Question 15, page F-23). Only two students provided substantive “additional responses” relating to existing courses and coursework

(Appendix F, Student Question 22, page F-24). Both felt that the grant-writing course (MCRO795) could be improved.

The students were asked about satisfaction with their training. Specifically, students were asked to rate their level of satisfaction with the quality of mentorship they received from their research advisors and other faculty, their opportunities to present their research in seminar-type and poster presentations, their opportunities to write papers and research proposals, and their opportunities to discuss science with other graduate students, postdocs, and faculty. The responses were overwhelmingly positive with a majority of responses being “very satisfied” or “satisfied”.

The students were questioned about their satisfaction with the preliminary exam process. Nearly all felt that they had ample time to write the proposal. A majority of the students were satisfied or very satisfied with the process of selecting a topic, the meeting with their topic selection committee, the availability of faculty to discuss their proposal, and the objectiveness and fairness of the evaluation of their proposals. The students were generally in favor of the change implemented in 2010 that allows at least one topic to be somewhat related to their own research.

A majority of the students were satisfied with the Teaching Assistant requirements.

Overall, the students who completed the survey were satisfied or very satisfied with the training they are receiving in the Department of Microbiology & Immunology. All but one or two students ranked the department as excellent or good compared to other departments at UNC and other departments at other universities. Twenty-nine out of 32 respondents indicated that they would recommend the Microbiology & Immunology graduate program to other trainees.

Postdoctoral scholar survey. The postdoctoral scholar survey response rate was $18/59 = 31\%$. All results received are included in Appendix F2 and are summarized here. Fifty percent of the respondents plan to pursue a career in academics at a large university and 43% plan to pursue a career in academics at a smaller university or college. Their time spent as a postdoctoral scholar was fairly evenly spread between one and four years.

The postdocs were queried about their satisfaction with regard to their training. Specific questions addressed opportunities to present their research orally, to present posters, to write research proposals and papers, and to discuss their research with other postdoctoral scholars, students, and faculty members in the department. The responses were overwhelmingly positive; in each of these areas at least 14 of the 18 respondents indicated that they were satisfied or very satisfied. When asked about the quality of mentorship that they were receiving from their research advisor, 10 responded with “excellent” and five with “good”. Thirteen respondents also felt that they received excellent or good mentorship from other faculty members in the department. Responses were also predominantly positive when asked about satisfaction with career advice received from faculty members.

Most postdoctoral scholars indicated that they were satisfied or very satisfied with the work environment in our department, both in terms of facilities and with regard to interactions with other postdoctoral scholars, with graduate students, and with faculty. Eighty-nine percent of the respondents indicated that the Microbiology & Immunology Postdoc Association is a valuable resource.

Faculty survey. The faculty survey response rate was $29/60 = 48\%$. All results received are included in Appendix F3 and are summarized here.

The faculty were queried about their teaching responsibilities. All but one or two were satisfied with the amount of teaching they typically do each year and the subject matter of their teaching responsibilities. Faculty also feel that the courses are generally in good shape, and that the course directors do a good job of keeping the classes organized and updated. A majority of the faculty felt that the graduate students are receiving sufficient didactic instruction.

The faculty were in nearly uniform agreement that the Teaching Assistant experience is an important part of graduate education and that the our departmental teaching requirement is optimal with regard to amount, timing, and subject matter.

The faculty were overwhelmingly positive about the preliminary examination process and the value it provides to the training of our graduate students. They felt that the process was rigorous and fair. The faculty spend a considerable amount of time advising students about their proposals and indicated that they are happy to do so.

All of the respondents agreed or strongly agreed that graduate students in our department are adequately trained in designing and conducting research in microbiology and/or immunology, writing manuscripts, and preparing and delivering oral and poster presentations. The faculty further believe our students are well-prepared for postdoctoral studies after completing their graduate training. All of the faculty respondents also agreed or strongly agreed that postdoctoral scholars in Microbiology & Immunology laboratories are being adequately trained and are well-prepared for faculty positions upon completion of their training.

B. Department Discussions

To follow up the opinion surveys, the survey committee organized and conducted separate meetings with the three respondent groups to discuss and clarify survey results, as well as ask additional questions to stimulate further consideration of possible changes. The results of the three discussion meetings are summarized below.

Graduate student discussion. Six graduate students attended an open meeting to discuss issues further. Although disappointing, the low meeting turnout is consistent with the generally high level of satisfaction with the status quo indicated in the opinion survey.

Overall, the discussion among students was positive. The students emphasized how invaluable and appreciated Dixie Flannery, Brandy Dykhuizen, and all the other

administrative staff are, and also commented on the benefits and enjoyment associated with the recently implemented weekly departmental TGIF social hours. Several suggestions are described below.

For coursework, the students agreed that an additional bacteriology course would be valuable, as well as an advanced, lecture-based immunology course in addition to the basic immunobiology course (MCRO614/MCRO615) already offered. The introductory biostatistics training currently offered through BBSP was not found to be very helpful and students thought that having a microbiology/immunology-specific biostatistics workshop(s) would be beneficial for applying statistics that are related to their research. Such a workshop could be short and potentially involve collaborations with students/faculty in the Department of Biostatistics or other units of the School of Public Health. For the MCRO795 writing course, there was quite a bit of discussion about possibly incorporating reading and critiquing of funded and unfunded research proposals of different formats, potentially in place of one of the two units of writing. One student suggested that more writing and critiquing of writing be incorporated in graduate courses.

With regard to preliminary exams, the students thought that decreasing the time between the written and oral portions of the exam could shorten the process. Also, as to be expected with changes in format, the students felt that there was some confusion in 2010 as to what were acceptable topics.

Two strategies to alleviate the heavy workload of second-year students were suggested. Students thought it would be helpful to increase flexibility on when they were required to act as Teaching Assistants, in particular having the choice to opt out during their second year. Such a delay might also help resolve the issue of there being too many students for the available TA slots. Another suggestion was to reduce the seminar attendance requirement for second-year students (e.g. 1/2 as opposed to 2/3).

The students felt that the resources available to them were sufficient, but minor improvements would be helpful. It was thought that having a more complete list of department-related seminars on the department website would be useful. A complete list of the software available from the department for lab computers would also be nice. The room reservation process was found to be somewhat complicated and unclear.

Postdoctoral scholar discussion. Five postdoctoral scholars attended a meeting to discuss postdoctoral issues in the Microbiology & Immunology department. No attendees had any specific criticisms, concerns, or suggestions for improvement.

Faculty discussion. About 30 faculty members attended a meeting to discuss issues in more depth. Overall, the faculty were very positive and in agreement that the quality of training graduate students and postdoctoral scientists receive in our department is excellent. Three issues were vigorously discussed at some length.

The first issue was course offerings and requirements. A student suggestion to offer another semester of bacteriology class (analogous to the existing two semester

sequence of MCRO630 and MCRO640 virology courses covering basic concepts and pathogenesis respectively) sparked discussion about the respective roles of primarily lecture based courses versus seminar/tutorials, as well as how department courses fit into the reality that BBSP students do not join the department until after their first year. The discussion naturally segued into the related issue of whether or not all graduate students in our department should be required to attain a minimum level of knowledge about specific, broadly based, microbiology and immunology content. The discussion confirmed that in spite of extensive departmental faculty turnover during the past decade, the longstanding lack of consensus about course requirements (i.e., should requirements be stricter or laxer) still persists. One specific suggestion for a compromise was to require all students to take at least one of the Fall semester courses in bacteriology (MCRO635), immunology (MCRO614), or virology (MCRO630), depending on their interests, and then create a new required Spring semester class for everyone that integrates all three topics in the context of microbial pathogenesis. There was agreement that courses are an issue that would not be resolved in a single meeting and we may like to consider further in the future.

The second issue discussed centered on the relatedness of the written preliminary exam proposal topic to the student's own research. In the past, the topic had to be unrelated to any research in the student's laboratory. Starting in 2010, at least one suggested topic had to be plausibly related to research in the student's laboratory (e.g. same microorganism or host cell type), but still could not involve real or proposed research from the student's laboratory. A few faculty members advocated for the benefits of having students write proposals on and defend orally their own thesis projects. After some discussion, it was agreed that the new constraint on topic choice should be continued for at least three years, at which point we would have enough practical experience to fairly evaluate the new format and consider what, if any, additional changes were desirable.

The third issue was whether it was desirable for the department to be more involved in recruitment and training of postdoctoral scholars than at present, and if so, what form such involvement might take. In contrast to graduate education, the department faculty does not have a long history of discussing postdoctoral training. The conversation began to generate some ideas, but we ran out of time. There was agreement that it would be useful to consider postdoctoral training issues more extensively.

C. Graduate Student Issues

Unresolved issues regarding graduate students that arose in this self-study include the following:

Continued adjustment to BBSP. The introduction of the BBSP umbrella admissions route and training for first-year students has necessitated numerous adjustments in our Ph.D. program. There are at least two areas described below where we need to adapt further. Given that BBSP is only two years old, additional as yet unrecognized issues might arise in the future.

First, the student surveys indicate a desire by first-year students to be included in and aware of departmental activities, even though they have not yet joined the department. To be candid, outside of standard orientation activities when the first-year students arrive in August, we haven't yet tried as a department to connect with BBSP students, because first-year students are not part of the department and we weren't aware of their desire for more interaction. (Obviously there are lots of individual interactions between first-year students and Microbiology & Immunology department members during classes, rotations, and First Year Groups). It would be productive to think through how to better connect. One simple action could be to create a special listserv for interested first-year students, which could be used to send out announcements for departmental activities such as the weekly seminars and TGIF social hour. BBSP students who are probably interested in Microbiology & Immunology can be identified based on their choices of rotation laboratories, course registration, and scientific interests declared to BBSP. We could then invite such students to join the proposed listserv.

Second, the influx of graduate students that resulted from BBSP has created an imbalance between the departmental demand for Teaching Assistants and the supply of students who need to fulfill the two-semester requirement. We will soon need to deal with this issue in a manner that preserves our ability to staff departmental courses (MCRO251, MCRO255, MCRO515) in the future. Some possible actions include:

- Reduce requirement to one semester of teaching. However, this choice raises a fairness issue with regard to students that have fulfilled the two-semester requirement and also might leave us without enough Teaching Assistants if fewer students join our department in the future.
- We could start using Teaching Assistants in department graduate courses, although it is not entirely obvious what their duties would be.
- We could actively reach out to other departments to see if they have needs for Teaching Assistants that our students could fulfill.

Graduate student publications. One surprising result of this self-study is that only about 45% of our Ph.D. graduates in the past five years met our goal of completing sufficient original research for two first-author publications, and about 10% of students left with no first-author publications. We will need to think carefully about whether we wish to retain or modify the publication goal, whether we are satisfied with the present level of graduate student authorship, and how we could do better in the future.

Course offerings and requirements. About 45% of the students who responded to our survey would like additional departmental course offerings (Appendix F1, Question 15), although no single topic was a clear favorite. The issue of additional course offerings also came up in the discussion meeting with graduate students. It could be worthwhile for the faculty to consider whether our current course offerings are adequate for a good education in modern microbiology and immunology. The issue of additional classes is intertwined with course requirements. Our faculty discussion suggested that it might be time to revisit the issue of whether knowledge of specific subjects should be required to earn a Ph.D. degree.

Special M.S. program. The last laboratory technician in our department's special Master's program graduated in 2007. We should consider whether or not we wish to continue the program, and if so, better advertise its existence. Given the substantial expansion of department faculty over the past few years, it is likely that many faculty and research staff are unaware of the program.

Recent changes to the graduate program. The Department of Microbiology & Immunology made numerous changes during 2009 and 2010 to our program of graduate education, as summarized below. It would be prudent to revisit these changes in several years to determine whether the new policies are having the desired effects or if further modification is appropriate.

Graduate courses

- Allowed one seminar/tutorial course taken outside our department to count toward departmental requirement, with approval by Director of Graduate Studies.

Seminars

- Required students to attend at least two-thirds of weekly departmental and student seminars.

Teaching assistants

- Allowed Director of Graduate Studies to approve completion of Teaching Assistant requirement through non-departmental courses on a case-by-case basis.

Thesis committees

- Required thesis committee chair to be different than research advisor.
- Prohibited spouse or "significant other" of research advisor from serving as thesis committee chair, to avoid the appearance of a conflict of interest. However, spouses/"significant others" are allowed to serve as committee members.
- Established a clear deadline (end of fall semester of second year in the department) for choosing thesis committee and chair.
- Explicitly uncoupled thesis committee formation from preliminary examination status (i.e. student can form thesis committee without having passed preliminary examination).
- Specified format for annual written progress reports to the thesis committee.

Thesis project approval

- Established clear deadline (March 31 of second year in the department) for students to present thesis project to their committee for approval.
- Specified format for written thesis project proposal.

Preliminary examinations

- Required one proposed topic to be plausibly relevant to research in the student's laboratory (e.g. involving the same bacterium, virus, host cell type, etc.) while maintaining prohibition against using past, present, or anticipated future research topics from the student's laboratory.

- Shortened proposal length and changed section format in conjunction with recent changes in NIH proposal structure.
- Shortened writing period from six to five weeks.
- Created the possibility of a "fast track" retake for students who fail their first written preliminary examination.
- Prohibited faculty members from serving on the written or oral preliminary examination committees of students whose research advisor is their spouse or "significant other", to avoid the appearance of a conflict of interest.

Thesis defense

- Moved private defense to at least two weeks before public seminar.

D. Postdoctoral Scholar Issues

Unresolved issues regarding postdoctoral scholars that arose in this self-study include the following:

Postdoctoral scholar publications. The data reported in this self-study (Figure III-4) indicate that the publication record for many of our postdoctoral scholars is surprisingly poor. Forty-six percent of the postdoctoral scholars who left our department in the past five years had no first-author publications. This represents an upper bound, because some recently departed scientists may still have manuscripts in the publication pipeline, but nevertheless cannot be considered a strong record of productivity. What can/should we do to help our postdoctoral scientists achieve more publication success?

Departmental communication with postdoctoral scholars. A fundamental issue with postdoctoral scholars is that the department cannot involve postdoctoral scholars in activities, track their progress, etc. without knowing who the postdocs are. Although attempts to identify postdoctoral scholars in departmental laboratories began a year and a half ago, this self-study nevertheless identified many additional postdoctoral scholars in summer 2010. A system to maintain an accurate, comprehensive, ongoing list of all postdoctoral scholars in the laboratories of primary departmental faculty needs to be devised and established. At a minimum, this list would be used to advertise activities sponsored by the Microbiology & Immunology Postdoc Association. We have just started to create a culture of postdoctoral inclusion in departmental activities, which can only be enhanced by informing all departmental postdoctoral scholars of available opportunities.

Departmental recruitment of postdoctoral scholars. Of our 59 current postdoctoral scholars, 26 are international and 21 earned their Ph.D. degree at a North Carolina university. Although there is some overlap between the two groups, together they constitute well over half of our postdoctoral population. Thus, there is likely to be a large pool of postdoctoral talent (American scientists from outside North Carolina) whom we could do a better job of attracting to our department. Furthermore, BBSP has largely relieved us of the administrative burden involved in recruiting graduate students, which provides an opportunity to turn our attention to postdoctoral scholars. It could be worthwhile to think creatively about how we might pool our efforts and perhaps leverage

a modest investment of departmental funds to recruit postdoctoral scholars.

Department participation in postdoctoral training. It could be beneficial for departmental faculty to engage in a serious discussion of how much structure we want postdoctoral training to have. Should postdoctoral training be exclusively based in individual laboratories, as is the current practice, or should there be a department role? How might the department make a positive contribution to postdoctoral training beyond what is currently done? We have not previously held such a discussion.

E. Faculty Issues

Unresolved issues regarding faculty that arose in this self-study include the following:

Faculty expansion. In the past two years, the Department of Microbiology & Immunology faculty active in graduate and postdoctoral education has added eight primary and 10 joint faculty, versus only three retirements or departures. Thus relatively new faculty constitute 30% of our 60 person total. It would be prudent to carefully contemplate how best to successfully assimilate the new faculty into our department and how much additional growth is desirable. We have thought about the directions in which growth should occur during the recent expansion, but perhaps have not fully considered the consequences of growth:

- How do we preserve our culture of collegiality and collaboration in spite of rapid growth?
- How do we maintain our academic expectations for graduate students when preliminary examination and thesis committees could be constituted almost entirely of faculty members new to our department?
- Should there be limits or a moratorium on expansion of departmental faculty? If so, what should be the guidelines?
- Is it a potential problem if joint faculty outnumber primary faculty, or if more Microbiology & Immunology students have joint than primary faculty members as research advisors? Primary faculty and their students still outnumber joint faculty and their students, but not by much.

Teaching evaluations. We are currently modifying our system for collecting student and peer evaluations of faculty teaching quality. Our new procedures should be examined in a few years to ascertain how well they are working and whether the new system accomplishes its intended functions.