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IMMUNOLOGY GRADUATE PROGRAM REVIEW

April 28 – 29, 2016

SECTION I: OVERVIEW OF ORGANIZATION

Mission & Organizational Structure

What does the unit believe in and what are its goals?

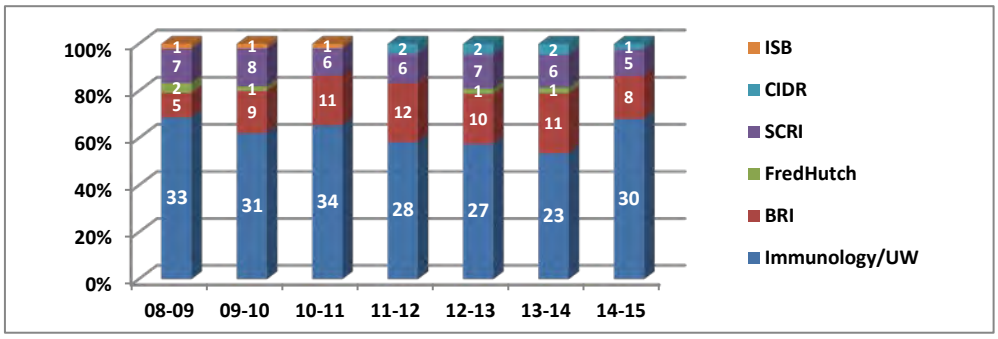
Overview and mission:
The Department of Immunology is a basic science department within the UW School of Medicine. Our mission is two-fold: 1) to conduct research that will advance our understanding of the immune system to better fight infectious diseases, cancer and diseases arising from dysregulation of the immune system; and 2) to train the next generation of basic scientists, physician scientists and clinicians to apply their knowledge of immunology to improve human health. We strive to provide a dynamic research environment for immunological discovery and a comprehensive, rigorous training program to Ph.D. students and postdoctoral fellows in the discipline of immunology. We believe that it is important to understand the function of the immune system from the cellular, molecular and systems biology perspective, emphasizing the connections between the immune system and other biological systems in health and disease. We also believe that research and training in both basic and translational immunology are necessary to fulfill our mission.

History 1986-present:
The Department of Immunology was established in 1986, with Dr. Roger Perlmutter appointed as Chair in 1989. The Graduate School approved our Ph.D. program in 1991. In the early years, there were seven Immunology faculty members: five primary faculty (four of whom were Howard Hughes Medical Institute investigators), as well as two additional joint faculty members who had primary appointments in the Depts. of Pediatrics and Medicine. These two joint faculty members were voting members in the Immunology Department and had significant departmental responsibilities, reflecting the fact that the interests of these faculty were strongly aligned with the mission of the Immunology Department. From its inception, the department also has had a small number of adjunct faculty members (faculty whose primary appointment is in a different department and who are not voting members of the department). In the mid-1990s, the department appointed a small number of scientists from the Benaroya Research Institute (BRI) as Affiliate Faculty (faculty with no reporting structure within the UW are considered Affiliate Faculty). These faculty members are immunologists who participate in training our graduate students both as instructors in our courses and as primary thesis advisors. Dr. Perlmutter left the UW in 1997 and Dr. Michael Bevan served as Acting Chair 1997–1999. Dr. Chris Wilson then served as Chair from 1999–2009. Dr. Joan Goverman became Acting Chair in 2009, and Chair in 2010.

There are now 10 primary/joint regular (tenured or tenure-track) Immunology faculty. Four Assistant Professors have been recruited since 2010, and one Research Assistant Professor joined the department in 2010. Additionally, the number of adjunct faculty and especially affiliate faculty in the department has grown significantly. There are now ten affiliate faculty members: six at BRI, two at the Center for Infectious Disease Research (CIDR) and two from the Institute for Systems Biology (ISB). There are eight adjunct faculty members: three in the Dept. of Pediatrics at the Seattle Children's Research Institute (SCRI), one from the Dept. of Pathology, two from the Dept. of Medicine (one from Div. of Rheumatology, one from Div. of Medical Oncology) and two in the Dept. of Microbiology. The inclusion of adjunct and affiliate faculty strengthens our department greatly. These faculty members are important scientific colleagues and collaborators in the greater Seattle community, and they participate in the teaching and administration of our graduate program.

Because of the close interactions between primary, adjunct and affiliate faculty, our graduate students do not perceive barriers to joining the laboratories of these faculty members located at different institutions. Collectively, the integration of affiliate and adjunct faculty into our department greatly strengthens the Seattle community of immunologists.

The figure below shows the distribution of our graduate students among primary, adjunct and affiliate faculty laboratories.



Indicate degrees offered and provide detailed information on enrollment and graduation patterns.

Graduate Degrees Offered:

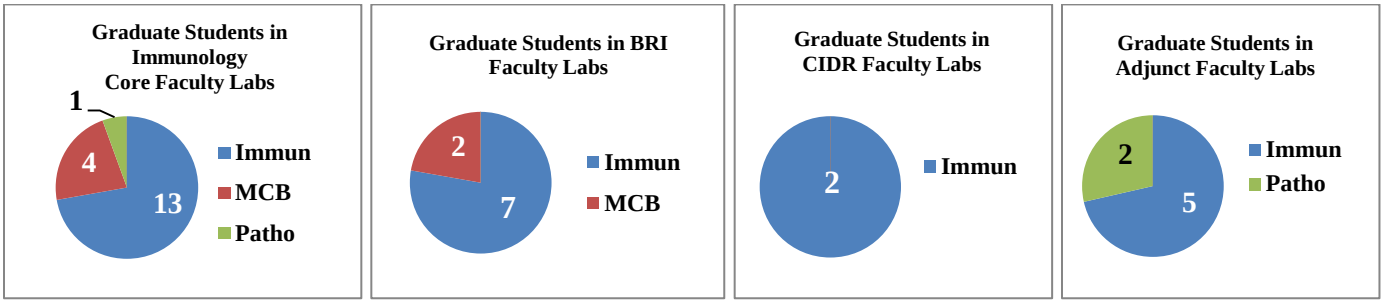
The Immunology Department offers only a Ph.D. degree. Occasionally circumstances arise when a student chooses to leave the program prior to completing their Ph.D. requirements. In these cases, the department faculty assess to what extent the student has completed a body of research and educational activities; and if deemed appropriate, a Masters degree is conferred. The department does not offer certificate programs. Application and matriculation patterns are shown in the table on the right (top) and graduation statistics are shown in the table below.

Entering Year	Applications	Interviewed	Enrolled*
2010	92	29	9
2011	77	25	6
2012	95	24	6
2013	94	18	3
2014	115	25	5
2015	103	26	5

Academic Year	Graduated w/Ph.D.	Average Years to Degree
2010-11	7	6.16
2011-12	4	5.54
2012-13	8	5.68
2013-14	9	5.28
2014-15	3	5.17

The core Immunology faculty also participate in other interdisciplinary training programs, such as Molecular and Cellular Biology, Pathobiology and Biochemistry. Our research programs are attractive to these students and it is common for students from these programs to join our laboratories. Although the students are matriculated in other programs that have different requirements, they become a part of the culture of the department once they join the laboratories of our faculty. We include these students in our Research in Progress weekly seminars; they participate in our department retreat, lunches with seminar speakers and joint lab meetings. They compete for slots on our training grant and are eligible for travel awards and other recognition supported by the Sandra Clark Fund (described in other sections). These students add an important interdisciplinary dimension to our graduate training and our research environment. Apart from the fact that these students have different course requirements from Immunology students, and that the Department is not responsible for monitoring their academic progress, we include students from other programs in all of our activities and make all opportunities available to them that are available to Immunology students.

The figures below show the composition of the graduate student body in the laboratories of our faculty for the academic 2015–16 year.



How is academic and non-academic staffing within the unit distributed?

The ultimate responsibility for management of all departmental activities, including the Immunology Graduate Program rests with the Chair. Various faculty members and staff have critical roles and responsibilities in managing these activities. The Department Organizational Chart in Appendix A shows the reporting structure for all department members. The Graduate Program Organization Chart on page three of Appendix A lists each committee's current membership. In addition, our training program funded by the National Institute of Allergy and Infectious Diseases (NIAID) has a separate organizational chart with Dr. Pam Fink as the principal investigator, and management committees that focus on the supported activities of this training program.

Describe the manner in which shared governance works in the unit, along with how the unit solicits the advice of external constituents.

As described above, the Chair is ultimately responsible for ensuring the provision of high-quality training to graduate students and postdoctoral fellows. While the Chair serves as a gatekeeper to the management of the graduate program, she seeks and receives feedback from all Immunology faculty and works closely with the various committees to ensure achievement of educational goals. With respect to the graduate program, the faculty as a whole are empowered to make decisions. Discussions on issues such as changes to program requirements for degree completion, changes in our curriculum or other substantive issues occur with the faculty as a whole (including affiliate and adjunct faculty). All changes in our program operation and requirements are subject to vote by all Graduate Faculty associated with our program (including votes of adjunct and affiliate faculty). Changes are implemented upon receiving a majority of votes from the faculty. The Graduate Program Coordinator (GPC) is a faculty member who plays an important role in administering our graduate program. The GPC serves as the advisor to first year students, and reports back to the whole faculty on their progress and laboratory rotation choices. The final selection of thesis advisors by first year students requires approval by all of the Graduate Faculty in our program before the selections are confirmed. The GPC is typically the "first point of contact" for any issues involving students. These vary in nature and include a consultation with the Chair depending on the seriousness of the issue. The Graduate Program Assistant (GPA) is a staff member who has significant responsibility in managing the program. The GPA interacts frequently with all students and plays a key role in ensuring that the students are taking the appropriate courses at the right time, and meeting program requirements up to the time of their defense. The GPA provides enormous support and guidance to the students as they navigate their progress toward earning a Ph.D. The GPA can often answer questions and resolve issues on her own; however, she will bring issues that are not easily resolved to the attention of either the GPC or the Chair. The GPA attends all departmental faculty meetings and is a resource for providing information about Graduate School guidelines.

External advice on management of our graduate program primarily comes from the Office of Research and Graduate Education in the School of Medicine. This office provides supportive activities for our graduate students (such as instructional courses on biomedical research integrity, programs providing exposure to alternative career paths etc) and holds monthly meetings of basic science department chairs in which issues and information related to graduate programs are discussed. If needed, the Graduate School is consulted on issues of student conduct and policy.

Provide an outline of the unit's budget

A detailed description of departmental funding sources and usage is shown in Appendix B.

While financially challenging, we believe that a training program focused on immunology, rather than dependence on umbrella programs, is strongly warranted. Research on the immune system is currently driving significant advances in biomedical research. In 2014, 12 of the 40 newly approved FDA-approved novel drugs were different forms of immunotherapy, and 6 of the 9 "breakthrough" drugs were immunotherapies. Therefore, we feel that graduate training in the discipline of Immunology is in strong demand. Nevertheless, we receive no financial support from the Graduate School or any other UW entity to alleviate graduate

program costs. The department is responsible for the salary for our GPA, annual financial costs of graduate student recruitment as well as the cost of tuition and stipends for first-year graduate students rotating through laboratories. It would not be possible for the department to bear these costs on its own and still maintain a critical mass of students in each class. Fortunately, our relationships with our affiliate and adjunct faculty have allowed us to put in place agreements with these other institutions to share the expenses of student recruiting, first-year student's costs and the costs of our GPA. The contribution of each individual institution is defined annually by the percentage of Immunology graduate students currently training at that institution. These costs vary each year according to the number of students interviewed, number of students that matriculate, increases in graduate student tuition, stipends and salary support for the Graduate Program Assistant (GPA) and changes in annual benefit load rates. As the majority of the graduate students train with Immunology primary/joint faculty, a majority of these costs are borne by the department. Appendix B details specific expenses and revenue from adjunct and affiliate institutions over the last six years.

The department also financially supports several critical graduate program events and needs. Events include our weekly seminar series in which visiting faculty present their work and have lunch with the students, an annual 1½ day retreat off-site, weekly Research in Progress talks followed by a social hour with refreshments and a weekly student-led journal club with refreshments. Although faculty, post-docs and students in other programs from adjunct and affiliate faculty labs participate in all of these events, the Immunology Department provides most of the financial support. It is helpful that the costs of lodging and food at the annual retreat are covered by adjunct and affiliate faculty for their lab members, and that BRI has generously provided $10,000/year for the past few years to support the expenses of some seminar speakers. The Immunology Department also supports the IT costs of all students in the program by paying $300/year/student to the Dept. of Medicine's Information Technology group to provide IT support (24/7) for student computers, access and space on the department server.

The department provides further opportunities for graduate students to enhance their training experiences. A fund endowed by Joint Immunology Professor Dr. Edward Clark, in memory of his sister Sandra Clark, supports several of these opportunities. The fund provides annual support for a student-selected keynote speaker at the retreat (including travel and honoraria); a $1,000 Outstanding Graduate Student Poster Award given at the retreat (the Department separately funds a second $1,000 award for Outstanding Postdoc Poster); and two travel awards. These travel awards enable students to attend and actively participate in international scientific meetings, or attend national conferences outside of the immunology field. A new award supported by the Sandra Clark Fund was introduced this year: an Outstanding Graduate Student will be selected annually based on outstanding citizenship and contributions to lab and to the Department of Immunology. The $5,000 award consists of $4,500 applied toward the student's stipend, benefits and tuition; and $500 augmented supplementation provided directly to the student. All opportunities funded by the Sandra Clark Fund are available to students from any graduate program conducting research in the lab of a faculty member in the Immunology Department, including adjunct and affiliate faculty.

Other costs for the graduate program incurred by the Immunology Department are covered using a variety of different funding sources. Please see Appendix B for a detailed description of funding sources and usage. In general, state funds derived from the faculty tax (defined in Appendix B) and funds from affiliate and adjunct faculty pay for first-year stipends and tuition as much as possible. After the first year, students are supported either from training grants or by research grants to faculty. Indirect Cost Recovery (ICR) funds pay for IT costs and all other programmatic expenses except those involving food and alcohol (paid from our discretionary gift account). To preserve sufficient funds, the department maintains a lean administrative and fiscal office team. As a result, the department retains a positive operating balance. We are also projecting a slight increase in our grant funding for FY15 and FY16. Please see Appendix A page 2 for the scope of work managed by this small team.

Indicate how the unit evaluates whether it is making the best use of its current funding and human resources.

We have developed comprehensive post-grant award tracking workbooks, which capture department financial activities and obligations and provide a big picture view of available funds and spending trends. These workbooks are reviewed by the Chair and the Administrator at least once/quarter for purposes of strategic planning. Our major goals have been to meet all current obligations and to steward funds for

future start-up packages for faculty recruitment, as well as identify equipment and core facilities needs. Similarly, the Administrator prepares workbooks for each faculty member meeting at least quarterly to review budget portfolios. This system allows faculty to assess needs for additional grant support, as well as their ability to support graduate, postdoctoral and staff positions in their labs. A robust training and continuous systems improvement process is ongoing for pre- and post-award administrative personnel.

Describe any fundraising/development plan, or grant/contract-getting strategies used to seek additional funding.

All graduate students are strongly encouraged to apply for training grant support, National Science Foundation (NSF) and National Institutes of Health (NIH) pre-doctoral awards. Reminders for National Research Service Awards (NRSA) and NSF fellowships are sent twice per year to students and postdocs. Immunology provides full administrative support in developing and submitting proposals to funding agencies. The department also has limited gift funds to support graduate education and a link to donate is located on our website. For the past two years, the department has distributed an annual newsletter which highlights student awards and achievements, degrees received in the past year, new faculty, research progress etc. This outreach effort has helped to place a strong emphasis on our graduate program and engage with our alumni community. The newsletter also contains links that enable donations to our education funds. With respect to funding for our research programs, our faculty members are aggressive in pursuing funding from NIH, the National Cancer Institute (NCI) and a variety of other sources. The Center for Innate Immunity and Immune Diseases headed by Dr. Michael Gale is also a designated priority in the new UW fundraising campaign; we are hopeful that this philanthropic effort will result in significant support for the Center.

Academic Unit Diversity

Does the academic unit have a diversity plan?

Although we do not have a written diversity plan, we hold diversity as a core value, and strive to create a climate that fosters belonging and respect for all members of our department. We have been most successful in increasing diversity among the student body. In the past five years, 6 of 23 students (26 percent) that matriculated in our program were Under Represented Minority (URM) students; demonstrating a strong increase from the previous five-year period where 5 of 28 (17.8 percent) were URM students.

Our specific recruitment strategies designed to increase student diversity are:

- Active participation in outreach programs to encourage minority students to apply to our program. Our GPA is active on the Biomedical Minority Recruitment (BMR) Task Force. For the past two years, several Immunology faculty and students participated in Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) and Annual Biomedical Research Conference for Minority Students (ABRCMS) meetings where we introduce potential URM applicants to our program. We plan to continue participation at ABCRMS and SACNAS conferences at least every other year.

- We interview a larger percentage of our URM applicant pool compared to the percentage of our non-URM applicant pool selected for an interview because we recognize that the records of academic accomplishment and research experience of URM applicants may not reflect their potential to succeed in our program in the same way as the records for non-URM applicants. In the past five years, we interviewed 22 of 63 (35 percent) of URM applicants compared to interviewing 95 of 419 (23 percent) of non-minority applicants.

- URM applicants participate in a breakfast during their recruitment visit hosted by the Research and Graduate Education (RGE) Office where they meet with current matriculated URM students.

Does the unit have a diversity committee and, if so, what is the representation on the committee?

As a small department, we do not have a separate diversity committee. The faculty that recently represented the department at the SACNAS and ABRCMS conferences were selected from faculty who currently have URM students in their labs. Last year, these were Drs. Betelli, Hamerman, Oberst, Pepper and Savan.

What is the diversity of the unit's faculty, administrative support services and technical staff?

The current demographics for our 10 primary faculty members are as follows: 80 percent (eight) of the faculty are Caucasian, 10 percent (one) is Asian and 10 percent (one) is from India. Women comprise 50 percent (five) of the core faculty. All six administrative staff members are Caucasian, five are female and one male. Technical Staff, Research Scientists and Research Coordinators are ~80 percent Caucasian, 13.3 percent Asian and 6.7 percent other. Our specific strategy to improve faculty and staff diversity includes the implementation of a new requirement for members of our faculty search committee to review a brochure titled "*Reviewing Applicants: Research on Bias and Assumptions,*" made available by the Center for Health Equity, Diversity and Inclusion at the UW School of Medicine. We will also provide this material to all faculty members as they all participate in decisions regarding graduate student admissions and in hiring their laboratory staff.

Describe how the unit utilizes institutional resources or partners with organizations such as the Graduate Opportunities and Minority Achievement Program (GO-MAP) in the Graduate School to conduct outreach and to recruit and retain underrepresented minority undergraduate and graduate students.

To enhance retention of minority students in our program, we facilitate their connection to Graduate Opportunities and Minority Achievement Program (GO-MAP) activities to ensure exposure to the broad community of minority students in different academic programs. We apply for Go-MAP support for URM recruitment every year. Two years ago, we received an award from GO-MAP but the applicant chose to matriculate elsewhere. Last year we did not receive an award; this year we received an award and the applicant has not yet decided where to matriculate.

Describe outreach strategies the unit employs with underrepresented minority students, women, student with disabilities, and LGBTQ students to diversify its student body.

The Center for Innate Immunity and Immune Disease (CIIID) within the department establishes 2–3 partnerships per year with middle and high schools from the greater Seattle area. These partnerships involve Immunology postdocs and graduate students visiting the schools, and the school's students then visit the department and participating in activities across multiple rotation stations. Partnerships include the Nautilus K–8 School, the Kent-Meridian High School Biotechnology and International Baccalaureate Biology classes and the Shoreline Community College Project Biotech Summer Camp. Student populations at these schools have had a broad representation of minority and/or underrepresented students. The CIIID also established a Summer Internship program for high school students to experience the field of innate immunity. In 2015, our three summer interns were from minority and/or underrepresented populations. We do not have data on the LGBTQ status of our students, and do not have students with declared disabilities.

Describe initiatives the unit has employed to create an environment that supports the academic success of underrepresented minority students, women, students with disabilities and LGBTQ students.

The increase in diversity in our student body of students from under-represented backgrounds is perhaps the most powerful factor enabling us to recruit and retain minority students. In most years, our graduate student body has a slightly higher percentage of women than men. The department has a zero-tolerance policy for any behavior that is discriminatory or demeaning to any person based on their ethnicity, gender or LGBTQ status.

Describe how the unit utilizes institutional resources such as the Office of the Associate Vice Provost for Faculty Advancement to recruit and retain faculty from underrepresented minority groups.

We plan to introduce our faculty to the "*Handbook of Best Practices for Faculty Searches*" created by the Office of the Associate Vice Provost for Faculty Advancement.

What specific strategy has the unit employed to support the career success of faculty members from underrepresented groups, and where applicable, women faculty? To what extent has the unit been successful in diversifying its faculty ranks?

We are a small department deeply invested in the success of all of our faculty members. Fifty percent of our faculty is female; three of four full professors are female. We do not currently have under-represented minority faculty.

SECTION II: TEACHING & LEARNING

Student Learning Goals and Outcomes

What are the student learning goals, what are they expected to learn?

There are two fundamental learning goals for our students:

1. Acquire the necessary body of knowledge needed to master the current understanding of the immune system and how it connects to other disciplines, the experimental methodologies used to address questions and an understanding of how to translate that knowledge into clinical applications.
2. Become proficient in critical thinking, hypothesized-based experimental design, written and oral communication skills and the ability to identify novel ideas of significant impact.

Our course curriculum (described below and see Appendix E), is designed to achieve the necessary body of knowledge described in the first goal. The second goal is achieved via the Qualifying Exam (QE), participation in many individual and joint lab meetings (where new findings, experimental design and overall impact are critically discussed) and the General Exam. There are additional opportunities to improve communication skills, including rotation talks, departmental Research in Progress (RIP) talks, lab meetings, retreat presentations and presentations at national meetings.

Our graduate students progress through our program as follows:
Incoming students are introduced to the program via a two-day New Student Orientation (NSO) in September before Autumn Quarter classes begin. Program requirements are discussed as well as the multiple training sessions required for all new personnel. The new students have lunch on the first day with second year graduate students, who can offer informal advice on navigating the new graduate school environment.

Our annual offsite department retreat occurs in September over a two-day period (the retreat occurs between Day 1 and Day 2 of the NSO). In addition to the student-selected Keynote Speaker, faculty, postdocs and students give talks throughout the afternoon of the first day and the morning of the second day. The talks on the first day are followed by informal sport and social activities, a reception and dinner. A poster session in which graduate students, postdocs and research scientists present their research is held in the evening followed by an informal social hour. Poster awards are announced on the second day after the morning session of talks.

First year students complete three quarters of required coursework and rotate through three laboratories for one quarter each (10 weeks). At the end of each rotation, the students present a short talk to Immunology faculty, postdocs and fellow students summarizing the problem addressed, the techniques used to approach it and any preliminary data acquired during the rotation. The first rotations are assigned by the GPC based on interests expressed by the students prior to their arrival; the next two rotations are selected by the students in consultation with the GPC. First-year students are required to take three core courses taught by Immunology faculty that are the backbone of our curriculum:

Immunological Methods (Fall quarter, weeks 1-5, graded) introduces graduate students to molecular, cellular, computational and whole-animal experimental strategies and methodologies. Through lecture, discussion and hands-on activities, students learn to critically evaluate experiments and the selection of appropriate strategies for any given immunological research question. They also learn how to use new methodologies by computer-based exercises in class.

Intersection of Innate and Adaptive Immunity in Disease (Winter quarter, weeks 1-10, graded) is the centerpiece of the our curriculum and immerses students in the principles and experimental approaches relevant to understanding the development and function of the immune system, the molecular basis of immune responsiveness, innate immunity and the regulatory mechanisms underlying immune tolerance

and cellular homeostasis. This intensive four credit quarter-long course consists of faculty lectures and student-led journal article discussions.

Immunological Based Diseases and Treatment (Spring quarter, weeks 1-10, graded) is our new course that is designed to be translationally oriented. Lecturers are selected who are experts in particular immune-based diseases and their treatment. Each lecture is followed by an hour of discussion led by the course chairs.

Central Issues in Immunology (Spring quarter, weeks 1-5, credit/no credit except graded for MSTP students) is designed to teach students how to design a robust research proposal. Faculty assign current research papers for each class session that serve as material for student-led discussions of the relevant findings and how a research proposal could be generated from these findings. The students are asked to 1) identify the fundamental question that arises from these papers; 2) define the relevance of the question to human health; 3) formulate a hypothesis that addresses the question and specific aims that would test the hypothesis; and 4) design a feasible experimental plan that accomplishes the aims. Students are asked to consider possible outcomes, limitations of their approaches and alternative approaches. This course is intended to help students prepare for their Qualifying and General Exams. This course also includes a session in which issues surrounding the ethical conduct of research are discussed using actual case-based studies.

Intro to Laboratory-Based Biostatistics (Summer quarter, graded) is designed to provide key background in statistical methodologies used in biomedical research.

Collectively, these formal courses offer an integrated program that builds in complexity, providing first a general foundation in biology and basic immunology, and then an in-depth consideration of diseases of allergic, infectious and immunologic nature. First year students also take some elective courses, choosing from a set of courses offered in five-week blocks by the Cellular and Molecular Biology Graduate Program. Individual students choose courses based on their background and their interests. The most popular choices of our students among these courses are Signal Transduction from Cell Membrane to Nucleus, Molecular Evolution of Viral Host Pathogens, Topics of Molecular Medicine, Molecular Medicine and Modern Approaches to Vaccines.

Our students also participate in the Biomedical Research Integrity Course administered by the SoM during the summer of their first year and again in four years.

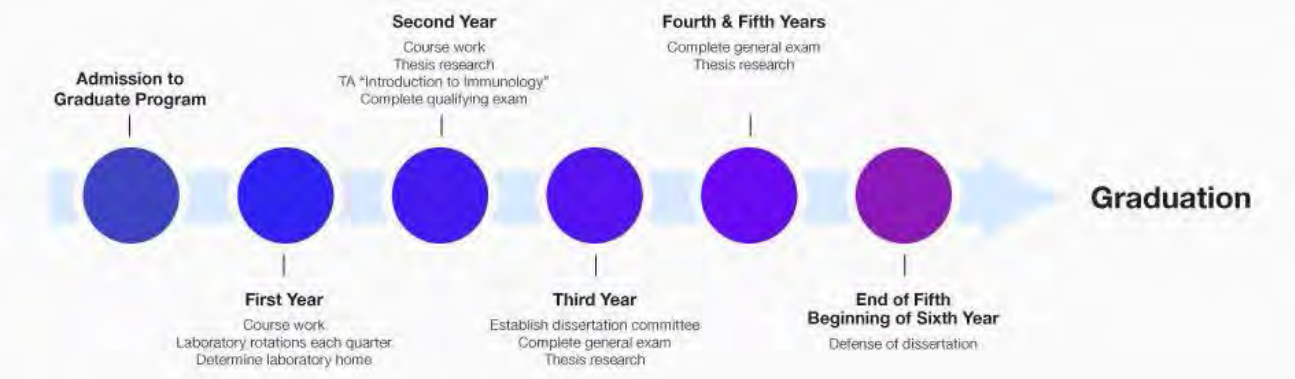
Students in their second year begin research in their newly chosen lab. They begin participating in lab meetings associated with their selected laboratory, and in joint lab meetings associated with the lab of their mentor. They also complete the remaining elective courses needed to fulfill the credits required for graduation, as well as their required teaching assistantship of our undergraduate immunology class in the fall quarter. In winter quarter of this year, students give their first Research in Progress (RIP, see below for description) seminar to the department. Second-year student again take the Central Issues in Immunology class as additional preparation for their Qualifying Exam. Each graduate student is required to take the Qualifying Exam in June immediately following his or her second year of classes. Students who have passed the Qualifying Exam focus for the next 6–9 months on their research, before beginning to prepare for the General Exam, which must be taken within 15 months of the Qualifying Exam. Graduate Students in Immunology generally take the General Exam prior to or in Autumn Quarter of their fourth year.

In the third year and beyond, students continue their dissertation research, attend seminars, journal clubs, lab meetings and participate in RIP, the department retreat, poster sessions and recruiting events.

Throughout their time in the program, all of our students attend a weekly Research in Progress (RIP) seminar series (IMMUN 550, credit/no credit) in which a graduate student and a postdoctoral fellow present their current research activities and findings, with opportunity for audience questions. The event is open to the public

and advertised to all members of the "Immunology Interest Group", i.e. home institutions for all of our affiliate and adjunct members and everyone else who has expressed an interest in our departmental events. Recently, we have instituted a requirement for all students to fill out peer-review forms for their fellow graduate student speaking each week. The forms are collected by a designated faculty member who synthesizes the feedback and also meets individually with the student speaker to provide constructive feedback. The emphasis is to provide students an opportunity to speak about their research, receive feedback on their oral presentation skills and stimulate collaborations. A social hour sponsored by the department follows where RIP attendees have the opportunity to unwind and build relationships with all department members. Over the past few years, attendance at RIP and the social hour have increased. This event contributes to the greater immunological community by keeping all members informed about ongoing research in Immunology faculty member labs and by forging new collaborations and relationships. Students also attend the weekly Immunology Seminar Series (IMMUN 573, credit/no credit) in which featured faculty lecturers from around the country (and sometimes from within the UIW School of Medicine) discuss their latest advances in research. In conjunction with the IMMUN 573 Seminar Series, graduate students meet weekly in a Student Journal Club to discuss the upcoming speaker's research with food provided by the department. Graduate students and postdocs volunteer to have lunch with the invited speaker on the day of the seminar.

The graphic below summarizes the progression of a student through our program:



In what ways does the unit evaluate student learning (such as classroom - and/or performance-based assessments, capstone experiences, portfolios, etc.)?

Most of our required classes are grade-based with a minimum grade of 3.2 in all required courses. Evaluations in graduate courses are largely based on problem sets that assess knowledge, critical thinking and experimental design skills. The GPC reports on any students who fall below this grade in any course, and the faculty collectively discuss remediation options. Passing the QE is a major checkpoint in assessing the student's ability to identify an important question, develop a reasonable hypothesis that, when tested, would have an impact on the field and design feasible aims that will test their hypothesis. Students take the Central Issues in Immunology course twice before they take their QE, and this is intended to strengthen the skills that they need to design a research proposal. The General Exam is another checkpoint. Here the student presents their proposed thesis in the written format of an NIH proposal and defends his/her ideas in an oral exam. In less formal arenas, the thesis advisor evaluates student progress via the student's presentations at individual lab meetings as well as in joint lab meetings, and during discussion of annual Individual Development Plans (IDPs). Annual committee meetings are also required after the committee is formed and these meetings are intended to monitor student progress and provide advice to the student on how to accomplish their goals. The students also have "peer review" at their RIP presentations as described above, and receive feedback on improving their oral presentation skills from the faculty member overseeing RIP that quarter.

What methods are used to assess student satisfaction? What efforts are made to gauge the satisfaction of students from under-represented groups?

The instructors in our graduate courses are evaluated by the students at the end of each course using standardized forms, and instructors receive quantitative evaluation on their effectiveness as well as personal comments from the students. For overall feedback on the program, much of the student's feedback has historically been received informally. Students express concerns to their PIs or to the GPC, or occasionally they are voiced by the student representative at monthly faculty meetings. Discussions at IDP meetings are a new forum intended to give the student an opportunity to provide feedback on the resources provided for their education. While our faculty felt they had a good sense of the student's views on the strengths and weaknesses of our graduate program, Dr. Goverman re-established the Curriculum Committee in 2012 in order to evaluate our curriculum, i.e., determine its effectiveness and identify any new directions that should be incorporated. Based on discussions within this committee, Dr. Goverman and the department administrator generated a graduate student survey in 2013 designed to obtain student feedback on all aspects of their graduate student experience. 66 percent of our 38 matriculated graduate students participated in the survey. The compiled results and a report that synthesizes the data are located in Appendix D. The survey (a first for our department) was extremely helpful in guiding changes to our graduate program.

We do not have a distinct process for gauging satisfaction of URMs in our program.

What are the findings of the assessment of student learning in each program of study?

Our students do very well academically; we have had few issues with low grades or GPA. In general, our students are also very successful as Teaching Assistants (TAs) for our undergraduate class, which we believe indicates that the students have acquired significant teaching skills. All students learn a tremendous amount of immunology when they serve as TAs. They also learn a great deal about the challenges of teaching, particularly as they are very engaged in generating the three exams and learn how to write relevant, clear questions that test knowledge. The students usually teach their quiz sections in pairs, although the preparation for the quiz section is done as a group. This is an extremely time-consuming activity for the students, they devote most of the fall quarter of their second year to TA responsibilities. The course chair of IMMUN 441, Dr. Stetson, has observed that most students exhibit significant growth in their teaching skills. However, we have also observed that more introverted students tend to let the more outgoing students engage the students in the quiz sections. We have not found a good solution to overcoming the reticence of more introverted students as we typically pair them with more confident students in order to ensure an effective quiz section for the undergraduate students. Each TA is evaluated by the entire undergraduate class at the end of the quarter using standardized evaluation forms; the students all tend to score quite well and are appreciated by their students. A majority of students reported on the survey that being a TA for our undergraduate class was a very valuable experience (52 percent), and the majority suggested that first year students should attend 441 lectures to be better prepared for the TA role.

One of the biggest challenges for our students is the Qualifying Exam (QE). It is not uncommon for a student to be required to re-write (and sometimes re-present) a portion of their NIH-style proposal, and on rare occasions, students are asked to prepare a new proposal if the original proposal appears fatally flawed. The initial outcome varies from year to year; generally, ~50 percent cleanly pass the exam and rarely does a student need to prepare a new proposal. The majority of students responding to the survey agreed that the QE was a very valuable component of their training. Students reported that the Central Issues in Immunology course was helpful in preparing for the QE, but also felt that more clarification of the guidelines and faculty expectations was needed. The QE committee has had increased involvement over the past three years in providing early feedback to the students (described below) before they take the exam and this has been very helpful. It is rare for a student to fail the General Exam on their first attempt. We have had one example of this recently; the student was asked to re-write one aim of her proposal and her committee felt that she would progress to completion of her degree.

In the past few years, our graduate students have won many awards for best poster presentation at the Mid-Winter Conference of Immunologists, and several of our students have been awarded speaking slots at this meeting and other meetings. We feel this recognition reflects good preparation of our students on presenting their research in both written and oral formats.

How has the unit used these findings to bring about improvements in the programs, effect curricular changes, and/or make decisions about resource allocation?

We have made a number of important changes to our curriculum in response to student feedback and to our own sense of changing needs for student preparation. Our students reported that the centerpiece course in our curriculum, Intersection of Innate and Adaptive Immunity in Disease (previously called Advanced Immunology), was very effective. Some students felt that the tag-team teaching made the course somewhat disjointed, but others appreciated hearing from lecturers who were experts in a diverse array of topics in immunology. In response, we have increased the number of lectures given by teaching faculty so there are fewer overall instructors, but have nevertheless retained diversity in our instructors as we endorse the view that hearing from a variety of experts is appropriate at the graduate level. Two of our core courses, Host Defense to Cancer and Host Defense to Infection were deemed only "somewhat valuable" in our student survey, some students felt that they suffered from a lack of focus and disjointed organization. Furthermore, only 48 percent of respondents felt that they received sufficient exposure to translational immunology. In response, we have eliminated the Host Defense classes and introduced the new course, Immunological Based Diseases and Treatments. This course addresses the mechanisms leading to the development of immunologically based diseases. Topics include the genetic and environmental basis for dysregulated innate and adaptive immune responses that lead to autoimmune diseases, as well as current therapeutic approaches used in treat different autoimmune diseases. In addition, this course covers the immunological responses directed against specific infectious agents relevant for global health including malaria, TB, HIV, HCV and discusses ways to improve those responses. This course also addresses immunological mechanisms involved in chronic inflammation and cancer and describes the approaches to enhance immunity to infectious agents and malignant cells. The course is designed to provide a translational perspective and integrate basic immunological mechanisms with the etiology of diseases (autoimmunity, infection and cancer) relevant to public health.

The students also expressed a desire for more training in biostatistics. In response, we now require that our students take the Conjoint course Introductory Laboratory Based Biostatistics. We have received positive feedback on this class and believe this is an excellent addition to the curriculum. Our new course, Immunological Methods, had only a few students evaluating it, and the response was mixed; some students found it useful but many students felt they were already familiar with much of the content. In response, we replaced one of the co-chairs of this course with Dr. Andrew Oberst, and he has introduced several changes. The content of the course now includes big data analyses, application of CRISPR technology and related topics. The course is also much more participatory; students bring their laptops to class and carry out assignments that include searches of gene banks, design of guide RNAs etc. Implementation of the QE has also changed in recent years. Previously, students submitted to the QE Committee only the topic on which they would base their proposal and a short description to obtain approval by the committee. The QE committee largely focused on whether the topic was sufficiently removed from their thesis research and had sufficient relevance to human health. The consensus among students and faculty was that more explicit feedback was needed before students fully prepare their proposals. Therefore, the students now submit a more robust draft of specific aims and experimental approaches for committee approval. This has resulted in more meaningful feedback from the committee to the student during the preparation stage, and overall resulted in better performance during the QE.

If applicable, note the courses typically taken by undergraduates who will not be majors in any of the unit's programs. Are there specific learning goals in those courses designed to accommodate such "non-major" students? If so, how is student achievement in reaching these goals assessed?

Our department teaches a 400-level class in Immunology that is required for majors in Microbiology. This Introduction to Immunology course (IMMUN 441) explores the general properties of immune

responses; cells and tissues of the immune system; lymphocyte activation and specificity; effector mechanisms; immunity to microbes; immunodeficiency and AIDS; autoimmune diseases; and transplantation. There are approximately 150 undergraduate students taking this course each year. Students are graded on two midterm exams and a final exam, all mainly multiple-choice. In addition, students are required to attend a Quiz Section each week led by second year Immunology graduate students serving as TAs. These Quiz Sections consist of non-graded quizzes, lectures and question/answer periods. This is a rigorous class; the average grade for the 159 students in Autumn Quarter 2015 was 3.07.

Instructional Effectiveness

Including the use of standardized teaching evaluation forms, describe and discuss the method(s) used within the unit to evaluate quality of instruction.

We utilize standardized teaching evaluation forms for the instructors in our different classes. These forms include student assessment of the overall value of the class in addition to the effectiveness of a particular instructor. We pay particular attention to the individual comments written by students about how the course could be improved.

Please note all opportunities for training in teaching that are made available to any individuals teaching within the unit (including graduate students). These may be opportunities that support teaching improvement, innovation, and/or best practices, for example.

Opportunities for training in teaching are provided to our students when they first enter the program and attend a workshop administered by the Center for Teaching and Learning. The annual TA/RA Conference on Teaching, Learning and Research is designed to help graduate students prepare for their roles and responsibilities as Teaching Assistants (TAs) and Research Assistants (RAs) at UW. The Conference provides attendees with information and resources on teaching and learning at the University and opportunities to explore and develop a variety of teaching strategies. Participants are able to ask questions of experienced TAs and RAs in similar disciplines.

There are a number of opportunities for training in teaching for faculty that are provided by The Office of Faculty Development. This office offers a number of training sessions designed to enhance faculty teaching skills. For example, some programs offered by OFD are: Teaching Tips for Teaching the Basic Sciences, A new paradigm for feedback: learner engagement and the intentional learning environment, as well as a number of video recordings on teaching such as Transforming your Teaching, Skills for Small Group etc. Regular communications on course availability are sent to our faculty, and the Chair supports the desire of any faculty to participate in these courses. However, the reality is that our faculty find it difficult to set aside the time needed for these courses.

Describe specific instructional changes you have seen made by instructors in response to evaluation of teaching within the unit.

As discussed above, the half of our Methods course led by Dr. Oberst has evolved to be a highly participatory course with students actively engaged in assignments during class time. Dr. Stetson has also implemented a significant change in the instruction of our undergraduate class in immunology. This was historically a very "tag-team" taught course, and the students were dissatisfied with the lack in continuity in teaching styles and lack of collaboration in coordinating content among lectures. In response, Dr. Stetson now teaches a very large number of lectures himself, which has met with a very positive response from the students. Dr. Stetson is a gifted teacher and has greatly enhanced the learning experience in this course.

Teaching and Mentoring Outside the Classroom

Describe and discuss how faculty members are involved in undergraduate and graduate student learning and development other than through classroom teaching (i.e., informal learning, independent studies, research involvement, specialized seminars or workshops, etc.).

The majority of teaching and mentoring by our faculty occurs outside the classroom. Immunology faculty members provide intense one-on-one mentorship to all of their graduate students. Most faculty members have a weekly one-on-one meeting with each graduate student; this is invaluable in keeping students on track with their studies. Our faculty also spend considerable time mentoring students conducting thesis research in other laboratories by providing feedback in joint laboratory meetings and serving on thesis committees. Based on the results of our survey, most students felt that they had adequate interaction with their PI but would benefit from more interaction with their thesis committees. We are attempting to be more rigorous in requiring annual committee meetings and meaningful reports on these meetings. We also hope that implementation of IDPs will provide more specific and individual mentoring to students. A number of our faculty, especially junior faculty, have mentored undergraduate students in their labs. While we do not have a formal mechanism for evaluation of these students, the experience appears to be very successful for both the student and the PI. In fact, we recently had one of these undergraduate students apply to our graduate program and she was immediately offered admission as one of our top candidates.

Describe how the unit works with undergraduate and graduate students to ensure steady academic progress and overall success in the program, and any additional efforts to support students from under-represented groups.

Academic progress of our students is largely monitored by their achievement of the QE and General Exam milestones, annual meetings and reports from their thesis committee, and the quality of their RIP presentations and joint lab presentations. In addition, IDPs represent a new mechanism to monitor student progress. If we detect a student struggling with any aspect of their training, the thesis advisor will work with the student to address deficiencies. The GPC reports to the faculty as a whole if a sufficient problem is perceived in a student's progress. We do not currently have separate programs or mechanisms for under-represented groups; although we strongly support participation in SACNAS and GO-MAP-related activities.

Describe how the unit works with undergraduate and graduate students to prepare them for the next phases of their academic or professional lives.

The goal of every thesis advisor is to prepare their student for a successful transition to the next phase of their career. For many, this means ensuring that the student's work is published in a timely way and in as visible a journal as possible. For both faculty and students, this goal often necessitates hard choices between accumulating sufficient data for a high impact journal or publishing more quickly in a journal that might require a less complete story. We recognize that only a minority of students will go on to faculty positions in academic institutions, and we attempt to take the students goals into consideration when determining where and when to publish the student's work. Discussions focused on IDPs should facilitate this process. We further recognize that many of our students will go on to careers in industry, teaching, journalism, administrative and legal work for which their Ph.D. in Immunology has relevance, and we wish to support exploration in these other types of careers. We encourage our students to attend workshops offered by the Office of Research and Graduate Education that provide exposure to, and role models for, alternative career choices. We are also discussing mechanisms to better connect our students with alumni who have entered alternative career paths. We believe this will provide our students with more informed and relevant perspectives on the career options before them as they complete their Ph.D. UW Immunology graduates have become successful researchers and scientists in both academia and industry, and we believe that direct exposure to their experiences would benefit our students

SECTION III: SCHOLARLY IMPACT

Describe the broad impact of faculty members' research and/or creative work. Note specific individuals and how their work embodies the unit's mission, or distinguishes the unit from those at peer institutions.

Since the last Graduate Program Review in 2003, the composition of our departmental faculty has changed from predominantly senior faculty to a mixture of senior and junior faculty with only one Associate Professor. Our primary faculty members consist of four full Professors, one Associate Professor and five Assistant Professors (one in the research track). We have also transitioned from being a fairly "T-cell centric" department to a more broadly-based faculty that studies innate immune responses as much or more than adaptive immune responses.

The four full professors are all well published and are recognized for the impact of their work on our understanding of the immune system. Dr. Pam Fink is the Editor-In Chief of the Journal of Immunology, a role conferred only on distinguished immunologists. This is the journal of the American Association of Immunologists and is very influential in conveying recent findings in immunology. Dr. Fink's research had advanced our understanding of the differences between T cells that first emerge from the thymus where they differentiate and T cells that have been in circulation for long periods of time. This work is important to understand how T cells learn to be tolerant of self-antigens, to gain insight into optimal strategies for vaccinating children (whose T cells are younger than those found in adults) and in optimizing T cell responses to tumors. Dr. Michael Gale Jr. is one of the co-discoverers of the RIG-I pathway in innate immunity and his research program has grown enormously since he joined the department. Broadly, Dr. Gale's laboratory studies innate immune responses to viral infections using mouse and non-human primate models. His work is funded by numerous NIH-funded grants and contracts, and he has authored more than 155 papers. In a very important development for the department and the field, Dr. Gale recently established the Center for Innate and Immunity and Immune Disease (http://ciiid.washington.edu/). We anticipate that this center will draw the best scientists focused on understanding mechanisms of innate immunity to the UW School of Medicine, and will have an enormous impact on both basic and translational medicine. The CIIID has also launched very significant outreach activities to K-12 students Dr. Joan Goverman is a leader in the study of autoimmune diseases with a focus on understanding the pathogenesis of multiple sclerosis. Her work is largely published in high profile journals and she is the recipient of a NIH merit award in recognition of the novelty of her work. She has largely worked in animal models in efforts to build models that more closely resemble the pathological features seen in MS patients. Recently, she has begun to test some of her findings in MS patients. Dr. Nancy Maizels is a well-respected immunologist who focused for many years on mechanisms underlying immunoglobulin gene diversification. Her studies on mechanisms that maintain and alter genomic structure have led to the development of new targeted approaches for gene therapy with a particular emphasis on therapies dependent on DNA nicks. Dr. Maizels is also a leader in the study of G4 (G-quadruplex) DNA in genomic biology. G-quadruplexes can promote genomic instability and have clear connections to human disease. Dr. Maisel's research is well funded and she has published over 122 papers.

Our Associate Professor, Dr. Dan Stetson, has built a strong, well-funded research program that has attracted many trainees. He has also played a crucial role in our teaching mission as he has single-handedly revamped our undergraduate immunology course and taught the vast majority of the lectures himself for several years. He is regarded as a leader in the field of innate immune sensing of nucleic acids: of the six primary research papers from his laboratory since he joined our faculty, one is published in Science, one in Nature Immunology, two papers are in Immunity, one is in J Exp. Med and one in the Journal of Immunology (JI).

One tenure-track Assistant Professor joined our faculty only five months ago; however, the other three tenure-track Assistant Professors all have RO1s and all have either a R21 or some other equivalent-type grant. Given the very difficult funding climate in which they launched their careers, this is a remarkable achievement reflecting their accomplishments and potential. Their research programs are very attractive to graduate students and postdocs, and they are all heavily engaged in our teaching mission. Each junior faculty member has been invited to speak at multiple high-profile meetings (Cold Spring Harbor, Keystone, etc.) and to participate in NIH grant review sessions, confirming that they have achieved recognition from the community. Importantly, each Assistant Professor focuses on a distinct area of immunological research and therefore is a pivotal piece of

the Chair's strategic plan to build a diverse community of immunologists that could intersect with many other research interests in the University and the larger community. It is a bit early to judge the publication record of these junior faculty, although they have published papers in Nature Immunology and Immunity.

For undergraduate and graduate students, describe significant awards, noteworthy representations, or activities that have had an impact on the field while in the program.

In the period of time since our last review, our students have garnered a number of important awards in recognition of their work. After a national competition, C.J. Cambier was awarded the prestigious Weintraub Award for his graduate work. Akshay Krishnamurty received an American Association of Immunologists 2014 Trainee Abstract Award; Quy Lee (MCB graduate student who worked in Nancy Maizels' laboratory) received the poster prize at the 2014 Seattle Genomics Instability Meeting. Katie Burleigh and Katie Wagner were both awarded NSF GRFP Fellowships. This year, Akshay Krishnamurty and Kristen Mittelsteadt won awards for outstanding oral presentations at the Midwinter Conference of Immunologists, and Nicole Arroyo won an outstanding poster award at the same meeting. Martha (Genita) Metzler received the Keystone Symposia Underrepresented Minority Award in 2015. She also received an AAI Trainee Abstract Award in 2016. Kerri Thomas won a Trainee Poster Award for AAI 2016. Talyn Chu was recently awarded a F31 Diversity NRSA Fellowship. Stephanie Varela (MSTP) received the Seattle ARCS Fellowship in July of 2015. Rochelle Joslyn received a TL1 graduate trainee award from the Institute of Translational Health Sciences from 2014-2016. In addition to scientific recognition, two of our students, Alexandria Grier and Genita Metzler, were nominated for the Excellence in Teaching Award competing with all TAs at the UW for their outstanding teaching of medical students in 2013.

For units in which postdoctoral fellows are appointed, describe their participation in the research and teaching activities of the unit.

The Department of Immunology is home to more than 20 postdoctoral fellows who come from a number of scientific backgrounds but share a common interest in understanding the function of the immune system. Another 50 plus postdoctoral fellows in labs of our affiliate and adjunct faculty are also fully engaged in the Immunology Department activities. They represent a significant part of each individual lab's research effort and culture, and are critical to our academic community. Postdoctoral fellows actively engage in departmental activities and present their research at weekly research-in-progress (RIP) events, the annual department retreat, and at professional scientific meetings. They also serve as mentors to graduate students and junior research staff in the Immunology laboratory groups. Several of our post-docs are also very engaged in outreach activities to high-schoolers or middle-schoolers, and this enhances their training in teaching and community involvement. Overall, the goal of our faculty is to provide the means for post-docs to achieve several key goals: acquire training in many aspects of independently running a research program (e.g. grant writing, budget management, networking and building collaborations), present research at scientific meetings and publish scholarly work that will enable the transition to an independent position, and obtain exposure to career paths other than academic positions.

Describe how program graduates have had an impact on the field either academically or professionally.

Obtaining a Ph.D. is the first step in a long training process for many of our students. To assess the longer-term outcome of students who obtained their Ph.D. from our department, it is necessary to take a historical perspective as our most recent graduates are typically still in training positions. There were 55 Immunology Department graduates between 1994 and 2007. Of them, at least 14 currently hold faculty positions at academic institutions with most of these positions being tenure or tenure-track. Examples of these institutions are Stanford University, University of California, San Diego, University of Massachusetts Medical School, Texas A&M and the UW. The table below describes the current positions of our graduates who have completed their degrees between 2008 and 2015. It is evident that most of them obtain postdoctoral training positions after graduating from the Department. In preparation for faculty and scientific jobs, the postdoctoral positions provide our graduates with opportunities to further develop independent research aims, apply for mentored career and grant funding, as well as opportunities to teach and mentor students. The second largest trend is towards scientific careers in industry. Many of these individuals currently hold positions at companies like Juno, Genentech, Novo Nordisk, Biogen and others. Our MSTP graduates assume M.D. residency after completing both of their Ph.D.

and medical school requirements. A smaller number of our graduates have been assuming staff positions such as research scientists at labs at institutions for higher education.

Grad Class	Postdoc	Industry Scientist	Residency Faculty	Staff in Academia	Other	Total
2008	1	1		2		**4**
2009	1		2	1	1	**5**
2010	6	5	2	1		**14**
2011	1	2				**3**
2012		2	3			**5**
2013	4	1	2		1	**8**
2014	6		1		1	**8**
2015	2	1				**3**

In what ways have advances in the field or discipline, changing paradigms, changing funding patterns, new technologies and trends, or other changes influenced research, scholarship or creative activity in the unit?

Like many fields of biomedical research, the ability to carry out deep sequencing and utilize an array of approaches to interrogate RNA transcripts and protein expression have influenced our research. Genomics, proteomics and metabolomics have had an impact on immunology, as they have had on other disciplines, and our faculty members have incorporated these approaches into their research where applicable. The department itself is not home to instrumentation that facilitates important technologies such as deep sequencing, which we view as a barrier to conducting our research. We plan to re-submit a S10 grant to purchase a sequencer as our demand for this resource is quite high. Our initial application was faulted only for a perceived lack of institutional support for a core instrument. The field of metabolomics is particularly important in immunology at this time, as the metabolic state of T cells and potentially other immune cells appears to play a pivotal role in regulating the immune system. We do not have a Seahorse instrument, and predict that this will become problematic in the future if the research programs of our faculty require significance use of this instrument.

During the past 10 years, Immunology has been significantly affected by the dramatic decrease in NIH funding, resulting in low pay-lines. This has been problematic for faculty at all ranks. Our assistant professors have been successful in securing RO1s, but it has required great perseverance and bridge funding in the case of one assistant professor. Junior faculty are now facing the challenge of securing a second RO1, and this has been very difficult. Given that a graduate student now costs >$50,000/year, and junior faculty are required to raise ~32% percent of their salary, it is difficult to support more than one PI, one graduate student and one technician on a RO1. Similarly, senior faculty have struggled to maintain funding at the level of 2 RO1s. For these faculty, the burden of raising money for their salary is even greater and consumes a larger percentage of a RO1 grant. One full professor has recently required bridge funding and it is anticipated that this will occur in the future with other faculty. Despite the challenges of RO1 funding, our faculty have been resourceful in obtaining R21s or other sources of support. We believe our programs are very competitive and will continue to receive funding; however, this is an “ever-present” concern.

List any collaborative and/or interdisciplinary efforts between the unit and other units at the University or at other institutions, and the positive impacts of these efforts.

Our core faculty hold adjunct or joint appointments in many other departments, including Biochemistry, Genome Science, Global Health, Medicine and Microbiology. Similarly, our adjunct and affiliate faculty have primary appointments in the Departments of Medicine, Pediatrics and Microbiology. These cross-departmental appointments reflect extensive collaborations and interactions than extend beyond the Immunology Department, strengthening the intellectual and training environment in the School of medicine. Our faculty also have many active collaborations with faculty in other UW departments that do *not* have appointments in Immunology. This information is summarized in Appendix C; where each faculty member has listed their collaborators both within the department and those with no affiliation with the Immunology Department. As discussed in other sections, the collaborative research and training environment in the Department of Immunology is greatly enriched by our affiliation with faculty housed at the BRI, CIDR and ISB, as well as adjunct faculty at Seattle Children’s Research Institute and the Fred Hutchinson Cancer Research Center (FHCRC). We continue to make new

affiliate appointments when the synergy of research interests becomes apparent and of benefit to our students. For example, in 2015, we appointed Dr. Stan Riddell from the Dept. of Medicine and the FHCRC as Adjunct Professor as we believe that Dr. Riddell will provide a strong connection to translational and clinical research in cancer and cancer-related disorders. The five institutions that are primary homes to our affiliate and adjunct faculty are now in close geographic proximity to the Immunology Department in South Lake Union. Each of the affiliate sites has a critical mass of scientists and facilities conducive to graduate training. Thus, training of students in our program occurs in a rich, interdisciplinary environment.

Over the years, the department has had close connections to local biotech companies. This has been more challenging recently with the departure of Amgen from the area and the loss of immunology programs at Novo Nordisk. However, the rapid growth of Juno has been quite significant for the department, with Dr. Phil Greenberg and Stan Riddell being founding members of this company. A substantial number of Immunology graduate students have recently been hired at Juneau.

How does the unit work with junior faculty to maximize their success?

The success of junior faculty is of utmost priority to the department, clearly the department's future rests with these faculty. We provide as generous start-up packages as we can for these faculty, and ensure that they have adequate space and administrative support. Mentoring is crucial for junior faculty and the department takes this very seriously. The Chair serves as a mentor for all junior faculty; however, each Assistant Professor also typically has two other faculty members who serve as mentors. The mentors review grant applications, review manuscript drafts and advise on publication strategies, and provide overall advice on networking, establishing collaborations, and laboratory management. The Chair maintains an "open-door" policy and frequently has informal discussions with junior faculty on a wide variety of topics. In addition, the Chair meets annually with all assistant professors to discuss accomplishments, challenges, opportunities and future directions. The Chair is primarily responsible for mentoring regarding the promotion process; discussions regarding promotion and career advancement begin early in the career of an Assistant Professor and continue throughout their tenure. The department is sufficiently small that we do not have a separate A&P committee. The SoM supports several activities and programs designed to facilitate faculty advancement via the SoM Office of Faculty Development, e.g., "Preparing for Your Promotion to Associate Professor". Information about their workshops is distributed to all faculty members, with junior faculty members especially encouraged to attend.

Describe how the unit utilizes institutional resources such as the Office of the Associate Vice Provost for Faculty Advancement to recruit and retain faculty from under-represented minority groups.

The Office for Faculty Advancement (OFA) promotes the hiring, retention and success of a diverse and inclusive faculty at the University of Washington. OFA provides an array of resources for hiring and retention of faculty from diverse origins. Immunology has utilized some of these resources and is working on making a greater use of them especially during the current faculty recruitment process. Resources that we plan to use are the "Handbook of Best Practices for Faculty Searches" along with an Online Toolkit distributed to the Immunology Faculty Search Committee.

To what extent has the unit been successful in diversifying its faculty ranks?
Of the ten core faculty members in the Department of Immunology, five are women (three professors, one assistant professor and one research assistant professor) and one is of Asian origin. One of the male assistant professors is of South-Asian origin (India).

What specific strategy has the unit employed to support the career success of, faculty members from under-represented groups?

The SoM's Office of Faculty Development sponsors several programs aimed at supporting women faculty and we encourage our faculty to attend these programs. Examples of such programs are the 4th-Annual Women Faculty Day (Dr. Goverman has participated in panel discussions in this workshop) and the new Women Faculty Support Group. We have not employed specific strategies tailored to under-represented groups.

SECTION IV: FUTURE DIRECTIONS

Where is the unit headed?

Although we are a small department, our faculty members have consistently produced very high quality scholarly work that has had a significant impact on the broad scientific community. Our department was ranked 5th in the world among Immunology Departments by US News and World Report in 2014; in 2015 it ranked 6th. The Immunology Departments that were ranked 4th-7th in 2015 differed very little in their scores, which are largely based on the number and quality of publications over a five-year period. We wish to maintain this excellence in research contributions and overall impact while continuing to grow as a department. We understand that the success of our faculty is entirely dependent on 1) the quality of our trainees, including graduate students; and 2) our ability to mentor these trainees to help them meet their full potential. We also recognize that the nature of biomedical research is changing, and that these changes affect research in Immunology as well. One important change is that biomedical research has become much more interdisciplinary. This is in part the result of advancements in our understanding of the interconnections between different biological systems, and in part the result of the availability of new technologies to conduct biomedical research that have sprung from different scientific disciplines. As we look toward the future, we envision the research programs of our faculty becoming increasingly collaborative, and we have observed this occurring in the past several years. Collaborations between our own faculty members have increased, as have the number of collaborations with faculty in different departments and institutions.

The second important change in biomedical research is the increased emphasis in translation of findings from basic research to the clinic. Our faculty members have moved in this direction as well, and the Center for Innate Immunity and Immune Disease has helped catalyze this effort with its emphasis on manipulation of the immune system to control infectious diseases. Even apart from CIIID, the research programs of our faculty have included more translational research. However, while it is important for our faculty to incorporate new, translational directions into their research programs, it is also critical that we include more exposure of our students to translational research. We have begun to do this with our new course “Immunological Based Diseases and Treatment”, and we will seek additional training opportunities in translational medicine in the future.

What opportunities does the unit wish to pursue and what goals does it wish to reach?

When the department was founded, it was focused heavily on T cell biology. Our strategic plan has evolved over the past decade, and we have sought to bring together faculty with research interests that span many aspects of immunology rather than build a department that concentrates its strength in one particular aspect of immunology. One challenge to having expertise and interest in a broad range of immunological topics is the size of our faculty. We currently have only nine regular faculty members and one Research Assistant Professor. This is a very small number of faculty compared to the critical mass needed for a robust enterprise focused on the entire scope of immunological research. We have two remaining positions to fill and we have the combined goals of 1) maintaining a balance of research interests between innate and adaptive immunology and 2) recruiting the most outstanding candidates in immunology.

Another important goal for our department is to help the CIIID grow and pursue its mission. We currently provide some financial support and as well as significant administrative support for the Center. The Center will enrich the training environment for our students by increasing our overall activity in immunological research, sponsoring seminars and symposiums and potentially introducing new instrumentation and cores. Furthermore, the Center is committed to engaging in outreach activities for middle- and high-schoolers, and this has provided teaching opportunities for our graduate students and postdocs.

Other departmental goals include identifying mechanisms whereby graduate students can gain more exposure to career paths other than faculty positions in academia and, if possible, shorten the time-to-degree of our students.

How does the unit intend to seize these opportunities and reach these goals?

Our highest priority is faculty recruitment. We would like to complete recruitment to our two open faculty positions within the next 2.5 years. We are currently attempting to recruit a new Assistant Professor whose research is currently focused more on innate immune cells but may expand to include connections to adaptive immunity. A major priority for the department is to recruit at least one more senior faculty member at either the Associate or Full Professor level. This is important as we currently have only one Associate Professor, and anticipate retirements of one or more Full Professors in the next 3-5 years. Recruiting a senior faculty member will be very challenging for several reasons. It is difficult to persuade outstanding senior faculty to leave their current institution, and retention efforts by their institutions usually result in a need for large start-up packages. Unfortunately, our start-up funds will be exhausted after the next recruitment and we would be dependent on provision of additional resources. As our recent recruitments have built strength in innate immunology, the last recruitment would ideally be of someone with a concentration in adaptive immunity.

We have discussed some strategies for providing more exposure to alternative career paths but have not yet made firm decisions about how to do this. The office of Research and Graduate Education sponsors a Bioscience Careers Seminar Series that features speakers who trained in biomedical research and are now engaged in different professional arenas. To our surprise, our students do not attend many of these seminars. We have communicated to our students the availability of the new Graduate Discovery Fellowships Program sponsored by the Office of Research and Graduate Education, but it is unclear whether any of students will participate in the program. We have also discussed holding some kind of event in which Immunology student alumni that are currently employed in biotech in the Seattle area would interact with our students and share their experiences.

The time-to-degree issue is more problematic. We are currently discusses our requirements for defending a thesis in our department; however, it does not seem likely than any change will have a great impact on the time to degree.

Describe the unit's current benefit and impact regionally, statewide, nationally, and internationally. Given the unit's envisioned future, describe how reaching this future will augment that benefit and impact.

At the national and international level, our faculty are seen as leaders in their fields. We have been productive in our scholarly work, resulting in our high ranking as an Immunology Department by US News and World Report. Most of us have served on several study sections for NIH and other funding institutions, frequently review manuscripts for many journals and have organized national and international meetings. We have also been consistently competitive for external funding. Thus, the Department of Immunology brings significant prestige and resources (on a per capita basis) to the School of Medicine and the UW.

We also fulfill an important teaching mission as our courses appear to provide a strong foundation in immunology to our students, and are attended by students in other graduate programs. Our faculty serve as thesis advisors for students matriculated in other graduate programs as well as our own, adding strength to the overall graduate training in the School of Medicine. We have already seen an impact of our new initiatives in outreach programs led by CIIID in the Seattle community, and we anticipate that this effort will expand and provide much-needed exposure of the excitement of biomedical research to young people, particularly those from disadvantaged backgrounds and minorities.

Finally, the Department of Immunology serves as a focal point for immunological research throughout the Seattle area due to the inclusion of other institutions in our graduate program. These interactions have catalyzed many collaborations, leading to innovative new research programs. We anticipate that these contributions will continue and grow as our faculty and research programs grow. We believe that the field of immunology will have one of the strongest impacts in medicine in the next ten years due to rapidity with which therapeutic strategies that manipulate the immune system are being translated to the clinic. New companies like Juno are producing a high demand for our students and post-docs in the Seattle area, providing significant economic benefit. Growth in the department faculty and the graduate program are critical to support this need and reach our full potential to improve human health.

PART B: IMMUNOLOGY PROGRAM REVIEW UNIT DEFINED QUESTIONS

1. *Are there differences between the experiences of students who choose primary faculty versus affiliate or adjunct faculty (whose labs are in different locations) as mentors? How does the department attempt to integrate the training of all graduate students regardless of location?*

   In general, students at all sites are well integrated into a common training program. All of these institutes have modern laboratory and core facilities that are similar to those on the main campus. Affiliate, adjunct and primary faculty all participate actively in the UW Immunology graduate program, and students working at different locations have numerous opportunities to interact both socially and scientifically. Students working at affiliate institutions usually have primary faculty members on their thesis committees, and students working with primary faculty usually have affiliate/adjunct faculty members on their committees. Over the years, a large number of students have trained at BRI and SCRI. Fewer have trained at the Center for Infectious Disease Research (CIDR) and ISB, likely reflecting the difference in number of Immunology faculty at these sites. Immunology students at BRI and SCRI interact regularly with other Immunology graduate students training at these sites, while students training at CIDR have fewer UW Immunology graduate students on-site (although CIDR has numerous graduate students in other programs including Pathobiology and Molecular and Cellular Biology). However, the proximity of CIDR to the department's home in SLU 3.1 (~three blocks) facilitates regular interactions with other Immunology students. Students training at SCRI, BRI or CIDR have additional opportunities to present and receive feedback on their work. SCRI also hosts talks given by trainees (also called *Research in Progress* sessions); at BRI, they are *Work in Progress* sessions; at CIDR, they are called *Pathogen Interest Group* sessions. The affiliated institutions host seminars in their specific areas of emphasis; autoimmunity at BRI, immunodeficiency and gene therapy at SCRI, and global infectious diseases, systems biology and vaccines at CIDR. Students in the labs of primary faculty will attend some of these seminars as well, depending on the relevance to their research.

   The requirements for students to attend non-course-related Immunology departmental events are the same for students at all locations, and these events promote interactions between Immunology graduate students as a whole and serve to integrate their training experiences. These events have been described in detail elsewhere and are briefly described below along with a perspective on effectiveness added by faculty at SCRI, BRI and CIDR:

   - Annual Immunology Department Retreat. *Perspective*: In addition to the scientific interchange, this is a major social bonding time for the students with sports, games, talent shows, campfires on the beach, etc.
   - Immunology Seminar Series: Occurs weekly and all graduate students are required to attend. *Perspective*: Attendance can be spotty depending on the topic, but this is true for students at SLU as well as students from other sites.
   - Research in Progress (RIP): Occurs weekly at SLU campus. One graduate student and one postdoctoral fellow present their research each week. *Perspective*: Perhaps rotating RIP to different institutes would further the interactions between the graduate students with the faculty and postdocs from other institutions.
   - Social Hour: Occurs weekly after RIP at the SLU campus. Snacks and beverages are provided. *Perspective*: The happy hour is not always as well attended as it could be, especially by students and faculty at SCRI and BRI. In part, this is because of the challenges of the end-of-the-day traffic in the SLU area. Participation has been increasing since student attendance is now taken at RIP
   - Immunology Department Parties: the annual December holiday party and end of quarter parties provide opportunities for students to mingle and socialize. There are also social events associated with each of the two recruiting sessions for prospective students. *Perspective*: These are well-attended, illustrating overall good camaraderie.

- Joint Lab Meetings: Urdahl lab members (CIDR) participate in a weekly joint lab meeting with the Fink, Gerner, Goverman, Greenberg and Pepper labs at SLU. The Subramanian lab members (ISB) attend the Gale/Stetson/Oberst joint lab meeting. In addition, four T cell-focused labs, Campbell (BRI), Pepper and Gerner (SLU), and Urdahl (CIDR) participate quarterly in a two-hour joint lab meeting on Friday afternoons, called T Cell Super Group. The lab meetings rotate between the different institutes, and the presenting/hosting lab provides snacks and beverages. *Perspective*: These joint lab meetings are enjoyed and valued scientifically by all participants. Perhaps similar rotating lab meetings between groups of similar interests could further enhance interactions between graduate students and faculty at different institutes.

  One challenge for students at BRI and SCRI is the time needed to travel to and back from the SLU campus. Travel time is 15-20 min each way and, although facilitated by shuttles, it can add up when the student have to go to classes and seminars every day. Overall, graduate students who choose to work in labs at BRI, SCRI and CIDR value the atmosphere, the community, the learning environment and the specific emphasis of their respective institute, which often reflects their personal interests. Thus, the opportunities to train at BRI, SCRI and CIDR are considered strengths of the graduate program that add diversity and value to the outstanding opportunities available at the main SLU campus.

2. *What are the biggest challenges to sustaining and enhancing the quality of your graduate program in the future?*

   The biggest challenge by far to sustaining the quality of our program is financial. With increases in tuition and stipend levels, the annual cost of supporting a student is >$50,000. While our students are fairly competitive for slots on the CMB training grant, the fact that there are only four slots on our training grant means that many students are supported by their PI's research grants for at least 2–3 years of their training period. Because many of our faculty members have only one RO1 and typically a smaller grant such as an R21, the cost of a student requires commitment of a significant percentage of their funding. Therefore, it is challenging for the faculty to feel confident that they have sufficient resources to take students in their laboratories even if their students are awarded training grant support for some period of time. The increases in tuition and stipends also mean that the higher cost of supporting first-year graduate students falls to the department and the affiliated institutions, which has created significant strain on departmental resources. It is also an increasing challenge for the department to ensure that enough students are admitted each year to maintain a critical mass in each class and that there are sufficient faculty with available funds to be able take a student at the end of the year. Obtaining some support from the Graduate School in the form of some salary support for our GPA or other financial support would add greatly needed stability to our program, and allow us to have a greater impact on the SoM and the UW. Investment in our program seems worthwhile as the particular expertise of our students is in demand in biomedical research enterprises. Many students are now employed in local biotech companies and research institutes, which has a significant impact on the state's economy.

   Another challenge for our graduate program is meeting the expectations established by the NIH Task Force, which require greater exposure of students to alternative career paths and shorter time to degree. These issues have been discussed in Part A, Section IV, where we describe some of our ideas on increasing exposure to alternative careers. Decreasing the time to degree for Immunology students will be more difficult. The most confounding factor is the requirement for a first author publication prior to defending the thesis. Publication can be a lengthy process, and it is difficult to weigh the advantage of publishing in a high impact journal that may demand extensive scope of research against publishing in a journal of lower impact that may allow more rapid publication.

3. *Does your training program provide sufficient interdisciplinary training in methodology and approaches relevant to immunology, i.e. bioinformatics, analyses of "big data", epigenetics, etc.? Are there other disciplines besides Immunology that should be integrated into the program? How might you increase interdisciplinary training?*

   The Immunology program is attempting to provide more significant training in interdisciplinary methods and approaches. A major source of this training comes from the "Immunological Methods" course co-chaired by Drs. Pamela Fink and Andrew Oberst. This course, which forms part of the Immunology graduate curriculum, was recently re-organized to provide a more cogent overview of modern methods relevant to immunology, while providing important interdisciplinary training to immunology graduate students. Newly-covered topics include online tools for genome analysis, interrogating publicly available databases of expression data, genome-wide assembly studies and single nucleotide polymorphisms from human patient samples. Examples of tools for which students receive guided hands-on training in class include:

   - CRISPR/Cas9 genome editing technology, including both fundamental principles and hands-on design of targeting constructs.
   - Understanding and analyzing large datasets, including deep sequencing, RNAseq, and array expression data. As part of this class, students are provided with a sample microarray dataset and they perform key analyses on that dataset.
   - Concepts and application of principal component analysis.

   Inclusion of these topics in the Immunological Methods course represents an important initial exposure to these concepts. However, in some cases additional training is appropriate. We contend that the appropriate nature and depth of this training will depend on the specific requirements of the project undertaken by a given student, and on the extent to which the project incorporates expertise from different individuals via collaboration. We believe that opportunities are available within the UW and the broader Seattle community for students to receive such training. However, we also believe that our program could do a better job of highlighting these opportunities, both to interested students and to their PIs. Areas in which students could deepen their knowledge by accessing coursework not offered specifically by the Immunology department include:

   - Bacterial pathogenesis, viral pathogenesis, and host-pathogen interactions
   - Genetics, genomics, and evolutionary analysis
   - "Big data" and bioinformatics
   - Biostatistics
   - Cancer pathogenesis and immunotherapy

   Importantly, we believe that the total volume of required coursework should not be increased to accommodate these topics. Rather, we aim to do a better job of presenting these options to the graduate students early in their training, with special emphasis on courses taken in the second year when they have chosen a lab and begun to develop a project, and therefore have a better sense of the topics from which they would most specifically benefit.

4. *To what extent and by what mechanisms are your students exposed to training in both basic and translational research? What should the balance be in their training? What is the balance between basic and translational research programs in your department?*

   Our department has more of a focus on basic immunology research, though overall, our department has become more translational over the last 10 years. Students can choose to rotate in and pursue their thesis research in either basic or translational labs based upon their interests. Regardless of whether students pursue basic or translational thesis projects, they are exposed to both types of approaches throughout their training.

From their first year in the program, students gain exposure to both basic and translational research through coursework, rotations and departmental RIP presentations and seminars. Though our seminar series speakers tend to be more focused on basic immunology, there are some translational talks in this series as well. The Immunological Methods course focuses on methods used in both basic and translational immunology research. The Intersection of Innate and Adaptive Immunity to Disease covers ~75 percent basic and 25 percent translational topics. The new Immunological Based Diseases and Treatments class was developed to expose students to translational approaches to a variety of immune-mediated diseases. The elective classes that students choose to take that are taught by other programs can be either basic or translational depending upon each student's research and interests. For example, the Molecular Medicine Certificate Program (now a part of the M3D program housed in the Dept. of Pathology) provides several classes focused on human disease and treatment that had been popular with our students.

5. *How have your courses changed over the past ten years? How will they need to change in the next ten years?*

Below we describe the courses taught by the Department of Immunology for the past 10 years. For each class, we indicate how it has changed over this time span.

Immunology 441 – Introduction to Immunology
This large survey course for upper level undergraduates has been described in Part A. Beginning in 1989, the class was team taught by immunology faculty. Our graduate students sit in on select lectures in their first year to bolster their immunology background, and they serve as TAs for the course in their second year. Although the topics have expanded and contracted in line with how the field of immunology has evolved, the broad scope of the course has not fundamentally changed. However, a significant change was made in this class structure approximately six years ago when the Course Chair, Dr. Dan Stetson, began reducing the number of lecturers to make it less team-taught. Dr. Stetson gave an increasing number of lectures himself each year; he now gives >75 percent of the lectures. He has also greatly improved the organization and content, lending more coherence and focus to the course. These changes are much appreciated by the students, although they still view the class as quite difficult.

Immunology 532 – Intersection of Innate and Adaptive Immunity in Disease
(Previously called Advanced Immunology)
As discussed in Part A, this course is the centerpiece of our curriculum. The course consists of three 80-minute lectures per week taught by multiple immunology faculty and four student-led discussions based on recent journal articles. The organization has not changed substantially over the past 10 years; changes are mostly continuous updates to the lectures to reflect the current state of knowledge of immunology.

Immunology 534 – Central Issues in Immunology
This course was initiated in 2008 to better prepare our graduate students for their Qualifying Exam, as described in Part A. The course consists of one 90-minute discussion weekly, led by first and second year students but coordinated by a faculty member. The goal of each class is to develop the student's ability to construct an outline for a grant proposal based on a selected papers assigned by the faculty member. Initially, a single paper was chosen for each session that highlighted an innovative area of research. Every session, students were expected to identify the next important question arising from the work presented in the paper, generate a hypothesis in response to the question, design aims that would test that hypothesis and then experimental approaches to achieve the aims. Approximately three years ago, the faculty discussed several problems associated with the structure of this class and introduced some changes. First, we felt that selecting just one paper for the students to read before class did not convey sufficient background in the topic for students to identify the "cutting edge" of that area such that they could identify a relevant question. Typically, only the students assigned to present the major findings from the selected paper had done any background reading. To address this problem, the instructor now assigns 2-3 recent papers on a topic that all students read so they have a deeper sense of the area discussed at the start of the class. We also found that one session was often not sufficient for students to work as a team and map out the entire structure of a grant proposal. Often the class would not progress much beyond developing tentative aims; therefore, they did not get practice and guidance on the importance of feasibility in their experimental approaches, or a sense of

what a reasonable scope for a project should be. We now devote more than one session to constructing the proposal so that the entire process becomes more familiar to the students. We have also recently condensed the course into the first five weeks of spring quarter to maximize its usefulness to our second year students who begin preparing for their Qualifying Exams in the second half of spring quarter.

Immunology 537 – Immunological Methods
This course was initiated in 2012 and has been discussed in detail in Part A and in Part B Question 3 above. We felt that the uneven experience with immunological techniques of our incoming students was hindering some students in their ability to critically read the scientific literature, and that many of our students did not have practical experience in using the tools that are introduced in this class. As two faculty members teach the class, one with experience in cellular techniques and one in molecular and analytical techniques, the students are exposed to a wide array of methodologies relevant to immunological research. The course emphasizes student participation, and has been a great way to get our incoming class to feel comfortable in their role as graduate students.

Immunology 538 – Immunological Based Diseases and Treatment
As discussed in Part A, this course was first offered in 2014 with the goal of integrating basic research and translational immunology. It consists of one student led discussion and one 50 minute lecture per week by a team of immunology faculty.

UCONJ 510 - Introductory Laboratory Based Biostatistics
We began requiring this class since 2012 to fill a gap in our students' background in statistics. Few of our students come with the knowledge of which statistical method to apply to different types of data sets, which is critical for their training. This class also brings us into compliance with the new NIH initiative to improve research reproducibility.

Discontinued classes:

Immunology 533 – Host Defense to Cancer
This spring quarter course was offered in odd years through 2013 and highlighted innate and adaptive immunological responses to neoplasm. It consisted of one 90-minute discussion and one 50-minute lecture per week taught by a team of immunology faculty. We opted to try to include these topics in Intersection of Innate and Adaptive Immunity in Disease and in Immunology-Based Diseases and Treatment, allowing students with a strong interest in cancer immunology to obtain additional training in Conjoint classes. This change allows us to take better advantage of a wider range of expertise among our faculty, and incorporate the new Immunological-Based Diseases and Treatment course into the curriculum.

Immunology 535 – Host Defense to Infection
This spring quarter course was offered in even years through 2013 and highlighted innate and adaptive immunological responses to infection with an emphasis on class discussion. It consisted of one 90-minute discussion and one 50-minute lecture per week taught by a team of immunology faculty. As for IMMUN 533 and above, we are attempting to include these topics elsewhere.

Human Biology 523 – Immunology for Medical Students
This ten-week course was required for all first-year medical students at all WWAMI (Washington, Wyoming, Alaska, Montana and Idaho) universities. WWAMI is a cooperative program for training medical students in these five states of which only Washington has a medical school). The UW SoM is responsible for leading the teaching at all universities, and this fell to the Immunology Department for this class. The course Immunology Course Chair was responsible for the Immunology class at the UW and for coordinating all Course Chairs at the other WWAMI sites. Typically, two faculty members gave most of the lectures; therefore, this class represented a heavy teaching load. Beginning in 2016, the medical school curriculum has been totally revamped and immunology faculty from UW did not teach in the class this past year. We anticipate increased involvement in the future.

How we anticipate our curriculum will change in the future:
Over the next ten years, we envision that we will continue to teach the fundamentals of immunology in our core program courses: Introduction to Immunology (IMMUN 441), Intersection of Innate and Adaptive Immunity in Disease (IMMUN 532), Immunological Methods (IMMUN 537), Immunological-Based Diseases and Treatment (IMMUN 538) and Central Issues in Immunology (IMMUN 534). As we have done over the last decade, course directors will continue to assess the content in each class annually and make changes to stay relevant as the field of immunology changes. We will also continue to evaluate the depth and breadth of our course offerings overall as a faculty over the next decade and again, make changes as necessary. Our introduction in 2014 of the Immunological-Based Diseases and Treatments class is an example of our adapting to the recent boom in the development of disease modifying therapies, vaccines and treatments for immunological diseases. Additionally, we will continue to modify course requirements if we feel that our students are lacking in exposure to training in a specific area, such as we did with the introduction of the requirement for taking Introductory Laboratory Based Biostatistics (UCONJ510). We anticipate that over the next 10 years, for these same reasons, we could potentially introduce interdisciplinary courses such as immune modeling, systems biology or bioinformatics.

6. *How do you measure student success (both during their graduate career and after)?*

During their enrollment in the Department of Immunology Ph.D. program, graduate student success is measured primarily through the student's ability to complete a series of programmatic 'milestones' that help ensure students are making adequate progress toward completing their degree. These include:

i. Selecting and completing three 10-week laboratory rotations in the first year and subsequently identifying and joining a laboratory for their thesis research;
ii. Completing 18 graded credits of graduate course work in good academic standing including our 'flagship' courses IMMUN 537 (Immunological Methods), IMMUN 532 (Intersection of Innate and Adaptive Immunity in Disease) and IMMUN 538 (Immunology – Disease and Treatment);
iii. Passing their qualifying exam at the end of the second year, which assesses their ability to identify an important unresolved question in immunological research, develop and write a detailed research proposal to address it, and orally defend their proposal to a panel of faculty members;
iv. Passing their general exam, in which they develop and write a detailed research proposal based on their thesis project, and orally defend it to their thesis committee'; and
v. Publishing all or a portion of their theses work as a first-author (or co-first author) publication in a peer-reviewed scientific journal.

Additionally, student success/progress is monitored throughout their graduate career in less formal ways through discussions with the graduate student advisor (currently Dr. Daniel Campbell) in the first year, annual thesis committee meetings once the general exam has been completed, participation in lab meetings and by peer review of oral presentation in the Department of Immunology RIP seminar series.

Acknowledging that academic science careers have become more scarce and difficult to obtain, student success after their graduate career is difficult to measure in traditional terms. Therefore, we assess success of our students post-graduation by the extent to which they obtain positions and careers in which they will utilize the technical, conceptual and analytical skills they developed and honed during graduate school. In addition to 'traditional' academic careers (postdoctoral fellowship/academic scientist), these include positions in the biotechnology and pharmaceutical industries, medicine, scientific policy and law, teaching and education, and scientific writing/publishing.

7. *How do you ensure adequate training in critical thinking, writing and presentation skills? Is the qualifying exam an appropriate vehicle?*

Training in critical thinking and writing:
The UW Immunology Department, the SoM and other Seattle-based research institutes provide an excellent environment for nurturing creativity and innovation. Training in critical thinking and writing skills by in large occurs during courses provided to first and second year students and via administration of the

qualifying exam. Courses taken by our students strengthen their basic scientific knowledge and also help develop critical thinking skills as most of the grades in the classes are based on problem sets that require critical thinking. The rigors of the qualifying and general exams push students to think "outside the box" and defend novel ideas orally and on paper. Attending and presenting at conferences helps build collaborations, teaches students how to network and very importantly, think about the big picture while performing research addressing a specific question. In seminar courses, students are graded in part based on their participation, but faculty differ in the extent to which they encourage or emphasize discussion. Students are required to read and discuss primary publications and learn to think more critically during seminar discussions and by observing questions by others during departmental seminars and RIP.

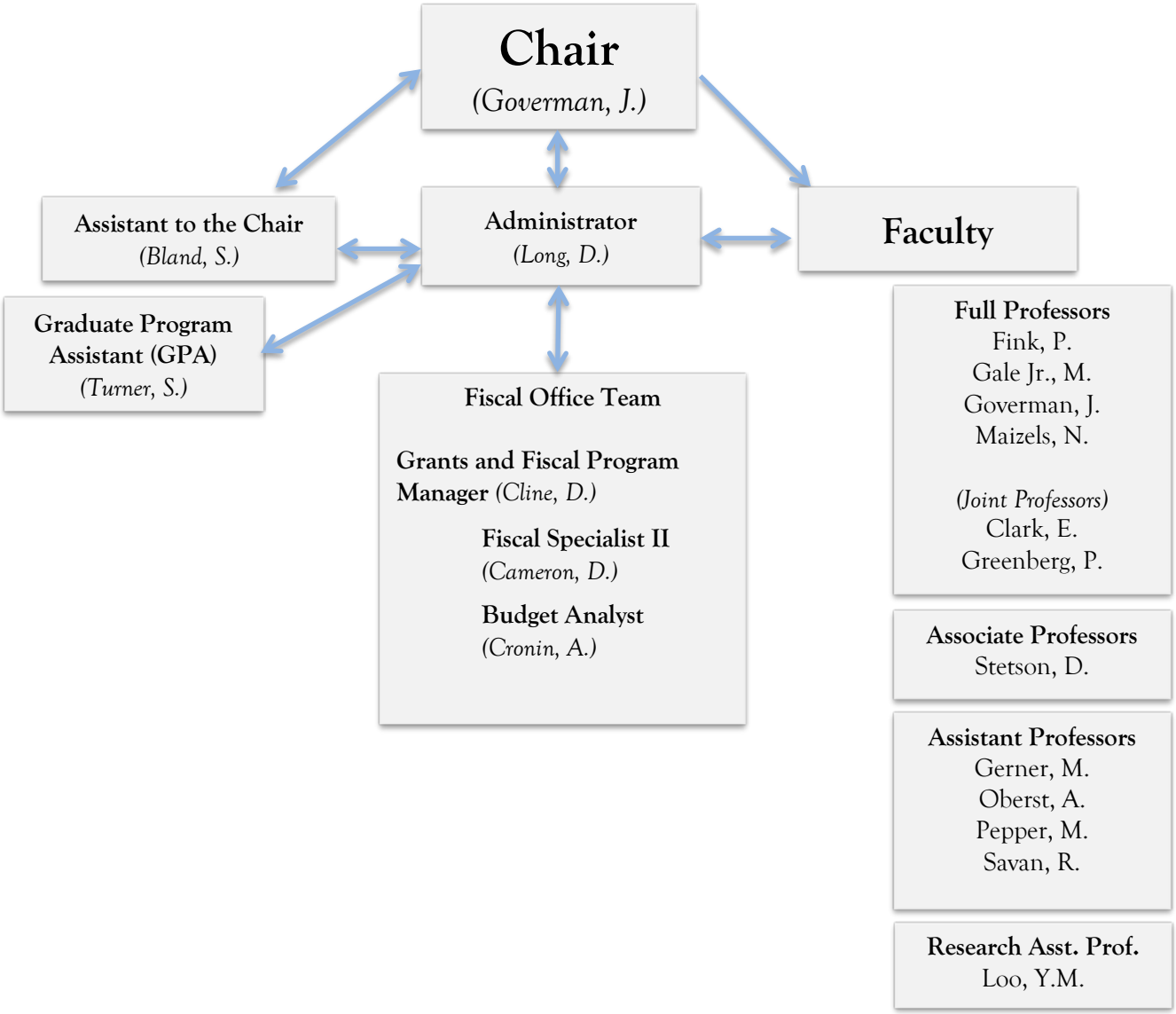
Presentation skills:
Each graduate student is required to present their research results at their individual and joint lab meetings, rotation talks and departmental RIP seminars, and at least annually to their Ph.D. committee members. They are also required to be teaching assistants in the undergraduate Immunology course (IMMUN 441), which not only provides a good foundation in basic immunology but teaching experience as well. Students present either a short talk or a poster at the annual Immunology Departmental retreat. The department has instituted several best poster awards which act as a positive reinforcement for students to improve the quality and clarity of presentations. Preparation for these presentations is taken very seriously, and students practice their talks in front of lab members and colleagues in order to receive feedback and improve the clarity of their presentation. Students are also required to present in the RIP seminar series; RIP seminars are evaluated anonymously by their peers to obtain a collegial feedback on the strengths and weaknesses of the presentation. The faculty then compile this feedback for the presenter. These evaluations have significantly improved the quality of graduate student presentations. Students are also encouraged to present their research at national and/or international meetings such as Midwinter Conference at Asilomar, AAI, Keystone or Davos meetings. Thus, Immunology graduate students have a wide range of opportunities to present research results and develop their presentation skills.

Is the qualifying exam an appropriate vehicle?
The Qualifying Exam requires the student to write a proposal outside their area of interest and then present and defend their proposal. Students can discuss their proposals with other students, postdocs and other faculty with expertise relevant to their topic. Examples of successful previous QE proposals are provided for students to review as they begin to prepare their own proposal. This exam helps teach students how to organize a research plan with a line of investigation including logic trees and possible outcomes and follow-ups. This process often leads to well thought out logical proposals. However, because the students know that they will be questioned about what they are proposing, we feel that some students 'play it safe' and opt for proposing relatively pedestrian hypotheses and experiments. In recent years, the QE committee has encouraged and rewarded imaginative, out of the box, research proposals to broaden their thinking. Although, the Qualifying Exam creates some anxiety for most students, we believe that this is part of learning realistically what it takes to be a scientist. Dealing with failure, being wrong and being receptive to criticism are part of what is necessary for becoming a determined scientist. It is worth noting that once the student has passed the QE, they have always acknowledged the benefits of going through these types of exams, and they recognize that the QE better prepares them for their general exam.

We believe that it is important to create a supportive environment for students, so they learn to view feedback and constructive criticism as something that can be helpful and part of the scientific experience. Some students who have done poorly in these exams have not paid sufficient attention to what is stated in the instructions, and did not read previous successfully defended proposals. An awareness and sensitive balance is necessary on the part of the QE committee that takes into consideration what each student needs. We believe that the Qualifying Exam is an appropriate vehicle if the students are given sufficient time to prepare for it, understand what is expected of them and see the exam as a learning experience.

APPENDIX A

DEPT. OF IMMUNOLOGY ORGANIZATIONAL CHART



Financial Workload Grants/Fiscal Office (Grant Submission and Award Activity Managed)

	# of Applications Submitted	# of Applications Awarded	Expenditure Processed (DC)	Total HR Count in Payroll
FY10	82	60	$16,912,545	**126**
FY11	79	65	$13,036,852	**125**
FY12	71	55	$13,251,981	**118**
FY13	79	38	$13,302,185	**110**
FY14	95	44	$10,913,910	**104**
FY15	87	41	$14,392,756	**94**

Administrative/Fiscal Team Roles and Responsibilities:

Administrator: Department financial planning/management, operational affairs and planning, hiring manager, human resource supervision and management, compliance monitoring, special project support and other functions.

Assistant to the Chair: Provides administrative and organizational support to the Chair. Primary resource for faculty searches, academic research, tenured faculty appointments and promotions and visiting faculty appointments; manages the Immun 573 Seminar Series, the Weiser Endowed Lecture and other departmental events and speakers.

Graduate Program Assistant: Serves as primary point of contact for and advises students and applicants; and coordinates, tracks, and monitors all phases of the department's graduate education program; facilitates the department's postdoctoral training program and organizes the annual department retreat.

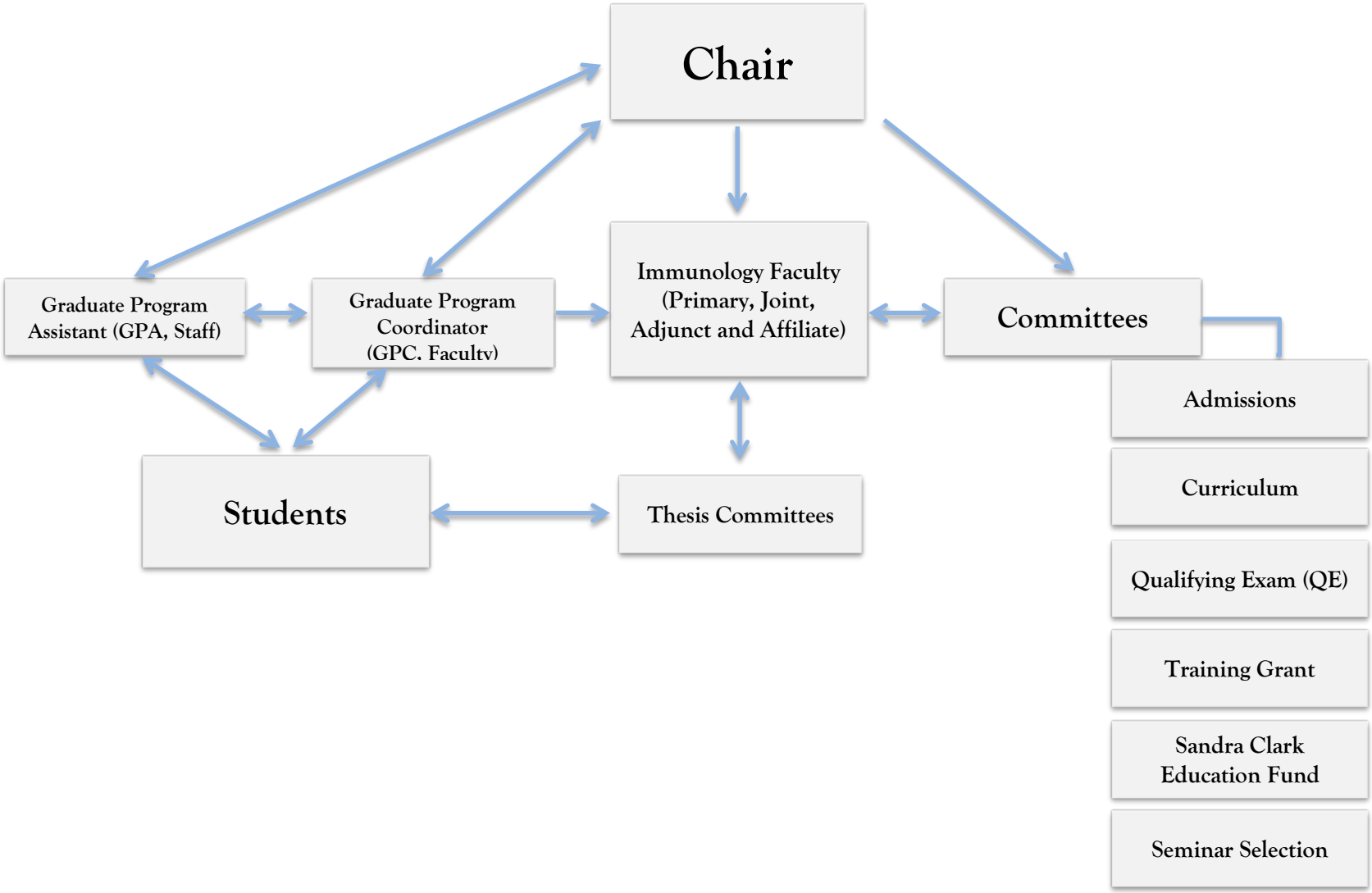
Grants and Fiscal Program Manager: Departmental grants and fiscal operations including pre- and post-award grants and contract management. Serves as primary conduit between the department and OSP, GCA, and other sponsoring agencies. Provides financial management of all other fiscal issues.

Fiscal Specialist II: provides fiscal support for departmental payroll and cost center billing and assists with purchasing and general budgetary reporting.

Budget Analyst: fiscal support for departmental purchasing, service and sub-contracts, budget reconciliation, equipment inventory, accounts closeout, and checks management.

APPENDIX A

GRADUATE PROGRAM STRUCTURE



APPENDIX A

IMMUNOLOGY COMMITTEE ASSIGNMENTS 2015-16

Admissions:

E. Bettelli, K. Oukka, M. Gale, ***A. Oberst (Chair)***

Curriculum Committee:

D. Campbell, E. Clark, P. Fink, ***J. Goverman (Chair),*** *N. Maizels*

Students: *TBD Each Year*

Qualifying Exam:

J. Goverman (Chair)*, A. Lacy-Hulbert, A. Oberst, M. Pepper, K. Urdahl*

Training Grant:

S. Ziegler, D. Campbell, ***P. Fink (PI),*** *J. Goverman, J. Hamerman, N. Maizels, D. Rawlings, K. Urdahl*

Retreat Planning/Sandra Clark Ed. Fund:

A. Scharenberg (Chair)*, J. Hamerman, M. Pepper*

Students: *J. Sullivan, K. Pestal*

Seminar Selection

J. Goverman (Chair)*, D. Campbell, A. Lacy-Hulbert*

APPENDIX B

SUMMARY OF FUNDS SUPPORTING THE IMMUNOLOGY GRADUATE PROGRAM

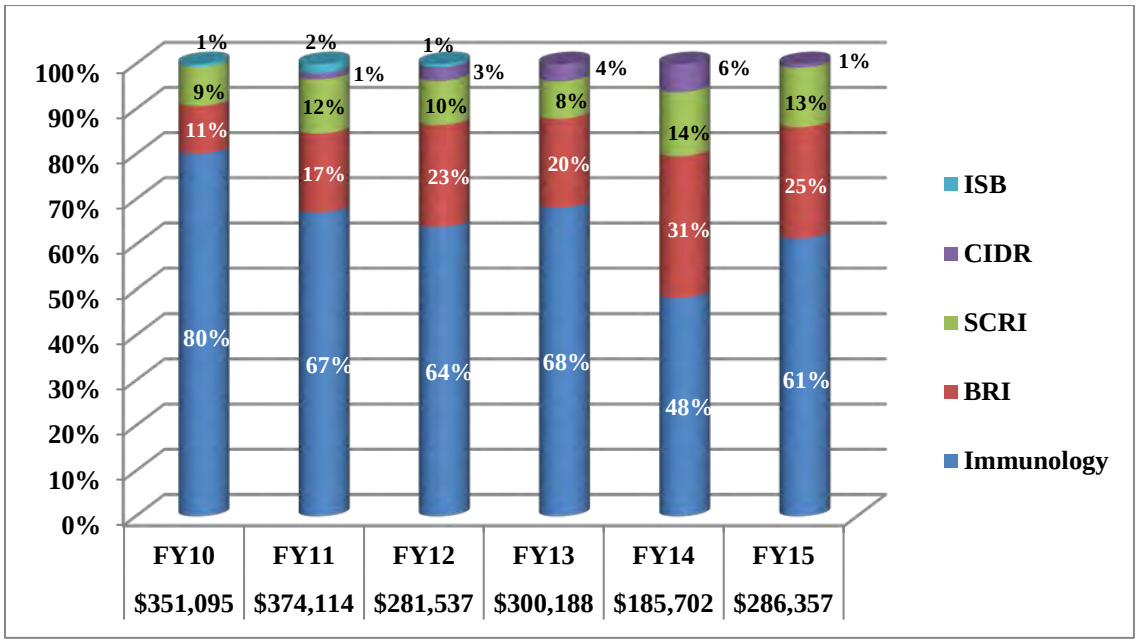
The tuition, stipend and benefits of graduate students in Immunology labs, including those enrolled in other training programs such as MCB and Pathobiology, are supported from several sources.

1. **Department funds**: Department funds are used to support the tuition, stipend and benefits of first-year graduate students, and if necessary to support these costs for graduate students in the lab of faculty who require bridge funding. The funds are derived from "departmental tax" paid by faculty, as defined below.

   Tenured faculty salaries at the Department are based on an A/B structure where the A portion is funded by a state line (hard money) and the B component is derived from research grants or contracts awarded to faculty. In addition to raising funds to pay their B component, faculty are asked to raise an additional portion of their salary from grants and contracts in order to return some of the A component salary money to the department (referred to as departmental tax). The tax is based on rank as follows: Assistant Professors: 10 percent of A component (begins after the third year in rank)

   Associate Professors: 17.5 percent of A component
   Full Professors: 25 percent of A component

2. **Support from Affiliate and Adjunct Faculty Institutions**: As described in Part A Section I, institutions with affiliate and adjunct faculty provide support for the graduate program in proportion to the number of Immunology students training in their laboratories. The graph below shows the relative contribution of these institutions compared to Immunology Department support.



The graph shows the annual total costs for new graduate student recruitment, first year graduate student support and GPA salary at the bottom, and the division of these costs between Immunology and its affiliate and adjunct institutions.

3. **Training and Fellowship funds**: These are funds awarded to students after their first year following competitive selection for positions on training grants or individual fellowships.

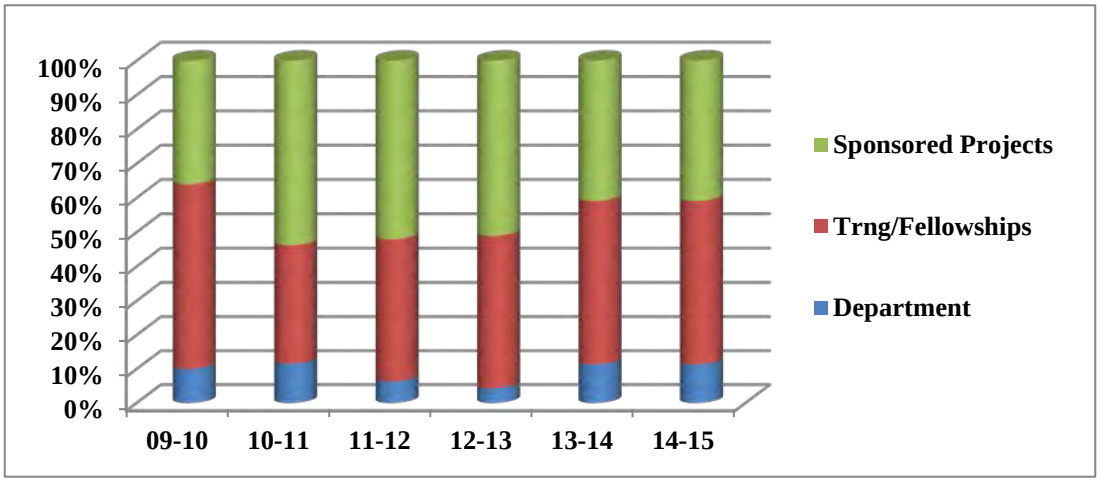
Training grants: *history*: A predoctoral training grant from the National Cancer Institute that was awarded to Dr. Perlmutter in 1985 provided support for the seven students, with Drs. Wilson and Goverman becoming the PI of this grant over the years. A second training grant from the Cancer Research Institute to Dr. Phil Greenberger provided additional graduate student support; however, CRI ceased issuing training grant sin 2012 and this grant ended. As the faculty body diversified over time, many students supported by the NCI training grant were difficult to justify in the context of cancer-related research. Therefore, the department decided not to renew this training grant and instead submitted a new training grant to NIAID with Dr. Pam Fink as the PI. *Current*: This grant (T32AI106677) was funded in 2013; however, it provides partial support for only four students. Fellowships are awarded annually, usually during summer, and based on a competitive process that is adjudicated by the Training Grant Selection Committee. UW Immunology students may also compete for a position on the Cell and Molecular Biology Training Grant, which currently has 31 slots that may be awarded to students in participating departments and 1-4 of these slots are usually filled with Immunology students.

Fellowships. NSF, US Army, International fellowships, Top scholar

4. **Grants and contracts awarded to faculty**: Used to support students after the first year if they have training grant of fellowship support.

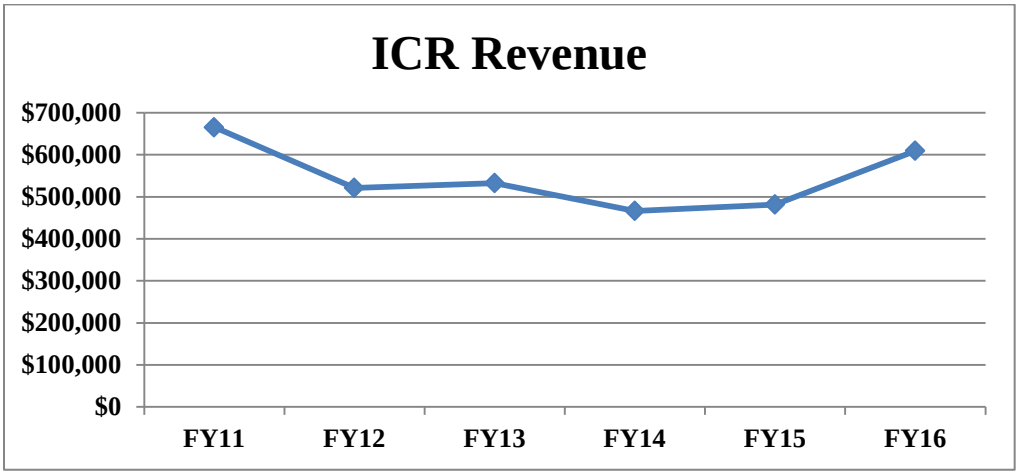
5. **Endowments**: The department currently has two very small endowments and one moderate endowment to support graduate student stipends, benefits and tuition. The Barbara Lovseth Education Fund and Chris and Sheryl Wilson Education Fund each were established with $10,000 by a former Immunology administrator and by a former Immunology Department Chair to support graduate education at the Department. Under the directions of the current Department Chair, all interest from the two endowments is returned back to the principle accounts with the goal to reach a level where the interest-bearing accounts would be able to provide ~$1,000 in support of a graduate student/year. We anticipate 10-15 years would be needed to reach this long-term goal. In September, 2013, a new endowed fund was established through a bequest in the amount of $510,614.50 by Dr. Richard Titus for graduate student support in Immunology. Under the directions of the current Department Chair, all current interest from the Titus Fund will be used for partial support of one student's stipend, benefits and tuition every other year as it will require two years to accumulate sufficient funds from interest on the principle to be roughly equivalent to the amount available from a training grant. We plan to select the first graduate student recipient in FY17.

   The chart below shows the source of funding support for all graduate student tuition, stipend and benefits (including MCB and Pathobiology students) in Immunology labs (including Adjunct and Affiliate faculty) over the past three biennia.



Costs associated with the graduate program other than tuition, stipend and benefits, e.g. salary support for the GPA, are supported from the following funding sources:

6. **Indirect Cost Recovery (ICR) funds**. The Department receives a small percentage (approximately 14 percent) each year in return of funds that the University has recovered from indirect costs charged on sponsored projects. These funds must support all costs of running the department, including administrative staff support, general supplies, equipment, maintenance contracts etc. These funds are also the only source for accumulating start-up funds for new faculty. The financial climate has been very challenging over the past 5–10 years: federal funding for research has been significantly more competitive. Nevertheless, Immunology faculty continues aggressively to seek research funding from both federal and non-federal sources. We experienced a sharp decline of 22 percent in ICR revenue in FY12 due to a challenging funding climate and the decrease in activity by Dr. Bevan as he approached retirement. We are now closer to the ICR levels that we received in FY11 (see chart below). The Department will be severely challenged if ICR savings remain the only source of finds for new faculty start-up as we will deplete all of these saved funds with the next recruitment, and will not have start-up funds for recruitment to the remaining position.



7. **Fund for Excellence in Immunology**. This gift fund is a discretionary account to which alcohol and food can be charged. One use of this fund is to support some graduate student activities such as our wine and cheese poster sessions during student recruiting, student recruiting dinners and some retreat expenses.

APPENDIX C

DEPARTMENT OF IMMUNOLOGY
FACULTY MEMBERS

(SORTED BY TITLE)

PRIMARY AND JOINT FACULTY

AFFILIATE AND ADJUNCT FACULTY

DEPARTMENT OF IMMUNOLOGY
FACULTY MEMBERS
(ALPHABETICAL BY LAST NAME)

DEPARTMENT OF IMMUNOLOGY
FACULTY MEMBERS

GOVERMAN, JOAN M., PH.D.

POSITION/TITLE: Full Professor & Chair **JOINED DEPARTMENT:** 08/01/2001
(Adjunct Asst. Prof: 01/01/1994 – 7/31/2001)

The Goverman Lab's research focuses on autoimmune disease, specifically understanding the pathogenesis of multiple sclerosis and identifying potential points of therapeutic intervention. Multiple sclerosis is believed to be an autoimmune disease in which self-reactive T cells that recognize myelin proteins escape normal mechanisms of immune tolerance and become activated, causing inflammation and destruction of myelin in the central nervous system (CNS). Our work employs animal models of this disease as well as human samples.

We study the mechanisms that normally maintain immune tolerance to myelin proteins, triggers that break this tolerance, the characteristics of T cells that mediate the disease and the effector mechanisms that ultimately cause tissue damage. We have developed a number of new animal models using T cell receptor transgenic mice that express either CD4+ or CD8+ T cell receptors specific for different myelin proteins. These models recapitulate different aspects of the complex pathology seen in MS patients, and have allowed us to discover novel mechanisms of maintaining tolerance. Using these tools, we are investigating the contribution of CD4+ and CD8+ T cells and B cells to autoimmunity in the CNS. We are also defining the parameters that govern T cell trafficking in the CNS, the effector mechanisms that propagate disease and how inflammatory responses are regulated in different microenvironments in the CNS. Recently, we have begun testing our hypotheses using samples from patients with multiple sclerosis to further define heterogeneity in pathogenic pathways and possible points of therapeutic intervention.

9 Total Number of Graduated Ph.D. Students
1 Total Number of Current Students
1 Total Number of Current Immunology Students
0 Total Number of Other Current Students

2 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. **Goverman, J.**, A. Woods, L. Larson, L.P. Weiner, L. Hood and D. Zaller. 1993. Myelin basic protein-specific T cells in transgenic mice are not tolerized *in vivo* and can cause spontaneous EAE. *Cell* **72**:551-560.
2. Huseby, E.S., D. Liggitt, T. Brabb, B. Schnabel, C. Ohlen and **J. Goverman**. 2001. A pathogenic role for myelin-specific $CD8^+$ T cells in a model for multiple sclerosis. *J. Exp. Med.*, 194:669-676.
3. Stromnes, I.M., Cerretti, L.M., Liggitt, D., Harris, R.A. and **J Goverman**. 2008. Brain and Spinal Cord Exhibit Different Requirements for T_H17 and T_H1-Mediated Inflammation. *Nature Med.* 14(3):337-42.
4. Ji Q, Castelli L, **Goverman JM.** MHC class I-restricted myelin epitopes are cross-presented by Tip-DCs that promote determinant spreading to $CD8^+$ T cells. Nat Immunol. 2013 Mar;14(3):254-61. doi: 10.1038/ni.2513. Epub 2013 Jan 6. PubMed PMID: 23291597; PubMed Central PMCID: PMC3581685.
5. Simmons SB, Liggitt D, **Goverman JM**. Cytokine-regulated neutrophil recruitment is required for brain but not spinal cord inflammation during experimental autoimmune encephalomyelitis. J Immunol. 2014 Jul 15;193(2):555-63. doi: 10.4049/jimmunol.1400807. Epub 2014 Jun 9. PubMed PMID: 24913979; PubMed Central PMCID: PMC4123857.

ALL PUBLICATIONS (Total Number of Publications: 70)

http://www.ncbi.nlm.nih.gov/sites/myncbi/1L3ykz6fa3WAc/bibliography/47745811/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROFESSIONAL SOCIETIES

1995-2000	Harry Weaver Neuroscience Junior Faculty Award 1995
1997-1999	Member, National Multiple Sclerosis Society Fellowship Review Committee
1999-2003	Member, National Institutes of Health Immunological Sciences Study Section (IMS)
2000-2005	Section Editor for The Journal of Immunology
2008-2014	Member, Scientific Advisory Board for Max Planck Institute for Neurobiology
2009-2014	Member, National Multiple Sclerosis Society Grant Review Committee A
2014-2018	Merit award for RO1 AI107494-01

FUNDING/ACTIVE RESEARCH SUPPORT	
RG 4792A6/1 (Goverman, J.) National Multiple Sclerosis Society (NMSS) Title: Defining mechanisms by which CD8+ and CD4+	04/01/13 – 03/31/16 Role: PI
R37 AI 107494-01 REV (Goverman, J) NIH Title: Mechanisms by which CD8 T cells shape CNS autoimmunity initiated by CD4 T cells	06/10/13 – 05/31/18 Role: PI
2P01 AI073748-06A1 (Kuchroo, VK) NIH Title: Tim-3-dependent regulation of autoimmune disease	06/15/15 – 05/31/20 Role: CO-I
TRAINEE SUPPORT	
T32 AI106677 F31 Fellowship (Wagoner, C) NIH Title: Interplay of CD4+ and CD8+ T cells in Chronic Experimental Autoimmune Encephalomyelitis (EAE)	09/01/15 – 08/31/17
Post-doctoral Fellowship (Johnson, M Postdoctoral Fellow) National Multiple Sclerosis Society Title: Defining T cell signatures associated with distinct neuroinflammatory patterns in multiple sclerosis	07/01/16 – 06/30/19

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Andrew Oberst, Ph.D.

OTHER COLLABORATIONS:

- Vijay K. Kuchroo, DVM, Ph.D. Harvard Medical School
- David Hafler, Ph.D. Yale University School of Medicine
- Jane Buckner, Ph.D. Benaroya Research Institute
- Mariko Kita, M.D. Virginia Mason

FINK, PAMELA J., PH.D.

POSITION/TITLE: Full Professor **JOINED DEPARTMENT:** 06/01/1990

Our work is focused on the analysis of recent thymic emigrants (the youngest peripheral T cells) from mice carrying a transgene for green fluorescent protein driven by the RAG2 promoter. Our work has shown that T cells complete both functional and phenotypic maturation in the lymphoid periphery, a process driven by factors other than those that control T cell homeostasis and survival. Our work suggests the purpose of post-thymic T cell maturation is to expose young T cells to antigens expressed only outside the thymus, during a tolerance-prone transitional phase of development. Current work is centered on interrogating the environmental cues (such as the inflammatory milieu) that tune this tolerance process and to develop a model to test the involvement of recent thymic emigrants (including neonatal T cells) in tumor rejection.

10 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

1 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Fink, P.J. and M.J. Bevan. 1978. H-2 antigens of the thymus determine lymphocyte specificity. *J. Exp. Med*. 148:766-775.
2. Fink, P.J., L.A. Matis, D.L. McElligott, M. Bookman, and S.M. Hedrick. 1986. Correlations between T cell specificity and the structure of the antigen receptor. *Nature* 321:219-226.
3. McMahan, C.J. and P.J. Fink. 1998. RAG reexpression and DNA recombination at T cell receptor loci in peripheral CD4 T cells. *Immunity* 9:637-647.
4. Boursalian, T.E., J. Golob, D.M. Soper, C.J. Cooper, and P.J. Fink. 2004. Continued maturation of thymic emigrants in the periphery. *Nature Immunol.* 5:418-425.
5. Hendricks, D.W. and P.J. Fink. 2011. Recent thymic emigrants are biased against the Th1 and toward the Th2 effector lineage. *Blood* 117:1239-1249. PMCID: PMC3056472

ALL PUBLICATIONS (Total Number of Publications: 111)

http://www.ncbi.nlm.nih.gov/myncbi/pamela.fink.1/bibliography/47898117/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1975	Phi Beta Kappa
1976	Goodbody Fellowship, Indiana University
1981	Jane Coffin Childs Fellowship
1985	American Cancer Society, Senior Fellowship
1987-present	Member, American Association of Immunologists
1988-1992	Associate Editor of The Journal of Immunology
1989	Junior Faculty Research Award, American Cancer Society
1989-1994	Scholar, Leukemia Society of America

1989, 1994	Ad Hoc member of the NIH Study Sections
1994	NSF Career Advancement Award
1995-1999	Fulltime Member, NIH Immunobiology Study Section
1996	Instructor, AAI Advanced Immunology course
1996-1999	Member, AAI Committee on the Status of Women
2000-04; 2012-present	Council, Midwinter Conference of Immunologists
2000-2013	Editorial Board, Cellular Immunology
2002-2005	Member, AAI Program Committee
2003-2008	Deputy Editor, The Journal of Immunology
2006-2008	Scientific Advisory Council, Alberta Heritage Foundation
2007-2008	Chair, AAI Nominating Committee
2009-2013	Member, Special Emphasis Panels, NIH
2009-2013	Member, AAI Publications Committee
2013-present	Editor-in-Chief, The Journal of Immunology

FUNDING/ACTIVE RESEARCH SUPPORT	
R01 AI064318 (PI: Fink, P.J.) NIH Title: Characterization of Recent Thymic Emigrants	04/01/05 – 02/28/20 Role: PI
Cost Share – 10%	

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Dan Campbell, Ph.D.
- Ed Clark, Ph.D.
- Steve Ziegler, Ph.D.
- David Rawlings, M.D.

OTHER COLLABORATIONS:

- Marc Gavin, Ph.D. Benaroya Research Institute
- Ian Sweet, Ph.D. Dept. of Medicine, Div of Metabolism, Endocrinology and Nutrition

GALE JR., MICHAEL J., PH.D.

POSITION/TITLE: Full Professor **JOINED DEPARTMENT:** 06/01/2007

Research in the Gale laboratory is focused on understanding innate immunity to virus infection, and the intracellular immune processes and virus-host interactions that govern viral replication and infection outcome. The laboratory is a component of the Immune Mechanisms of Virus Control Research Center network supported by the NIH. Additionally, the Gale laboratory has research programs focused on understanding immune control of flaviviruses including Zika virus, West Nile virus, and dengue virus, and on understanding how innate immunity directs the outcome of infection and immunity in hepatitis C virus and HIV infection. The lab also conducts translational research to develop immunomodulatory and antiviral agents for application in infectious disease therapy and vaccination.

Virus infection of mammalian cells triggers an intracellular immune response, termed the "innate immune response" that functions to suppress replication and spread of the virus. During infection specific motifs within viral products are recognized as pathogen associated molecular patterns (PAMPs) by cellular factors called pathogen recognition receptors (PRRs). Studies in the Gale laboratory have defined the retinoic acid-inducible gene I (RIG-I) as the major PRR that triggers immunity against hepatitis C virus and a variety of pathogenic RNA viruses. Accumulating evidence now indicates that immunity against RNA viruses is largely triggered through the PRR actions of RIG-I and/or a related protein called MDA5. RIG-I and MDA5 are cytosolic RNA helicase and are expressed at a low levels in most cells. During virus infection RIG-I or MDA5 bind to RNA PAMP motifs of viral genome or viral RNA replication products generated by specific viruses. RIG-I binding of viral RNA triggers its downstream signaling to induce the activation of latent transcription factors and the eventual production of alpha/beta interferons and expression of interferon-stimulated genes. These processes induce the innate immune response that serves to limit virus replication and spread. Many viruses direct actions of immune evasion through regulation of innate immune signaling and function. Our studies have linked the course of virus infection to regulation of innate immune processes, and have identified novel interactions as therapeutic targets for the intervention of infection.

18 Total Number of Graduated Ph.D. Students
4 Overall Total Number of Current Students
2 Total Number of Current Immunology Students
2 Total Number of Other Current Students
1-Pathobiology
1-Molecular and Cellular Biology

8 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Saito, T., Owen, D.M., Jiang, F., Marcotrigiano, J. Gale, M. Jr. (2008) Innate immunity induced by composition-dependent RIG-I recognition of hepatitis C virus RNA. Nature. 454:523-527. PMID: 18548002 PMCID: PMC2856441
2. Liu, H.M., Loo, Y-M., Horner, S.M., Zornetzer, G.A., Katze, M.G., Gale, M. Jr. (2012) The Mitochondrial Targeting Chaperone 14-3-3 Regulates a RIG-I Translocon that Mediates Membrane Association and Innate Antiviral Immunity. Cell Host Microbe. 11:528-537. PMID: 22607805 PMCID: PMC3358705
3. Suthar, M.S., Ramos, H.J., Brassil, M.M., Netland, J., Chappell, C.P., Blahnik, G., McMillan, A., Diamond, M.S., Clark, E.A., Bevan, M.J., Gale, M. Jr. (2012) The RIG-I-like Receptor LGP2 Controls CD8(+) T Cell Survival and Fitness. Immunity. 37:235-248. PMID: 22841161 PMCID: PMC3910444
4. Schnell, G., Loo, Y-M., Marcotrigiano, J., Gale, M. Jr. (2012) Uridine composition of the poly-U/UC tract of HCV RNA defines non-self-recognition by RIG-I. PLoS Pathog. 8:e1002839. PMID: 22912574 PMCID: PMC3410852
5. Kell A, Stoddard M, Li H, Marcotrigiano J, Shaw GM, Gale M Jr. (2015) Pathogen-Associated Molecular Pattern Recognition of Hepatitis C Virus Transmitted/Founder Variants by RIG-I Is Dependant on U-Core Length. J Virol. 2015 Nov 1;89(21):11056-68. doi: 10.1128/JVI.01964-15. Epub 2015 Aug 26. PMID: 26311867

ALL PUBLICATIONS (Total Number of Publications: 168)

http://www.ncbi.nlm.nih.gov/sites/myncbi/michael.gale.2/bibliography/47891670/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1994	Outstanding Graduate Student Scholarship Award, University of Washington School of Public Health and Community Medicine
1995-1996	Public Health Service Post-doctoral Training Grant #CA09229-18
1996-1999	Helen Hay Whitney Post-doctoral Fellowship
1996	American Cancer Society Fellowship #PF-4381; declined for HHW Fellowship
1996	NIH Public Health Service Award (7/96-7/99); declined for HHW fellowship
1997	Young Investigator Award, International Society for Interferon and Cytokine Research
1999	Endowed Scholar in Biomedical Research. University of Texas Southwestern Medical Center
2001	Ellison Medical Foundation New Scholar in Global Infectious Disease Research
2002	WM Keck Foundation Research Achievement Award
2003	Burroughs Wellcome Fund Investigators in Pathogenesis of Infectious Disease Award
2006	Seymore and Vivian Milstein Award, Intl Society for Interferon and Cytokine Research
2014	American Academy of Microbiology, Fellow
2014, 2015	Thompson-Reuters top 1% cited in Microbiology

FUNDING/ACTIVE RESEARCH SUPPORT	
2 U19 AI083019-06 (M. Gale, PI) NIH/NIAID Title: Immune mechanisms of Flavivirus Control	5/01/09-4/30/19 Role: Program Director and Project 1 PI
5 R01 AI098943-03 (M. Gale (PI) NIH/NIAID Title: Innate Immune Antivirals for Biodefense	5/01/12-4/30/17 Role: PI
5 U19 AI100625- 04 (Baric/Heise, PIs) NIH/NIAID Title: Systems Immunogenetics of Biodefense Pathogens in the Collaborative Cross	8/01/12-7/31/17 Role: Project 3 PI
NIH/NIAID 5 R01 AI104002-03 (M. Gale (PI) Title: Innate immune control of West Nile virus	7/01/13-6/30/18 Role: PI
HSSN272201300023C COA1 (M. Gale (PI) NIH Title: Development of KIN-1148 as a Novel Innate Immune Adjuvant system for Emerging RNA Virus Vaccines	9/30/13–9/29/16 Role: PI
HHSN272201400055C (Nelson, PI) NIH/NIAID Title: Targeting IRFs for immune adjuvant enhancement of vaccine immunogenicity	9/30/14-9/29/19 Role: Co-PI
2 R56 AI060389-12 (M. Gale (PI) NIH/NIAID Title: The Host Response to Hepatitis C Virus	8/15/14-7/31/16 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Edward Clark, Ph.D.
- Daniel Stetson, Ph.D.
- Marion Pepper, Ph.D.
- Keith Elkon, M.D.
- Ram Savan, Ph.D.
- Andrew Oberst, Ph.D.
- Yueh-Ming Loo, Ph.D.
- David Rawlings, M.D.

MAIZELS, NANCY, PH.D.

POSITION/TITLE: Full Professor **JOINED DEPARTMENT:** 08/01/2000

Research in our laboratory builds on the conviction that molecular understanding is key to treatment of human disease. We focus on the mechanisms that maintain and alter genomic structure and sequence, which are key to the immune response, cancer, genetic disease, and — most recently — gene therapy.

CRISPR/Cas and other targeted endonucleases now make it possible to edit essentially any site in any genome. The challenge is to make genome editing as efficient and safe as possible. Nicks are the most common form of DNA damage, but their potential to cause genomic instability had been largely ignored. Our evidence that DNA nicks (not double-strand breaks) initiate Ig gene conversion suggested that nicks could initiate homology-directed repair (HDR) in human cells. We worked with colleagues to develop an early "nickase", and showed HDR at nicks was efficient accompanied by far less local mutagenesis than HDR targeted by a double-strand break. We discovered that human cells can carry out HDR at nicks using a novel alternative pathway that may be activated in solid tumors, especially breast and ovarian cancers (Davis and Maizels, 2014). We are currently optimizing pathways of HDR to improve targeted gene therapies.

Many cancer therapies overload nuclear repair pathways to kill rapidly dividing tumor cells, in some cases by promoting formation of stable, covalent DNA-protein complexes. We have developed a robust and quantitative assay for these complexes, the RADAR assay (Kiianitsa and Maizels, 2013, 2014). We are applying the RADAR assay to study and optimize the response to radiation therapy and to drugs that function as topoisomerase poisons, such as irinotecan and etoposide.

14 Total Number of Graduated Ph.D. Students
3 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
3 Total Number of Other Current Students
  2 Biochemistry
  1 Molecular Medicine Training Program (M3D)

1 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Weiner, A.M. and Maizels, N. 1987. tRNA-like structures tag the 3' ends of genomic RNA molecules for replication: Implications for the origin of protein synthesis. Proc. Natl. Acad. Sci. USA 84:7383-7387.
2. Duquette, M.L., Handa, P., Vincent, J., Taylor, A.F., and Maizels, N. 2004. Intracellular transcription of G-rich DNAs induces formation of G-loops, novel structures containing G4 DNA. Genes Dev. 18: 1618-1629.
3. Larson, E.D., Cummings, W.J., Bednarski, D.W. and Maizels, N. 2005. MRE11/RAD50 cleaves DNA in the AID/UNG-dependent pathway of immunoglobulin gene diversification. Molecular Cell 19: 367-375.
4. Gray, L.T., Vallur, A.C., Eddy, J. and Maizels, N. 2014. G-quadruplexes are genomewide targets of transcriptional helicases XPB and XPD. Nature Chem. Biol. 10:313-318.
5. Davis, L. and Maizels, N. 2014. Homology-directed repair of DNA nicks via pathways distinct from canonical double-strand break repair. Proc. Natl. Acad. Sci. USA 111:E924-932.

ALL PUBLICATIONS (Total Number of Publications: 123)

http://www.ncbi.nlm.nih.gov/pubmed/?term=Maizels+N.

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1967	Phi Beta Kappa
1968	A.B. with great distinction, University of California, Berkeley
1968-1971	National Science Foundation Predoctoral Fellow, Harvard University
1974-1987	Junior Fellow of the Society of Fellows, Harvard University
1996	Basic Science Teaching Award, American Medical Women's Association
2010	Service Excellence Award, University of Washington
2009-2014	Editorial Committee, Annual Review of Genetics
2009-	Associate Editor, PLoS Genetics
2010	Chair, Mutagenesis Gordon Conference Co-Chair 2008
2011-	Program Director, NIH/NIGMS Molecular Medicine Training Program T32 GM095421
2012	Organizer, FASEB SRC on Dynamic DNA Structures Co-organizer 2010
2013	Editor "Molecular and Genetic Bases of Disease" issue, Curr Op Genet Develo
2013-15	Member, Israel Cancer Research Foundation Review Panel
2014,15	ad hoc Reviewer, NCI Special Emphasis Panels
2014	ad hoc Reviewer, Radiation Therapeutics and Biology (RTB) Study Section
2015	Organizer, Fifth International Conference on G4 DNA, Bordeaux, France
2015-	International Scientific Council, Israel Cancer Research Foundation
2015-	Member, Radiation Therapeutics and Biology (RTB) Study Section

FUNDING/ACTIVE RESEARCH SUPPORT	
1R01 CA183967-01A1 (PI: Maizels, N.) NIH/NCI Title: Genomic Instability at DNA Nicks	09/13/14 - 08/31/19
5PO1 CA077852-16A1 (PI: Monnat, R.J.) NIH/NCI Title: Molecular Determinants of Cancer Therapeutic Response Project 3: Therapeutic Response Signatures (Project Leader: Maizels)	07/08/15 – 6/30/20
1R21 CA190675-01 (PI: Maizels, N.) NIH/NCI Title: Mechanisms of Loss of Heterozygosity in Cancer	09/01/14 - 08/31/16
1R21 CA194876-01 (MPIs: Ong, S.E., Maizels, N.) NIH/NCI Title: Novel Targets of Chemotherapeutic Drugs that Trap Protein on DNA	04/01/15 - 03/31/17

OTHER COLLABORATIONS:

- Pam Becker, MD PhD — UW Dept. of Medicine/Hematology
- Larry Loeb, MD PhD — UW Dept. of Pathology
- Ray Monnat, MD — UW Dept. of Pathology
- Shao-En Ong, PhD — UW Dept. of Pharmacology
- Peter Rabinovitch, MD PhD — UW Dept. of Pathology
- Dipankar Sen, PhD — Simon Fraser University, Vancouver BC
- David Sherman, PhD — CIDR, Seattle

CLARK, EDWARD A., PH.D.

POSITION/TITLE: Joint Professor **JOINED DEPARTMENT:** 06/01/2001
PRIMARY APPOINTMENT: Professor, Dept. of Microbiology

A major goal of Dr. Clark's lab has been to define receptors and ligands regulating B cells and dendritic cells (DCs) and to help translate findings for use in clinical immunology. His lab helped discover and characterize human B cell/DC-associated surface molecules like CD20, CD22, CD40, CD80 (B7.1), CD150 (SLAM) and CD180 (RP105). Recently, the lab has focused on defining C-type lectin receptors (CLRs) on DCs including DCAL1, which binds to a ligand on CD4 T cells and promotes IL-4 production, and DCAL2, which is a useful marker to identify and isolate mouse DC subsets. In order to assess the function of CLRs and their possible use for vaccine development, Dr. Clark's lab has coupled antigens (Ags) to monoclonal antibodies (mAbs) specific for CLRs expressed on DC subsets. The Ag-mAb conjugates are inoculated into mice as a kind of 'antigen-delivery system', which enables Ags to be selectively targeted to a particular DC subset, which then responses and programs an appropriate, protective immune response. Transgenic mice expressing human CLRs such as DCAL1 or BDCA2 have been made and are being used as preclinical vaccine models for assessing Ag-anti-human CLR conjugates in vivo.

B cells are very social cells; their behavior is influenced not only by T cells, but also by Ag presented in different forms including in association with DCs or macrophages. DCs and macrophages also produce cytokines like BAFF, which are essential for B cell survival and maturation. The Clark lab investigates how DCs regulate B cell responses. Current projects in this area include: 1) defining the role CD22 and other B cell/DC-associated receptors play in protective immune responses to West Nile virus; 2) characterizing how TLR7 regulates and dysregulates B cell development and antibody production; 3) defining how DCs program B cells to develop extrafollicular Ab responses or germinal centers and long-lived humoral immunity; 4) investigating how BAFF from different cell sources regulates B cell responses to Ag.

13 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

3 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Clark EA, Ledbetter JA. Activation of human B cells mediated through two distinct cell surface differentiation antigens, Bp35 and Bp50. Proc Natl Acad Sci USA 1986. 83:4494-8. PMID: 3487090 (recognized as a Pillar of Immunology, see G Bishop, J Immunol 188:4127-29, 2012)
2. Law CL, Sidorenko SP, Chandran KA, Zhao Z, Shen SH, Fischer EH, Clark EA. CD22 associates with protein tyrosine phosphatase 1C, Syk and phospholipase C- 1 upon B cell activation, J Exp Med 183: 547-560, 1996. PMID: 8627166
3. Pinchuk LM, Polacino PS, Agy MB, Klaus SJ, Clark EA. The role of CD40 and CD80 accessory cell molecules in dendritic cell-dependent HIV-1 infection. Immunity. 1994. 1:317-25. PMID: 7534204
4. Craxton A, Magaletti D, Ryan EJ, Clark EA. Macrophage- and dendritic cell-dependent regulation of human B cell proliferation requires the TNF-family ligand, BAFF, Blood 101:4464-4471, 2003. PMID: 12531790
5. Chappell CP, Draves KE, Giltiay NV, Clark EA. Extrafollicular B cell activation by marginal zone dendritic cells drives T cell-dependent antibody responses. J Exp Med 2012. 209:1825-40. PMID: 22966002

ALL PUBLICATIONS (Total Number of Publications: 69)

http://www.ncbi.nlm.nih.gov/sites/myncbi/clark.edward.1/bibliography/47896484/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1965-1967	University of California Regents Scholar
1977	Inter-Science Research Foundation Graduate Student Research Prize
1977-1979	Edna A. Old Memorial Fellow of the Cancer Research Institute of New York
1987	Japanese Ministry of Education (Mombusho), Foreign Research Scholar, Osaka University
1995	Science Watch Most Highly Cited Authors in Immunology 1990-1994, No. 15
2001	Science Watch Most Highly Cited Authors in Immunology 1981-2001
2004-2014	NIH/NIAID MERIT Award
2014-	University of Washington Presidential Entrepreneurial Faculty Fellow

FUNDING/ACTIVE RESEARCH SUPPORT	
R01 AI52203-11 Clark EA (PI) Title: Programming protective immunity by targeting antigens to the CD180 receptor	5/1/2003-6/30/2020 Role: PI
R01 AI44257-16A1 Clark EA (PI) Title: Role of B cell activating factor (BAFF) in B cell responses and autoimmunity	12/1/2015-11/30/2020 Role PI
U19 AI83019-06 Gale, Jr M (PI) Title: Immune Mechanisms of Flavivirus Control	5/1/2014-4/30/2019 Role: Project Leader
U19 AI83019-06 Gale, Jr M (PI) Title: Immune Mechanisms of Flavivirus Control Core 2: Mouse Resources	5/1/2014-4/30/2019 Role: Core Leader
UCB Pharmaceuticals Clark EA (PI) Title: Research Contract: Characterization of B cell responses to Epratuzumab (Emab)	9/1/2012-6/30/2016 Role: PI
Life Science Discovery Fund Clark EA (PI) Title: Therapeutic vaccine of hepatitis B virus (HBV) and disease	3/16/2015-3/17/2017 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Mike Gale, Jr, Ph.D.
- Keith Elkon, M.D.

OTHER COLLABORATIONS:

- Natalia Giltiay, Ph.D., UW Rheumatology
- Deborah Fuller, Ph.D., UW Microbiology
- Mike Diamond- Washington University, St. Louis

GREENBERG, PHILIP D., M.D.

POSITION/TITLE: Joint Professor **JOINED DEPARTMENT:** 07/01/1988
PRIMARY APPOINTMENT: Professor, Dept. of Medicine, Division of Medical Oncology

Dr. Greenberg's laboratory is involved in studies elucidating the immunobiology of host T cell responses to infectious viruses and transformed cells. Analysis of T cell responses to pathogenic viral infections and tumors has demonstrated that reactive T cells are often rendered anergic or dysfunctional as a consequence of encounter with the antigen, and the basis for these defects are being explored and molecular strategies to restore and augment T cell function via genetic modification of T cells with vectors expressing novel proteins, dominant negative proteins, or RNAi are being evaluated. The mechanisms of tolerance to tumor antigens that are over-expressed pro-oncogenic self-proteins are being examined in transgenic mouse models that express tumor-derived proteins of known immunogenicity under the control of tissue-specific promoters- these models are making it possible to isolate and track antigen-specific tolerant cells, to use technologies such as gene expression arrays to identify abnormalities in tolerant T cells, and to begin testing molecular strategies for correcting defects. Immunity to human pathogenic viruses is being studied with the goal of defining methods to generate or augment protective immune responses. These studies include the development of transgenic/knock-in mice in which human genes are being expressed to create models that better typify human immune responses, and these mice are being used to evaluate and improve the design of candidate HIV vaccines. Previous studies of human CMV immunobiology led to a clinical trial in which immunosuppressed leukemia patients at high risk for fatal CMV infection were infused with CMV-specific cytolytic T cell clones. The clones had been previously selected for recognition of an immunodominant protective epitope and expanded to large numbers in vitro, and this trial demonstrated that T cell transfer can reconstitute immunity in humans and provide protection from disease. This adoptive therapy approach with cloned T cells of known function and specificity is now being pursued to both elucidate the immunobiology of human malignancies and infections and to develop novel immune-based therapies. Clinical trials of adoptive T cell therapy are now underway in patients with leukemia. Methods to modulate the effector functions, survival, target avidity, and localization of T cells, and to impart desired antigen specificity are being developed using retroviral-mediated gene transfer, and such engineered T cell clones are now being evaluated in mouse models and will soon be tested in treatment of human disease.

6 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

7 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Greenberg PD, Cheever MA, Fefer A. Eradication of disseminated murine leukemia by chemoimmunotherapy with cyclophosphamide and adoptively transferred immune syngeneic Lyt-1+2- lymphocytes. J Exp Med, 154: 952-963, 1981. (Republished as a "Pillar of Immunology" in J Immunol, 190:1899-910, 2013).
2. Riddell SR, Watanabe KS, Goodrich JM, Li CR, Agha ME, Greenberg PD. Restoration of viral immunity in immunocompromised humans by the adoptive transfer of T cell clones. Science, 257:238-41, 1992.
3. Nelson B, Lord JB, Greenberg PD. Cytoplasmic domains of the IL 2 receptor β and γ chains mediate the signal for T-cell proliferation. Nature, 369:333-6, 1994.
4. Gilbert MJ, Riddell SR, Plachter B, Greenberg PD. Cytomegalovirus selectively blocks antigen processing and presentation of its immediate-early gene product. Nature, 383:720-2, 1996.

5. Riddell SR, Elliot M, Lewinsohn DA, Gilbert MJ, Wilson L, Manley SA, Lupton SD, Overell RW, Reynolds TC, Corey L, Greenberg PD. T-cell mediated rejection of gene-modified HIV-specific cytotoxic T lymphocytes in HIV-infected patients. Nature Med, 2:216-23, 1996.

ALL PUBLICATIONS (Total Number of Publications: 234)

http://www.ncbi.nlm.nih.gov/sites/myncbi/philip.greenberg.1/bibliography/40315209/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1970	Alpha Omega Alpha
1971	Graduation from Medical School Summa Cum Laude
1974 – 1976	USPHS Individual Postdoctoral Research Fellowship
1978 – 1981	American Cancer Society Junior Clinical Faculty Fellowship
1987	American Society of Clinical Investigation
1998	American Association of Physicians
1991 – 2007	NIH MERIT Awards
2007	Fellow, American Association for the Advancement of Science
2008	Fellow, American College of Physicians
2010	Society for Immunotherapy of Cancer Team Science Award for Career Achievements
2011	Cancer Research Institute's William B. Coley Award for Distinguished Research in Tumor Immunology
2016	Editor-In-Chief, *Cancer Immunology Research*, (2-15-present)

FUNDING/ACTIVE RESEARCH SUPPORT	
P30 CA15704-42 (PI: Corey, L.) NIH/NCI Title: Cancer Center Support Grant	01/01/2015- 12/31/2020 Role: Co-Director
Juno Therapeutics, Inc. Title: Research and Development of Cellular Immunotherapy Products	10/16/2013 – 10/15/2019 Role: PI
Korean Research Institute of Bioscience and Biotechnology Title: Development of Platform Technology for Cancer Immunotherapy	6/1/2013 – 3/31/2016 Role: PI
R01 CA33084-33 (Greenberg, P.) NIH/NCI Title: Mechanisms of Murine Tumor Eradication by Adoptive Immunotherapy	04/01/2013 - 03/31/2018 Role: PI
Restricted Donation Developing T cell reagents for a broad patient population that target antigens in AML	12/01/2013 - 11/30/2016 Role: PI
SU2C-AACR-DT10 (Ribas, T.; Co-PI: Yee, C.) AACR/Stand Up To Cancer Dream Team Project: Adoptive Cell Transfer for Cancer Treatment; Subcontract: (PI: Greenberg, P. Co-PI: Riddell, S.)	3/1/2013 - 02/28/2017 Role: Project PI
P01 CA18029-40 (Appelbaum, F.) NIH/NCI Title: Adult Leukemia Research Center Project 3: Specific Adoptive Immunotherapy of Myeloid Malignancy	09/25/2012 - 06/30/2017 Role: Project Leader

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Stanley Riddell, M.D.

STETSON, DANIEL, PH.D.

POSITION/TITLE: Associate Professor **JOINED DEPARTMENT:** 04/01/2008

Research in the Stetson lab focuses on mechanisms by which cells detect and respond to viral infection. All organisms have viral pathogens, and an ancient and fundamental mechanism for detecting viral infection makes use of sensors that recognize viral nucleic acids. In vertebrates, these sensors coordinate an inducible antiviral response by activating the production of type I interferons (IFNs). While the pleiotropic roles of IFNs have been studied since their discovery over five decades ago, recent advances have allowed us to understand their means of induction and complex regulation at a molecular level.

We are particularly interested in a recently described pathway that detects cytosolic DNA within mammalian cells. This pathway, termed the interferon stimulatory DNA (ISD) response, is analogous to the well-characterized RIG-I and MDA5 RNA helicases that detect RNA. However, the ISD pathway signals activation of the antiviral response through a distinct, still poorly characterized mechanism. One goal of our research is to define the specific signaling cascades of the ISD pathway and, more importantly, to determine why they are different from those activated by viral RNA. Another is to understand the biological relevance of the ISD pathway and its connections to Toll-like receptor mediated nucleic acid detection.

Nucleic acid recognition is the principal strategy of viral detection, yet its very nature raises fundamental questions of self/non-self-discrimination because of the abundance of self-derived nucleic acids in all cells. We are developing novel mouse model systems to study how dysregulated nucleic acid detection initiates and precipitates autoimmunity and investigating a new mechanism of autoimmunity caused by excessive activation of cytosolic nucleic acid sensors. Finally, the recent renaissance in our understanding of nucleic acid detection will allow us to revisit a number of long-standing, unanswered questions. One fascinating example is the question of why DNA viruses – but not RNA viruses – cause cancer. This question can now be framed in specific molecular terms, and tools are being developed to probe the interconnections between DNA-activated antiviral responses and tumor suppression.

3 Total Number of Graduated Ph.D. Students
4 Overall Total Number of Current Students
2 Total Number of Current Immunology Students
2 Total Number of Other Current Students
2 Molecular and Cellular Biology (MCB)

3 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Stetson DB*, Ko JS, Heidmann T, and Medzhitov R*. 2008. Trex1 prevents cell-intrinsic initiation of autoimmunity. *Cell 134(4)*:587-598. *Corresponding Authors. PMCID: PMC2626626.
2. Brunette RL, Young JA, Whitley DG, Brodsky IE, Malik HS, Stetson DB. 2012. Extensive evolutionary and functional diversity among mammalian AIM2-like receptors. *Journal of Experimental Medicine 209(11):*1969-1983. PMCID: PMC3478938.
3. Gall A, Treuting P, Elkon KB, Loo Y-M, Gale M Jr, Barber GN, Stetson DB. 2012. Autoimmunity initiates in non-hematopoietic cells and progresses via lymphocytes in an interferon-dependent autoimmune disease. *Immunity*, 36(1):120-131. PMCID: PMC3269499.
4. Lau L, Gray EE, Brunette RL, Stetson DB. 2015. DNA tumor virus oncogenes antagonize the cGAS-STING DNA sensing pathway. *Science 350(6260):*568-571.
5. Pestal K, Funk CC, Snyder JM, Price ND, Treuting PM, Stetson DB. 2015. Isoforms of the RNA editing enzyme ADAR1 independently control nucleic acid sensor MDA5-driven autoimmunity and multi-organ development. *Immunity*, 43(5):933-944. NIHMS ID: 736550.

ALL PUBLICATIONS (Total Number of Publications: 24)

http://www.ncbi.nlm.nih.gov/sites/myncbi/1VSS0Sn865cAY/bibliograpahy/47891782/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1996-1997	Howard Hughes Medical Institute Undergraduate Research Fellowship
1997	Graduation with Distinction, Duke University
2003	AAI Huang Foundation Trainee Achievement Award
2004-2006	Cancer Research Institute Postdoctoral Fellowship
2007-2010	NIH K99/R00 Pathway to Independence Award
2009-2014	Rita Allen Foundation Scholar Award
2014-2019	Burroughs Wellcome Fund Investigator in the Pathogenesis of Infectious Disease

FUNDING/ACTIVE RESEARCH SUPPORT	
R01 AI084914 NIH/NIAID Title: Intracellular nucleic acid detection in autoimmunity	05/15/2010- 05/14/2020 Role: PI
Burroughs Wellcome Investigator in the Pathogenesis of Infectious Disease Title: Why do DNA viruses cause cancer	07/01/2014- 06/30/2019 Role: PI
Bill and Melinda Gates Foundation Title: Next generation CD8-directed nanoparticle vaccines for HIV	09/01/2014- 09/30/2017 Role: Co-PI
Collaborative Study Group for Autoimmune Disease Prevention Pilot Grant NIH Title: The 7SL RNA hypothesis for endogenous MDA5 RNA ligands in autoimmune disease	11/01/2015- 10/31/2016 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Michael Gale, Jr. Ph.D.
- Keith Elkon, M.D.
- Marion Pepper, Ph.D.
- Andrew Oberst, Ph.D.

GERNER, MICHAEL Y., PH.D.

POSITION/TITLE: Assistant Professor **JOINED DEPARTMENT:** 11/01/2015

The immune system is composed of a highly heterogeneous network of innate and adaptive cell populations with unique phenotypic and functional properties. These diverse cells are differentially distributed within tissues, creating specialized microenvironments with select roles and functions. Furthermore, these localized cells are in constant communication with one another and coordinate their activities to generate immune responses specifically tailored to distinct challenges. In the Gerner lab, we investigate these processes directly in situ by studying micro-anatomical tissue organization on cellular and molecular levels, cell-cell communication events that generate immune responses, as well as localized effector responses in inflamed peripheral sites that allow for protective immunity. We utilize cutting-edge microscopy tools, such as 2-photon intra-vital microscopy, multi-parameter whole-organ confocal microscopy and analytical Histo-Cytometry. Investigating such cell-cell crosstalk and coordinated activity, as well as the broader structure-function relationships for whole organs and inflamed sites is critical for understanding the underpinnings of immune processes. These studies will lead to improved design of vaccines and immuno-modulatory therapeutics and will allow for tight and regionalized regulation of select cells and functions.

0 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

0 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Liu Z, **Gerner MY**, Van Panhuys N, Levine AG, Rudensky AY, Germain RN. Immune homeostasis enforced by co-localized effector and regulatory T cells. Nature. 2015 Dec 10;528(7581):225-30. PubMed PMID: 26605524; PubMed Central PMCID: PMC4702500.
2. Fonseca DM, Hand TW, Han SJ, **Gerner MY**, Glatman Zaretsky A, Byrd AL, Harrison OJ, Ortiz AM, Quinones M, Trinchieri G, Brenchley JM, Brodsky IE, Germain RN, Randolph GJ, Belkaid Y. Microbiota-Dependent Sequelae of Acute Infection Compromise Tissue-Specific Immunity. Cell. 2015 Oct 8;163(2):354-66. PubMed PMID: 26451485.
3. **Gerner MY**, Torabi-Parizi P, Germain RN. Strategically localized dendritic cells promote rapid T cell responses to lymph-borne particulate antigens. Immunity. 2015 Jan 20;42(1):172-85. PubMed PMID: 25607462.
4. **Gerner MY**, Kastenmuller W, Ifrim I, Kabat J, Germain RN. Histo-cytometry: a method for highly multiplex quantitative tissue imaging analysis applied to dendritic cell subset microanatomy in lymph nodes. Immunity. 2012 Aug 24;37(2):364-76. PubMed PMID: 22863836; PubMed Central PMCID: PMC3514885.
5. **Gerner MY**, Heltemes-Harris LM, Fife BT, Mescher MF. Cutting edge: IL-12 and type I IFN differentially program CD8 T cells for programmed death 1 re-expression levels and tumor control. J Immunol. 2013 Aug 1;191(3):1011-5. PubMed PMID: 23804712; PubMed Central PMCID: PMC3720703.

ALL PUBLICATIONS (Total Number of Publications: 16)

http://www.ncbi.nlm.nih.gov/myncbi/browse/collection/49544943/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

2001 Edward and Anna Birge Research Scholarship, University of Wisconsin - Madison
2005 NIH sponsored Cancer Biology Training Grant, University of Minnesota – Twin Cities
2008 NIH sponsored MICaB Travel Grant, University of Minnesota – Twin Cities
2009 NIAID Intramural Research Training Award (IRTA), NIH
2009 Beatrice Z. Milne and Theodore Brandenburg award for outstanding graduate research in the basic biomedical sciences, University of Minnesota – Twin Cities
2010 Office of AIDS Research Intramural Grant, NIAID, NIH
2012 FARE Awards (Fellows Award for Research Excellence) for 2012, 2013 and 2014, NIAID, NIH
2015 K22 – NIAID Career Transition Award, NIAID

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Andrew Oberst, Ph.D.

OTHER COLLABORATIONS:

- Rafi Ahmed, Ph.D. Emory University
- Robert Seder, M.D. Vaccine Research Center, NIAID
- Richard Koup, M.D. Vaccine Research Center, Immunology Laboratory, NIAID

OBERST, ANDREW A., PH.D.

POSITION/TITLE: Assistant Professor **JOINED DEPARTMENT:** 08/01/2012

Programmed cell death—cellular suicide—is a fundamental process required for embryonic development, tissue homeostasis, tumor suppression and immunity. We now understand that cells can die in several different ways: in addition to the well-studied process of apoptosis, cells can activate other suicide programs, such as pyroptosis and necroptosis. Importantly, apoptotic cells are rapidly cleared from the body by phagocytes, and apoptosis is generally considered a non-inflammatory event. In contrast, cells dying by pyroptosis or necroptosis release both their contents and specific cytokine signals into surrounding tissues, activating immune cells and promoting both inflammation and adaptive immunity. Pathogen infection may trigger any of these cell death programs (depending on the bug), and various viruses and bacteria encode specific inhibitors of cell death effectors. Oncogenic transformation can also lead to inhibition of cell death signaling, and re-engagement of cell death within tumors is a major goal of cancer therapies. These observations lead to one of the central hypotheses on which the Oberst lab focuses: That how a cell dies—not simply whether it dies—is a key determinant of the innate and adaptive immune response that follows. We use engineered forms of cell death proteins and knockout mouse models to understand how different forms of cell death occur, and to compare the immune response triggered by each in vivo in the context of infection, cancer, and autoimmunity. Specific questions currently under investigation include:What are the determinants of the immune response to necroptotic cells? Necroptosis is a form of cellular suicide involving both lytic cell death and the production of inflammatory cytokines. We are investigating how these two immunogenic events are linked, in both engineered cellular models and viral infection. How does pathogen sensing engage cell death? Activation of innate immune pattern-sensing pathways such as the Toll-like receptors, RIG-I-like receptors, NOD-like receptors or the cGAS-STING pathway can trigger immune cytokine production. These pathways can also lead to apoptosis, pyroptosis, or necroptosis, depending on the cell and tissue context in which they occur. We study the causes and consequences of these cell death programs.Are there death-independent roles of the cell death machinery? (Yes, there are.) Mice lacking necroptotic effector proteins are highly susceptible to multiple types of viral infection. Surprisingly however, in some cases this susceptibility is not due to a failure to trigger cell death, but rather to non-death functions of these proteins in innate immune signaling. How does activation of inflammatory cell death alter models of cancer and autoimmunity? Promoting inflammation and an immune response to dying cells may be beneficial in the context of infection or cancer, but an overexuberant immune response to dying cells can lead to autoimmunity. We have created engineered cell death effectors that allow us to induce specific forms of cell death in vivo. We are applying these systems to models of tumorigenesis, type-I diabetes, and lupus.

0 Total Number of Graduated Ph.D. Students
3 Overall Total Number of Current Students
1 Total Number of Current Immunology Students
2 Total Number of Other Current Students
2 Molecular and Cellular Biology (MCB)

2 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Yatim N, Jusforgues-Saklani H, Orozco S, Schulz O, Barreira da Silva R, Reis e Sousa C, Green DR, Oberst A, Albert ML. RIPK1 and NF-κB signaling in dying cells determines cross-priming of $CD8^+$ T cells. Science. 2015 Oct 16;350(6258):328-34. doi: 0.1126/science.aad0395. Epub 2015 Sep 24. PubMed PMID: 26405229.
2. Orozco SL, Yatim N, Werner MR, Tran H, Gunja SY, Tait WG, Albert ML, Green DR, Oberst A. RIPK1 both positively and negatively regulates RIPK3 oligomerization and necroptosis. Cell Death Differ. 2014 Oct;21(10):1511-21. doi: 10.1038/cdd.2014.76. Epub 2014 Jun 6.
3. Caspase-8 mediates caspase-1 processing and innate immune defense in response to bacterial blockade of NF-κB and MAPK signaling. Philip NH, Dillon CP, Snyder AG, Fitzgerald P, Wynosky-Dolfi MA, Zwack EE, Hu B, Fitzgerald L, Mauldin EA, Copenhaver AM, Shin S, Wei L, Parker M, Zhang J, Oberst A, Green DR, Brodsky IE. Proc Natl Acad Sci U S A. 2014 May 20;111(20):7385-90.
4. Oberst A, Dillon CP, Weinlich R, McCormick LL, Fitzgerald P, Pop C, et al. Catalytic activity of the caspase-8-FLIP(L) complex inhibits RIPK3-dependent necrosis. Nature. 2011;471(7338):363-7. PubMed PMID: 21368763

5. Tait SW*, Oberst A*, Quarato G, Milasta S, Haller M, Wang R, Karvela M, Ichim G, Yatim N, Albert ML, Kidd G, Wakefield R, Frase S, Krautwald S, Linkermann A, Green DR. Widespread mitochondrial depletion via mitophagy does not compromise necroptosis. Cell Reports. 2013 Nov 27;5(4):878-85. *Shared first-authorship

ALL PUBLICATIONS (Total Number of Publications: 31)

http://www.ncbi.nlm.nih.gov/sites/myncbi/andrew.oberst.1/bibliography/40979048/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

2001	Oscar E. Schotte Award for Most Outstanding Undergraduate Thesis in the Field of Biology, Amherst College. Title: "The fate of lipid rafts in the membranes of apoptotic cells."
2001	Undergraduate thesis awarded Highest Honors, the only thesis so awarded in the Amherst biology department in 2001.
2005	Graduate thesis awarded Highest Honors by a panel of professors from the University of Rome and the University of Paris.
2009	Rhodes College Teaching Fellowship award, Rhodes College, Memphis, TN.
2012-Present	Editorial Board Member & Section Chief, *Cell Death and Disease* (Nature Publishing Group journal, impact factor 5.3)
2014-Present	Editorial Board Member, *Frontiers in Cell Death & Survival*, a topical sub-journal of *Frontiers in Cell & Developmental Biology*
2015-Present	Editorial Advisory Board Member, Autophagy & Cell Death section, *Oncotarget* (Impact Factor 6.63)

FUNDING/ACTIVE RESEARCH SUPPORT	
NIAID R01 1R01AI108685-01: Oberst (PI) The physiological role of RIPK3-dependent necroptosis This project seeks to understand the signals that trigger RIPK3-dependent necroptosis under physiological conditions.	1/1/2014-12/31/2018 Role: PI
NCI R21 1R21CA185681: Oberst (PI) Inducing immunogenic cell death in cancer This project studies the effect of how tumor cells die on disease outcome.	5/2015-5/2017 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Daniel Stetson, Ph.D.
- Michael Gale, Jr, Ph.D.
- Savan Ram, Ph.D.
- Stanley Riddell, M.D.

OTHER COLLABORATIONS:

- Igor Brodsky, Ph.D. University of Pennsylvania
- Chandrashekhar Pasare, Ph.D. University of Texas Southwestern
- Matthew Albert, M.D., Ph.D. Genentech

PEPPER, MARION, PH.D.

POSITION/TITLE: Assistant Professor **JOINED DEPARTMENT:** 08/01/2011

The adaptive immune system is characterized by specificity, functional diversity and memory. These characteristics engender the body with the ability to mount a directed response against an individual pathogen for many years after vaccination, but also allow for the propagation of long-lived allergic responses. In the Pepper lab, we study how cells of the adaptive immune system, called CD4+ T cells and B cells, form immunological memory by visualizing their differentiation, retention and function in both mice and humans. We accomplish this by using novel tetramer-based enrichment strategies to study small populations of antigen specific CD4+ T and B cells in both complex infectious diseases, such as malaria, as well as during allergic asthma using a house dust mite model. We additionally use transgenic mice with various genetic ablations to interrogate the underlying molecular mechanisms involved in memory cell development and function. The overarching goals of these studies are to both enhance immune memory to design better vaccines and inversely block the formation of immune memory to prevent allergic disease.

0 Total Number of Graduated Ph.D. Students
2 Overall Total Number of Current Students
2 Total Number of Current Immunology Students
0 Total Number of Other Current Students

2 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Krishnamurty AT, Thouvenel CD, Portugal S, Keitany G, Kim K, Holder A., Crompton PD, Rawlings DJ, **Pepper M.** *Plasmodium*-specific IgM^+ memory B cells are rapid, plastic first responders to a secondary malaria infection. In Review at Cell.
2. Hondowicz BD, An D, Schenkel JM, Kim KS, Steach HR, Keitany GJ, Krishnamurty AT, Garza EN, Fraser KA, Moon JJ, Altemeier WA, Masopust D, **Pepper M**. Interleukin-2-Dependent Allergen-Specific Tissue-Resident Memory cells drive asthma. Immunity. 2015 Dec 28;155-166.
3. **Pepper M**, Pagán AJ, Igyártó BZ,Taylor JJ and Jenkins MK. 2011. Opposing signals from the Bcl6 transcription factor and the interleukin-2 receptor generate T helper-1 central and effector memory cells. Immunity. 35 (4): 583-595. PMID: 22018468.
4. **Pepper M**, Linehan JL, Pagán AJ, Zell T, Dileepan T, Cleary PP, and Jenkins MK. 2010. Different routes of bacterial infection induce long-lived T_h1 memory cells and short-lived T_h17 cells. Nature Immunology 11 (1): 83-9. Article of the month. Commentary 11(1):47-9. PMID: 19935657
5. **Pepper, M.,** Dzierszinski, F.,Crawford, A., Hunter, C., Roos, D. 2004. Development of a system to study $CD4^+$-T-cell responses to transgenic ovalbumin-expressing *Toxoplasma gondii* during toxoplasmosis. Infection and Immunity. 72(12): 7240-6. PMID: 15557649

ALL PUBLICATIONS (Total Number of Publications: 30)

http://www.ncbi.nlm.nih.gov/sites/myncbi/marion.pepper.1/bibliography/47215313/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

2003-2006	Recipient of NIH Training Grant Program position in Parasitology, University of Pennsylvania
2005	Invited Speaker and Travel Award, American Society of Tropical Medicine and Hygiene
2006-2009	National Research Service Award Training Grant (T32) Recipient, Univ. of Minnesota
2012	NIH Early Career Reviewer, Immunity and Host Defense Study Section
2012	Invited Participant, Improving Malaria Vaccine Strategies through the Application of Immunological Principles, NIH
2012	Biomedical Scholar Award, Scholler Foundation
2013	AAI Early Career Faculty Travel Award, AAI (2013-2015)
2013	Biology of Parasitism Lecturer, Woods Hole Marine Biological Laboratories, (2013-)
2014	Invited Speaker. B Cell Help in HIV Vaccine Strategies Think Tank. NIAID/NIH
2014	Invited participant, Food Allergy Workshop, NIH
2015	Invited speaker. Malaria Branch, National Institutes of Health
2015	AAI Careers in Immunology Fellowship, AAI

FUNDING/ACTIVE RESEARCH SUPPORT	
R01 AI108626-01A1, NIAID Title: The differentiation and function of CD4+ Th2 cells during allergen-induced asthma	2014/02/01- 2019/01/31 Role: PI
R01 AI108626-01A1S1 NIAID Title: The differentiation and function of CD4+ Th2 cells during allergen-induced asthma	2014/02/01- 2019/01/31 Role: PI
The Bill and Melinda Gates Foundation #OPP1118840 Title: Next Generation CD8 Directed Nanoparticle Vaccines for HIV	2014/12/01- 2016/12/30

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Michael Gale, Ph.D.
- Daniel Stetson Ph.D.
- David Rawlings M.D.
- Jessica Hamerman Ph.D.

SAVAN, RAM, PH.D.

POSITION/TITLE: Assistant Professor **JOINED DEPARTMENT:** 12/05/2011

Our laboratory investigates the regulation of immune genes and its impact on infection and autoimmunity, with specific interests in identifying post-transcriptional regulators of innate immune effectors that include RNA binding proteins and non-coding RNAs.

There are several regulatory mechanisms that have evolved to regulate gene expression via the 3′ untranslated region (3′ UTR). Many interferon and cytokine genes are regulated by cis-acting repetitive adenosine-uridine stretches (AUUUA), referred to as AU-rich elements (ARE) that destabilize the mRNA through an ARE-mediated decay (AMD) process. The ARE regions are targeted by RNA-binding proteins for degradation and/or stabilization. Majority of cytokine genes harbor ARE motifs in their 3′ UTR and are known to be regulated by AMD. In addition to the ARE elements in the 3′ UTRs, target sites for microRNA (miRNA) binding have also been identified. miRNAs are endogenous, single stranded RNA molecules 21-23 nucleotides in length and have emerged as potent regulators of gene expression that can inhibit translation of proteins in mammals through the miRNA-induced silencing complex (miRISC). As testament to their importance, 30 % of all genes are known to be regulated by miRISC. We and others have shown that miRISC and ARE-binding proteins interact to control gene dosage. Another level of post-transcriptional regulation occurs via shortening of the 3′ UTR in order to escape RNA binding proteins and/or miRNA-mediated regulation. Additionally, as immune genes are under positive selection, these genes adapt to host and environmental pressures by varying their expression, often to protect the host against infection. One method of adaptation involves polymorphisms in the 3′ UTR, which alter the targeting of RNA-binding proteins and miRNAs. These mechanisms of post-transcription regulation, and their effect on the immune response, are just beginning to be understood. Although individual miRNA:gene interactions are important, they do not adequately represent the full complexity of regulatory events. Our laboratory is focused on understanding the complexity of these pathways by coupling robust computational approaches with functional studies.

0 Total Number of Graduated Ph.D. Students
3 Overall Total Number of Current Students
3 Total Number of Current Immunology Students
0 Total Number of Other Current Students

2 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. McFarland, A. P., S. M. Horner, A. Jarret, R. C. Joslyn, E. Bindewald, B. A. Shapiro, D. A. Delker, C. H. Hagedorn, M. Carrington, M. Gale, Jr., and Savan. R. 2014. The favorable IFNL3 genotype escapes mRNA decay mediated by AU-rich elements and hepatitis C virus-induced microRNAs. Nature Immunology 15: 72-79.
2. Kulkarni, S*., Savan R * (co-first authors), Y. Qi, X. Gao, Y. Yuki, S. E. Bass, M. P. Martin, P. Hunt, S. G. Deeks, A. Telenti, F. Pereyra, D. Goldstein, S. Wolinsky, B. Walker, H. A. Young, and M. Carrington. 2011. Differential microRNA regulation of HLA-C expression and its association with HIV control. Nature 472: 495-498.
3. Steinhagen, F., McFarland, AP, Rodriguez, L G., Tewary, P., Jarret, A., Savan, R. and Klinman DM. 2013. IRF-5 and NF-kappaB p50 co-regulate IFN-beta and IL-6 expression in TLR9-stimulated human plasmacytoid dendritic cells. European Journal of Immunology 43: 1896-1906.
4. Savan, R., A. P. McFarland, D. A. Reynolds, L. Feigenbaum, K. Ramakrishnan, M. Karwan, H. Shirota, D. M. Klinman, K. Dunleavy, S. Pittaluga, S. K. Anderson, R. P. Donnelly, W. H. Wilson, and H. A. Young. 2011. A novel role for IL-22R1 as a driver of inflammation. Blood 117: 575-584.

5. Savan, R., A. Aman, K. Sato, R. Yamaguchi, and Sakai, M. 2005. Discovery of a new class of immunoglobulin heavy chain from fugu. European Journal of Immunology 35: 3320-3331. PMID: 16224815.

ALL PUBLICATIONS (Total Number of Publications: 44)

http://www.ncbi.nlm.nih.gov/sites/myncbi/ram.savan.1/bibliography/47016494/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

2004	Dr. V.G. Jhingran Award, Professional Fisheries Graduate Forum, India
2005	Dr. T.V.R. Pillai and Dr. M.V. Gupta Award, Professional Fisheries Graduate Forum, India
2006	Travel Award, International Society for Developmental and Comparative Immunology (ISDCI) to present at 10th ISDCI congress, Charleston, SC, USA
2008	Federal Technology Transfer Award, National Cancer Institute, NIH, USA
2009	The American Association of Immunologists (AAI) trainee abstract award, Seattle, WA, USA (2009, 2010)
2009	Cancer and Inflammation Post-doctoral Project Award, National Cancer Institute, NIH, USA
2009	Director's Intramural Innovation Award, National Cancer Institute, NIH, USA
2010	Cancer and Inflammation Post-doctoral Project Award, National Cancer Institute, NIH, USA
2010	Director's Intramural Innovation Award, National Cancer Institute, NIH, USA
2010	Milstein Young Investigator Award, The International Society for Interferon and Cytokine Research.
2012	Early Career Faculty Travel Award, AAI, Boston, MA, USA (2012, 2013, 2015)
2014	Damon Runyon-Rachleff Innovation award, Finalist.

FUNDING/ACTIVE RESEARCH SUPPORT	
R01 AI108765, NIH Title: Novel regulatory mechanisms control IFNL3 expression during HCV infection	1/01/2014 – 12/31/2019 Ram Savan (PI)
R21 AR 067980-01A1, NIH	07/01/2015 – 06/30/2017 Ram Savan (PI)
CSGADP, Benaroya Research Institute/NIAID Pilot: Role of inflammasomes in type I diabetes	11/01/2015 – 10/31/2016 Ram Savan (PI)

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Michael Gale Jr., Ph.D.

OTHER COLLABORATIONS:

- Karen Cerosaletti, Ph.D. (BRI)

ADEREM, ALAN A., PH.D.

POSITION/TITLE: Affiliate Professor **JOINED DEPARTMENT:** 04/01/1996
AFFILIATE INSTITUTE: Center for Infectious Disease Research

Aderem is an internationally recognized immunologist and cell biologist whose research focus is on the innate immune system - how it recognizes and formulates responses to infectious agents, and how it instructs the adaptive immune system to provide long-lived immunity to the pathogen. His initial studies define how pattern recognition receptors, in particular the Toll-like receptors, identify bacteria and viruses - in essence, how the immune cell reads the molecular barcode of the infectious agent and, thereby, precisely defines the nature of the threat. This precise recognition triggers a specific, highly regulated response to the pathogen by the host. A pioneer in the field of systems biology, Aderem is currently using these approaches of host-pathogen interaction to define these mechanisms and develop predictive, molecular models of immune and inflammatory responses.

Aderem is also applying the tools of systems biology to the study of diseases that significantly impact global health with an emphasis on the role of the innate immune system in vaccine response. The Aderem Lab is focused on deciphering the role played by the innate immune response to HIV vaccination on the subsequent development of protective immunity. Systems biology approaches are also used to evaluate vaccine candidates against HIV, Mtb, and plasmodium. The Aderem Lab is also studying the host response to the influenza virus. Specifically, the lab's research is focused on identifying mechanisms by which highly-pathogenic viruses can evade and often dysregulate the innate immune system. The National Institutes of Health, the National Institute of Allergy and Infectious Diseases, and the Bill & Melinda Gates Foundation provide support for Aderem's current research.

1 Total Number of Graduated Ph.D. Students
1 Overall Total Number of Current Students
1 Total Number of Current Immunology Students
0 Total Number of Other Current Students

1 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Underhill DM, Ozinsky A, Hajjar AM, Stevens A, Wilson CB, Bassetti M, Aderem A. (1999). The Toll- like receptor 2 is recruited to macrophage phagosomes and discriminates between pathogens. Nature 401:811-815.
2. Gilchrist M, Thorsson V, Li B, Rust AG, Korb M, Roach J, Kennedy K, Hai T, Bolouri H, Aderem A. (2006). Systems Biology Approaches Identify ATF3 as a Negative Regulator of Innate Immunity. Nature. 441:173-8.
3. Litvak V, Ramsey SA, Rust AG, Zak DE, Kennedy KA, Lampano AE, Nykter M, Shmulevich I, Aderem (2009). Function of C/EBPdelta in a regulatory circuit that discriminates between transient and persistent TLR4-induced signals. Nat. Immunol. 10:437-43. PMCID: PMC2780024.
4. Litvak V, Ratushny AV, Lampano AE, Schmitz F, Huang AC, Raman A, Rust AG, Bergthaler A, Aitchison DJ, Aderem A. (2012). A FOXO3-IRF7 gene regulatory circuit limits inflammatory sequelae of antiviral responses. Nature. 490:421-5. PMCID: PMC3556990.
5. Tam VC, Quehenberger O, Oshansky CM, Suen R, Armando AM, Treuting PM, Thomas PG, Dennis EA, Aderem A. (2013). Lipidomic profiling of influenza infection identifies mediators that induce and resolve inflammation. Cell. 154:213-27. PMCID: PMC3753192

ALL PUBLICATIONS (Total Number of Publications: 203)

http://www.ncbi.nlm.nih.gov/sites/myncbi/alan.aderem.1/collections/48044368/public/

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1986 – 1990	Pew Scholar in the Biomedical Sciences
1990 – 1995	Established Investigator of the American Heart Association
1992 – 1996	Paul Ehrlich Chair at The Rockefeller University
1995 – 2005	MERIT Award from National Institute of Allergy and Infectious Diseases
1994 – present	Scientific Advisor to Ministry of Science, South Africa
1996/2001	Chair, Parliamentary Review Commission of the MRC, South Africa
2000 – 2004	Burroughs Wellcome Fund Scholar Award in Molecular Parasitology
2003	Chairman, Gordon Conference on Phagocytes
2006	Chairman, Keystone Conference on Systems Biology
2007 – present	Advisory Board Member, Intl. Immunology Frontier Research Center, Osaka University
2007 – 2014	Chairman, Scientific Advisory Board, Centre for Integrative Systems Biology at Imperial College, London
2007 – 2014	Scientific Advisory Board, International AIDS Vaccine Initiative
2008 – present	Science Steering Committee, Global HIV Vaccine Enterprise
2008 – present	Advisory Board Member, NIH LIPID MAPS Consortium
2008 – present	European Research Council, Advisory Panel
2010 – present	Chairman, Board of Directors, HHMI funded KwaZulu-Natal Research Institute for Tuberculosis and HIV (KRITH)
2015	Honorary Doctorate, University of KwaZulu-Natal, South Africa

FUNDING/ACTIVE RESEARCH SUPPORT	
Ongoing Research Support R01 AI25032 (Aderem) NIH/NIAID Title: LPS Regulation of Macrophage Function	05/01/12 – 04/30/17 Role: PI
R01 AI32972 (Aderem) NIH/NIAID Title: LPS Signaling in Macrophage: The Role of Toll	07/01/11 – 06/30/16 Role: PI
U19 AI106761 (Aderem-Sherman) NIH/NIAID Title: Omics for TB Disease Progression (OTB)	06/21/13 – 05/31/18 Role: PI (Multiple)
U19 AI100927 (Ulevitch) NIH/NIAID Title: Systems Approach to Immunity and Inflammation	09/01/12 – 08/31/17 Role: Co-PI
OPP1087783 (Aderem) BMGF Title: Systems Immunology Consortium: Systems Biology	11/01/13 – 10/31/16 Role: PI
OPP1065330 (Hanekom) BMGF Systems biology to identify signatures of risk of TB disease in Gates Global Challenge 6-74 cohorts	10/01/12 – 12/31/16 Role: Co-I

COLLABORATIONS W/ IMMUN. FACULTY:

- Ed Clark, Ph.D.
- Pamela Fink, Ph.D.
- David Rawlings, M.D.
- Sam Miller, Ph.D.
- Lee Hood, Ph.D.
- Kevin Urdahl, Ph.D.

OTHER COLLABORATIONS:

- University of Cape Town (various)
- Stellenbosch University (various)
- K-RITH
- Systems Immunity U19 grant: Scripps, Stanford, UT Southwestern
- OTB U19 grant: Institute for Systems Biology

BETTELLI, ESTELLE, PH.D.

POSITION/TITLE: Affiliate Associate Professor **JOINED DEPARTMENT:** 09/01/2009
AFFILIATE INSTITUTE: Benaroya Research Institute at Virginia Mason

Dr. Bettelli has studied T cells, which induce and regulate the development of experimental autoimmune encephalomyelitis (EAE), an animal model of multiple sclerosis. CD4+ T helper cells can differentiate in different subsets characterized by specific effector functions and cytokine production. Th17 cells promote inflammation and have been implicated in the pathogenesis of many experimental autoimmune diseases and human inflammatory conditions. I have been one of the pioneers in the field of Th17 cell development and identified the factors, which are critical for the differentiation of pathogenic Th17 cells. I am currently studying the underlying mechanisms that govern the generation and functions of IL-17 producing T cells (Th17) and developing strategies to block their functions. Using mice lacking IL-23, Th17 effector cytokines, and Th17 specific genes, we seek to determine how Th17 responses are modulated and how the development of EAE can be inhibited. These studies will provide valuable insights into IL-17 and Th17 functions, and should help to design more specific therapies for the treatment of autoimmune diseases such as MS. As an assistant professor at Harvard Medical School and affiliated assistant professor at the University of Washington, I had the opportunity to train and mentored several pre and post-doctoral candidates. My work has been seminal in defining the factor important for the differentiation of a new subset of T helper cells called Th17.

2 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

4 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Bettelli E, Pagany M, Weiner HL, Linington C, Sobel RA, Kuchroo VK. Myelin oligodendrocyte glycoprotein-specific T cell receptor transgenic mice develop spontaneous autoimmune optic neuritis. J Exp Med. 2003; 197:1073-81. (PMC2193967)
2. Bettelli E, Sullivan B, Szabo SJ, Sobel RA, Glimcher LH, Kuchroo VK. Loss of T-bet, but not STAT1, prevents the development of experimental autoimmune encephalomyelitis. J Exp Med. 2004; 200:79-87. (PMC2213316)
3. Bettelli E, Dastrange M, Oukka M. Foxp3 interacts with nuclear factor of activated T cells and NF- B to repress cytokine gene expression and effector functions of T helper cells. Proc Natl Acad Sci USA. 2005; 102:5138-43. (PMC555574)
4. Bettelli E, Carrier Y., Gao W, Korn T., Strom T., Oukka M., Weiner H.L., Kuchroo V.K. Reciprocal developmental pathways for the generation of pathogenic effector (Th-IL-17) and regulatory (CD4+CD25+, Foxp3+) T cells. Nature. 2006;441:235-8. (PMID: 16648838)
5. Bettelli E, Baeten D, Jager A, Sobel RA, Kuchroo VK. Myelin oligodendrocyte glycoprotein-specific T and B cells cooperate to induce a Devic-like disease in mice. J Clin Invest. 2006;116:2393-2402. (PMC1555670)

ALL PUBLICATIONS (Total Number of Publications: 44)

http://www.ncbi.nlm.nih.gov/sites/myncbi/estelle.bettelli.1/bibliography/40670779/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1996-1999	Fellowship from the French Minister of Research and Technology (MRT).
2003-2005	Grant from the Wadsworth Foundation as Co-Investigator
2006-2011	Transition Award from the National Multiple Sclerosis Society (NMSS)
2010	Ad Hoc Reviewer, Department of Defense for Multiple Sclerosis-related research.
2012	Ad Hoc Reviewer, Fast Forward-EMD Serono Inc NMSS
2012	Ad Hoc Reviewer, NIH HAI study section
2010-2013	Ad Hoc Reviewer, NIH New Innovator Award
2013-2014	Ad Hoc Reviewer, NIH CNBT study section
2014-Present	Permanent Member NIH CNBT study section
2014-Present	Reviewer NMSS pilot grants

FUNDING/ACTIVE RESEARCH SUPPORT	
4468A1/3 (Bettelli) National Multiple Sclerosis Society Title: Identification of pathogenic T cells in EAE	10/01/2012 – 09/30/2016 Role: PI
5 R01 NS081687-03 (Ziegler/Bettelli) NIH/NINDS Title: Molecular mechanisms of Th17 plasticity in MS	05/15/2013 – 01/31/2018 Role: CO-I
5 UM1 AI109565-02 NIH/NIAID Title: ACCLAIM (ITN035AI) Follow-Up Studies	02/01/2015 – 01/31/2016 Role: Project PI
1 R44AI125165-01 (Fanger) NIH Title: A Novel Tolerance Therapeutic for Treating Multiple Sclerosis	04/01/2016 – 03/31/2017 Role: Subcontract
1 R21NS098807-01 (Bettelli) NIH Title: Control of EAE by STAT1-mediated signaling in microglia	07/01/2016- 06/30/2018 Role: PI
RG-1601-07436 (Bettelli) NMSS Title: Cell type specific modulation of STAT1 signaling to prevent the development of CNS autoimmunity	09/01/2016 – 08/31/2019 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Steve Ziegler, PhD
- Daniel Campbell, PhD
- Jessica Hamerman, PhD
- Adam Lacy-Hulbert, PhD
- Mohamed Oukka, PhD

CAMPBELL, DANIEL, PH.D.

POSITION/TITLE: Affiliate Professor **JOINED DEPARTMENT:** 03/01/2004
AFFILIATE INSTITUTE: Benaroya Research Institute at Virginia Mason

The cells and tissues of the immune system are precisely organized to ensure the proper development, activation, function and regulation of diverse lymphocyte populations. Tissue and microenvironment selective lymphocyte homing is the basis for this organization, which in turn is mediated by lymphocyte expression of specific combinations of surface adhesion and chemoattractant receptors. Expression of these homing receptors therefore defines functionally specialized lymphocyte populations with unique tissue-tropisms.

We are interested in further exploring the relationship between lymphocyte function, homeostasis and localization. Using mouse models of autoimmunity, our goals are to track the differentiation and localization of various homing receptor-defined populations of CD4+ T cells, and to determine how each of these contributes to the function and regulation of immune responses in specific tissues. In addition, we seek to understand the signaling events and transcriptional networks that direct T cell expression of different homing receptor combinations, and therefore control 'organ-specific' immunity and autoimmunity. Our work promises to yield new insights into lymphocyte differentiation and function, and holds great potential for the therapeutic manipulation of lymphocyte responses in the context of chronic infection, autoimmunity and transplantation. The Campbell Laboratory is taking students at this time.

5 Total Number of Graduated Ph.D. Students
3 Overall Total Number of Current Students
2 Total Number of Current Immunology Students
1 Total Number of Other Current Students
1 Microbiology

1 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Kim CH, Rott LS, Clark-Lewis I, **Campbell DJ**, Wu L, Butcher EC (2001) Subspecialization of CXCR5+ T cells: B helper activity is focused in a germinal center-localized subset of CXCR5+ T cells., *J Exp Med*, 193 (12), 1373-81 (PMC 2193300)
2. **Campbell DJ**, Butcher EC (2002) Rapid acquisition of tissue-specific homing phenotypes by CD4(+) T cells activated in cutaneous or mucosal lymphoid tissues., *J Exp Med*, 195 (1), 135-41 (PMC 2196018)
3. Arnold CN, **Campbell DJ**, Lipp M, Butcher EC (2007) The germinal center response is impaired in the absence of T cell-expressed CXCR5., *Eur J Immunol*, 37 (1), 100-9 (PMID 17171760)
4. Sather BD, Treuting P, Perdue N, Miazgowicz M, Fontenot JD, Rudensky AY, **Campbell DJ** (2007) Altering the distribution of Foxp3(+) regulatory T cells results in tissue-specific inflammatory disease., *J Exp Med*, 204 (6), 1335-47 (PMC 2118615)
5. Dudda JC, Perdue N, Bachtanian E, **Campbell DJ** (2008) Foxp3+ regulatory T cells maintain immune homeostasis in the skin., *J Exp Med*, 205 (7), 1559-65 (PMC 2442633)

ALL PUBLICATIONS (Total Number of Publications: 45)

http://www.ncbi.nlm.nih.gov/sites/myncbi/daniel.campbell.1/bibliography/40679008/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1993	Received Merck Index Award for excellence in chemistry - University of Michigan
1993	Received Claude W. Plase Class of 1901 Graduate Fellowship - University of California
2010-2014	Associate Editor, Journal of Immunology
2015	AAI Laboratory Travel Award, AAI annual meeting, New Orleans, LA
2014-Present	Editorial Board, Trends in Immunology

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Steve Ziegler, PhD
- Estelle Bettelli, PhD
- Jessica Hamerman, PhD
- Adam Lacy-Hulbert, PhD
- Marion Pepper, PhD

CRISPE, IAN NICHOLAS, M.B.B.S., PH.D.

POSITION/TITLE: Adjunct Professor **JOINED DEPARTMENT:** 04/16/2013
PRIMARY APPOINTMENT: Professor, Dept. of Pathology (Immun. Affiliate Prof: 07/01/2009 – 4/15/2013)

The central research mission of the lab is to understand the distinctive features of immune responses that are generated in the liver, and reveal aspects of T cell function that are prominent in this environment. We are driven by the central idea that liver antigens can prime T cells locally, and that such priming has distinctive requirements in terms of the cell types competent to act as APC, the need for CD4+ T cell help in CD8+ T cell responses, the involvement of the innate immune system, and the long-term fate of such liver-primed T cells. This research agenda has led us to build expertise in Kupffer cell biology, and we view these cells as central in determining whether immune responses are biased towards immunity or tolerance. Multiple important pathogens target the liver, including viral hepatitis A, B, C and malaria. Therefore, we are interested in the immune responses to such pathogens, and seek to model some aspects of their immunopathology in vitro. We have developed an Adeno-Associated Virus (AAV)-based model for gene delivery to hepatocytes, and find that the CD8+ T cell response to this vector may be used to study T cell-dependent hepatitis, liver injury and fibrogenesis. Thus, we are dissecting the role of T cell- and Kupffer cell-derived cytokines in the development of liver immunopathology. Since AAV is a strong candidate vector for gene therapy, our investigations are relevant to efforts to improve this type of therapy, and in particular to negate the immune response to AAV vectors.

6 Total Number of Graduated Ph.D. Students
2 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
2 Total Number of Other Current Students
2 Pathobiology

1 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Crispe, I. N., M. W. Moore, L. A. Husmann, L. Smith, M. J. Bevan, and R. P. Shimonkevitz. 1987. Differentiation potential of subsets of CD4- ,CD8- thymocytes. *Nature 329:336.*
2. Shimonkevitz, R. P., L. A. Husmann, M. J. Bevan, and I. N. Crispe. 1987. Transient expression of IL-2 receptor precedes the differentiation of immature thymocytes. *Nature 329:157.*
3. Huang, L., G. Soldevila, M. Leeker, R. Flavell, and I. N. Crispe. 1994. The liver eliminates T cells undergoing antigen-triggered apoptosis in vivo. *Immunity 1:741*
4. Crispe, I. N. 2003. Hepatic T cells and liver tolerance. *Nat Rev Immunol 3:51.*
5. Klein, I., and I. N. Crispe. 2006. Complete differentiation of CD8+ T cells activated locally within the transplanted liver. *J Exp Med 203:437.*

ALL PUBLICATIONS (Total Number of Publications: 115)

http://www.ncbi.nlm.nih.gov/pubmed/?term=Crispe+NOT+Crispe+E

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1977	Max Bonn Prize and Gold Medal for Research in Pathology.
1981	Welcome Pathology Fellowship
1984	Damon Runyon/Walter Winchell Cancer Fund Fellowship.
1991	Cancer Research Institute Investigator Award
1999-03	Regular Member NIH Study Section (IMB)
2006	Hans Popper Basic Science State-of-the-Art Lectureship, AASLD.
2012-18	Regular Member NIH Study Section (IHD).
2016-current	Member, CIIID, University of Washington

FUNDING/ACTIVE RESEARCH SUPPORT	
R01 AI 114630-01A1 NIH/NIAID Title: Innate Immune Response to Hepatocyte Death	02/01/2015- 01/31/2020 Role: PI
R21 AI 114827-01A1 NIH/NIAID Title: Sessile Kupffer cells in Liver Tolerance	07/01/2015- 06/30/2017 Role: PI
Janssen Sciences Title: Human innate liver immunology	04/01/2015- 03/31/2017 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Keith Elkon, M.D.

OTHER COLLABORATIONS:

- Dr Matthew Yeh Dept of Pathology.
- Dr. Stephen Polyak Dept of Lab Medicine.
- Dr. Venu Pillarisetty Dept of Surgery
- Dr. Raymond Yeung Dept of Surgery
- Dr. Nichole Klatt School of Pharmacy

ELKON, KEITH, M.D.

POSITION/TITLE: Adjunct Professor **JOINED DEPARTMENT:** 08/01/2001
PRIMARY APPOINTMENT: Professor, Dept. of Medicine, Head of the Div. of Rheumatology

Dr. Elkon's research objective is to better define the molecular and genetic basis for autoimmune diseases such as lupus and arthritis. Current areas of investigation include the following:

Apoptosis and the Immune Response – especially as it relates to lupus (SLE). Loss of tolerance leads to autoantibody production in systemic autoimmune disorders such as systemic lupus erythematosus (SLE). There is considerable evidence to support the concept that autoantibodies are generated in response to impaired clearance of dead and dying cells. Dr. Elkon's laboratory has identified novel pathways that involve opsonization of dying cells by serum factors (complement, CRP and natural antibodies) thereby promoting the phagocytosis of apoptotic cells. Deficiencies of these serum opsonins leads to delayed clearance of dying cells sequentially facilitating necrosis, an inflammatory response to self-antigens and loss of tolerance. Current studies explore the how self-antigens (e.g. nucleoprotein particles such as nucleosomes, spliceosomes and ribosomes) are processed and activate the innate immune system, especially plasmacytoid dendritic cells (pDCs) to induce IFN-a. In addition, apoptotic cell processing and the downstream molecular signals in DCs that lead to anergy or T cell activation are being investigated. Removal of inflammatory nucleoprotein complexes. A related line of investigation explores how the debris derived from apoptotic cells, nucleoprotein particles, can be rendered less immunogenic. The research involves the creation of transgenic mice expressing "cleanup" molecules as well as biologics that can be administered exogenously.

4 Total Number of Graduated Ph.D. Students
1 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
1 Total Number of Other Current Students
1 Peking University Medical School, China

5 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Giltiay NV, Chappell CP, Sun X, Kolhatkar N, Teal T, Wiedeman A, Kim J, Tanaka L, Buechler MB, Hamerman JA, Imanishi-Kari T, Clark EA, Elkon KB. Overexpression of TLR7 promotes cell-intrinsic expansion and autoantibody production by transitional T1 B cells. J Exp Med, 210:2713-23, 2013. PMID: 24145511. PMC3832927.
2. Sisirak V, Ganguly D, Lewis KL, Couillault C, Tanaka L, Bolland S, D'Agati V, Elkon KB, Reizis B. Genetic evidence for the role of plasmacytoid dendritic cells in systemic lupus erythematosus. J Exp Med, 2011:1969-1976, 2014. PMID: 25180061
3. Colonna L, Lood C, Elkon KB. Beyond apoptosis in lupus. Curr Opin Rheumatol. 26:459-466, 2014. PMID: 25036095
4. Barrat FJ, Elkon KB, Fitzgerald KA. Importance of nucleic acid recognition in inflammation and autoimmunity, Ann Rev Med, Jan 14;67:323-36. doi: 10.1146/annurev-med-052814-023338. Epub 2015 Nov 2. PMID: 26526766.
5. Lood C, Blanco LP, Purmalek MM, Carmona-Rivera C , De Ravin SS, Smith CK, Malech HL, Ledbetter JA, Elkon KB, Kaplan MJ (co-last authors). Mitochondrial ROS generate NETs enriched in oxidized interferogenic mitochondrial DNA and contribute to lupus-like disease. Nat Med. 22:146-53. PMID: 26779811. Highlighted in News & Views: Muller S, Radic M. Nat Med. 4;22:126-7, 2016.

ALL PUBLICATIONS (Total Number of Publications: 202)

http://www.ncbi.nlm.nih.gov/pubmed/?term=elkon+k

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

Medical Graduates' Association Medal for best student in Medicine; Hoechst Award for most distinguished student in Medicine; Seymour Hemann Prize for top honors in Pediatrics; Alice Cox Prize for best student in Psychiatry; S.L. Sive Prize for best performance in Clinical Pathology, Second place in Pharmacology and Pathology and third place in Physiology; Kiely prize for best research performed by a registrar in the Department of Medicine at Hammersmith Hospital (1980/1981); Rockefeller Brothers Clinical Scholarship (1983/1984); NIH Research Career Development Award (1987 1992); NIH Immunological Sciences Study section (1994-1999) - NCI Consortium Review Panel, 1998-1999; Ad Hoc NIH HAI (2007-present), NIH AMS (2010). NIH ad hoc reviews 2009-2013. Section leader: Lupus Research Institute (2008- 2012); National Arthritis Foundation (2009-12). Scientific Advisory Board, Lupus Research Institute (2012-13); Medical and Scientific Advisory Board, Arthritis Foundation (OR, CA, WA). President of the Henry Kunkel Society (2013-15). University of Washington CoMotion Presidential Innovation Fellow (2015-2016) Editorial boards: Lupus, Autoimmunity, Clin Exp Rheumatol, Arthritis Research and Therapy, J Exp Med (2000-2010), J Cytokine & Interferon Research, Frontiers of B cell Biology and Frontiers of Innate Immunity

FUNDING/ACTIVE RESEARCH SUPPORT	
R21ES024437 NIH Title: Mechanisms of Ultraviolet Inflammation in Lupus (Dissect innate immunity following UV light in mice)	8/1/14 - 7/31/16 Role: PI
Life Sciences Discovery Fund Title: Targeted Therapy to Inhibit cGAS stimulated Type I IFN Production	11/01/14-02/28/16 Role: PI
Lupus Research Institute Title: Mouse models to explore responses to ultraviolet light and lupus	02/01/2014- 01/31/2017 Role: PI
NIH 5T32AR007108-35 Title: Research Training in Rheumatology	7/01/2015- 06/30/2020 Role: PI
Alliance for Lupus Research (ALR) Title: To explore the role of the cGAS interferon pathway in SLE	02/01/2015- 01/31/2018 Role: PI
NIH 1R01AI114630 Title: Innate Immune Response to Hepatocyte Death	04/01/2015- 03/31/2020 Role: Co-I

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

*Edward Clark, Mike Gale, *Jessica Hamerman, **Nick Crispe, *Dan Stetson
* = publication
** NIH Grant

HAMERMAN, JESSICA A., PH.D.

POSITION/TITLE: Affiliate Associate Professor **JOINED DEPARTMENT:** 01/01/2007
AFFILIATE INSTITUTE: Benaroya Research Institute at Virginia Mason

Research in our laboratory focuses on the regulation of the innate immune response to pathogens with an emphasis on macrophages and dendritic cells. Macrophages and dendritic cells are distributed throughout the body where they are poised to detect pathogens and to subsequently alert the immune system to the presence of infection through the production of inflammatory mediators. The production of inflammatory mediators, such as tumor necrosis factor (TNF) and other pro-inflammatory cytokines, is tightly regulated. Although these important cytokines are beneficial to the host for pathogen clearance, they can be detrimental if unchecked. This can be seen in septic shock as well as in autoimmune disorders such as rheumatoid arthritis and systemic lupus erythematosus.

Macrophages and dendritic cells recognize pathogens by a variety of cell surface and intracellular receptors including the family of Toll-like receptors (TLR). We study how signaling through pattern recognition receptors results in the appropriate inflammatory response by macrophages and dendritic cells. We are particularly interested in proteins that inhibit signaling through pattern recognition receptors, providing an essential brake to the inflammatory response. We study a variety of cell surface receptors and signaling molecules that regulate responses through TLR and other pattern recognition receptor families. Our studies span signal transduction and functional assays of macrophages and dendritic cells in vitro to in vivo infection models and models of autoimmunity. We also are investigating the effect of human autoimmunity susceptibility alleles on macrophage function to test the hypothesis that increased innate immune responses can participate in the predisposition to autoimmune disease. Overall, our goal is to understand how the appropriate inflammatory response is determined to fight against infections, yet protect against autoimmunity.

2 Total Number of Graduated Ph.D. Students
2 Overall Total Number of Current Students
2 Total Number of Current Immunology Students
0 Total Number of Other Current Students

3 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Ni M, MacFarlane AW, Toft M, Lowell CA, Campbell KS, Hamerman JA (2012) BCAP negatively regulates Toll-like receptor signaling through activation of PI3-Kinase. *Proceedings of the National Academy of Sciences* USA 2012 Jan 3;109(1):267-72. PMCID: PMC3252908
2. Buechler M.B., Teal T.H., Elkon K.B., Hamerman, J.A. 'Cutting edge: Type 1 IFN drives emergency myelopoiesis and peripheral myeloid expansion during chronic TLR7 signaling' J Immunol. 2013 Feb 1;190(3):886-91
3. Yee N.K., Hamerman, J.A. 'ß(2) integrins inhibit TLR responses by regulating NF-kB pathway and p38 MAPK activation' Eur J Immunol. 2013 Mar;43(3):779-92
4. Ito H., Hamerman, J.A. 'TREM-2, triggering receptor expressed on myeloid cell-2, negatively regulates TLR responses in dendritic cells' Eur J Immunol. 2012 Jan;42(1):176-85
5. Buechler MB, Gessay GM, Srivastava S, Campbell DJ, Hamerman JA. (2015) Hematopoietic and nonhematopoietic cells promote Type I interferon- and TLR7-dependent monocytosis during low-dose LCMV infection. *European Journal of Immunology*. 2015 Nov;45(11):3064-72. PMCID: PMC4675142.

ALL PUBLICATIONS (Total Number of Publications: 39)

http://www.ncbi.nlm.nih.gov/sites/myncbi/jessica.hamerman.1/bibliography/40649027/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1994-1999	Howard Hughes Medical Institute Pre-Doctoral Fellowship
2001-2005	Irvington Institute for Immunological Research Postdoctoral Fellowship
2005-2009	Arthritis Investigator Award, Arthritis Foundation
2007-2012	Cancer Research Institute Investigator Award
2008	American Association of Immunologists, AAI Pfizer-Showell Award
2015	AAI Laboratory Travel Award, AAI annual meeting, New Orleans, LA

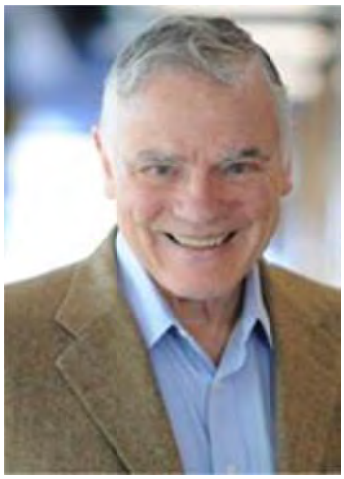
FUNDING/ACTIVE RESEARCH SUPPORT	
1 R01 AI113325-01 Hamerman (PI) Title: BCAP/PI3K regulation of innate immunity to Listeria monocytogenes	09/01/2015 – 08/30/2019 Role: PI
1 R21 AG07502-01 Hamerman (PI) Title: Function of the TREM2 R47H variant associated with risk of Alzheimer's disease	02/15/2015 – 01/31/2017 Role: PI
5 U01 AI101990-04 Buckner (PI) Title: Supplemental Request for Administration of the IOF for the CSGADP (Pilot)	06/01/2015 – 05/31/2016 Role: Pilot PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Steve Ziegler, PhD
- Estelle Bettelli, PhD
- Adam Lacy-Hulbert, PhD
- Daniel Campbell, PhD
- Marion Pepper, PhD
- David Rawlings, MD
- Keith Elkon, MD
- Kevin Urdahl, PhD
- Ram Savan, PhD

HOOD, LEROY E. M.D., PH.D.

POSITION/TITLE: Affiliate Professor **JOINED DEPARTMENT:** 04/16/2013
AFFILIATE INSTITUTE: Institute for Systems Biology



Dr. Hood's professional career began when he and his colleagues developed the DNA gene sequencer and synthesizer and the protein sequencer and synthesizer —four instruments that paved the way for the successful mapping of the human genome and automating DNA sequencing, which revolutionized biomedicine and forensic science. Dr. Hood's projects center on cancer biology (prostate, ovarian, breast and liver cancers), systems approach to prion disease in mice and prostate cancer, new strategies for obtaining blood biomarkers, and a systems approach to the differentiation of hematopoietic stem cells. He is also interested type I diabetes. Finally, Dr. Hood's laboratory is developing new tools and applications for genomics (large-scale DNA sequencing), computation (various approaches to delineating and engineering biological networks), and nanotechnology measurements of blood proteins.

25+ Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students
2 Pathobiology

4 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Smith LM, Sanders JZ, Kaiser RJ, Hughes P, Dodd C, Connell CR, Heiner C, Kent SBH, Hood LE. (1986) Fluorescence Detection in Automated DNA Sequence Analysis. Nature 321:674-679
2. Roach A, Takahashi N, Pravtcheva D, Ruddle F, Hood L. (1985) Chromosomal Mapping of Mouse Myelin Basic Protein Gene and Structure and Transcription of the Partially Deleted Gene in Shiverer Mutant Mice. Cell 42:149-155.
3. Early P, Rogers J, Davis M, Calame K, Bond M, Wall R, Hood L. (1980) Two mRNAs can be Produced from a Single Immunoglobulin Gene by Alternative RNA Processing Pathways. Cell 20:313-319.
4. Li XJ, Hayward C, Fong P-Y, Dominguez M, Hunsucker SW, Lee LW, McLean M, Law S, Butler H, Schirm M, Gingras O, Lamontagne J, Allard R, Chelsky D, Price ND, Lam S, Massion PP, Pass H, Rom WN, Vachani A, Fang KC, Hood L, Kearney K. A Systems Biology-Derived, Blood-Based Proteomic Classifier for the Molecular Characterization of Pulmonary Nodules. Sci Transl Med. 16 October 2013 Vol. 5, Issue 207, p. 207ra142. PMCID: PMC4114963.
5. Roach JC, Glusman G, Smit AR, Huff CD, Hubley R, Shannon PT, Rowen L, Pant K, Goodman N, Bamshad M, Shendure J, Drmanac R, Jorde LB, Hood L, and Galas DJ. (2010). Analysis of genetic inheritance in a family quartet by whole genome sequencing. Science. 328(5978): p. 636-9. PMCID: PMC3037280.

ALL PUBLICATIONS (Total Nmber of Publications: 320+

http://www.ncbi.nlm.nih.gov/pubmed?term=Hood%20L%20%2B%20Institute%20for%20Systems%20Biology

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

National Academy of Sciences, 1982
American Academy of Arts and Sciences, 1982
Analytical Prize, German Society for Clinical Chemistry Award for "The Development of Microchemical Facilities for High-Sensitivity Protein Sequencing," 1986
Albert Lasker Basic Medical Research Award for Studies of Immune Diversity, 1987
Commonwealth Award of Distinguished Service for Work in Developing Instruments Used to Study Modern Biology and Medicine, 1989
American College of Physicians Award for Distinguished Contributions in Science Relating to Medicine, 1990
Kyoto Prize in Advanced Technology, 2002
The Economist Innovation Award for Bioscience, 2002
Lemelson MIT Prize, 2003
Pittcon Heritage Award, 2008
Russ Prize in Engineering, 2011
National Medal of Science, 2012
Future in Review, CEO of the year, 2013
Alvin J. Thompson Award for Leadership in K-12 education and science (awarded by NW Assoc. for Biomed Research), 2013
Fellow, American Association for Cancer Research (AARC,) 2013
Peking University Global Fellowship Award, 2013
Honorary Professorship - Peking University, 2013
Seven Over 70 Best Innovators in MIT Technology Review Magazine, 2013
Geoffrey Beene Builders of Science award presented by Research!America, 2014
Institute of Electrical and Electronics Engineers Medal for Innovations in Healthcare Technology, 2014
Received 17 honorary degrees from National and International Institutions

LACY-HULBERT, ADAM, PH.D.

POSITION/TITLE: Affiliate Associate Professor **JOINED DEPARTMENT:** 06/16/2014
AFFILIATE INSTITUTE: Benaroya Research Institute at Virginia Mason

The overall research objectives of the Lacy-Hulbert Laboratory are to understand the mechanisms by which innate immune cells, such as macrophages and dendritic cells, regulate immunity and tolerance. The laboratory team uses a range of molecular and cell biology approaches, in isolated cells and whole organisms, to approach these important problems. The group has a longstanding interest in how the recognition of dying cells promotes immune tolerance and tissue repair, and the role of a specific family of cell adhesion molecules, the alpha-v Integrins, in this process. A major focus of the laboratory is how breakdown of these mechanisms can lead to inflammatory bowel disease (IBD) and autoimmunity.

In a joint program with Lynda Stuart, M.D., Ph.D., and her group, the laboratory also works to discover new mechanisms by which cells recognize and resist infection.

2 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

5 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Lacy-Hulbert, A., Smith, A.M., Tissire, H., Barry, M., Crowley, D., Bronson, R.T., Roes, J.T., Savill, J.S. and Hynes, R.O. (2007) "Ulcerative colitis and autoimmunity induced by loss of myeloid v integrins", Proceedings of the National Academy of Sciences, USA. 104:15823-15828 PMCID: 1994135
2. # Acharya, M., Mukhopadhyay, S., Paidassi, H., Jamil, T., Chow, C., Kissler, S., Stuart, L.M., Hynes, R.O. and Lacy-Hulbert, A. (2010) "Alpha(v) integrin expression by DCs is required for Th17 cell differentiation and development of experimental autoimmune encephalomyelitis in mice." Journal of Clinical Investigation, 120: 4445-52. PMCID: 2993596
3. Chen, L., Stuart, L.M., Ohsumi, T.K., Burgess, S., Varshney, G.K., Dastur, A., Borowsky, M., Benes, C., Lacy-Hulbert, A.* and Schmidt, E.V.* (2013) "Transposon activation mutagenesis as a screening tool for identifying resistance to cancer therapeutics" BMC Cancer 13: 93. PMCID: PMC3598783 (* senior authors contributed equally)
4. Sokolovska A, Becker CE, Ip WK, Rathinam VA, Brudner M, Paquette N, Tanne A, Vanaja SK, Moore KJ, Fitzgerald KA, Lacy-Hulbert A and Stuart LM. (2013) "Activation of caspase-1 by the NLRP3 inflammasome regulates the NADPH oxidase NOX2 to control phagosome function." Nat. Immunology 14: 543-53. PMCID:3708594
5. Acharya M, Sokolovska A, Tam J, Conway K, Stefani C, Raso F, Mukhopadhyay S, Feliu M, Paul E, Savill J, Hynes RO, Xavier RJ, Vyas JM, Stuart LM and Lacy-Hulbert A (2016) " v Integrins combine with LC3 and atg5 to regulate Toll-like Receptor signaling in B cells" Nat. Communications 7:10917

ALL PUBLICATIONS (Total Number of Publications: 44)

http://www.ncbi.nlm.nih.gov/sites/myncbi/adam.lacy-hulbert.1/bibliography/43918956/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

2005 Recipient of a UK Research Council Fellowship
2009 Vice Chair, Gordon Research Conference on Apoptotic Cell Recognition and Clearance
2011 Chair, Gordon Research Conference on Apoptotic Cell Recognition and Clearance

FUNDING/ACTIVE RESEARCH SUPPORT	
RO1 DK093695-05 NIH Title: Dendritic Cell Control of Intestinal T Cell Responses	07/01/12 – 06/30/16 Role: PI
R21/R33 AI102266-04 Stuart/ Lacy-Hulbert (PIs) NIH Title: Transposon Mutagenesis for Host-Target and Drug Discovery in Infectious Disease	07/01/12 – 06/30/17 Role: Joint PI
R21AI119341-01 Lacy-Hulbert (PI) Title: Identification of Host Drug Development Targets in Influenza Using Transposon Mutagenesis	07/01/15 – 06/30/17 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- David Rawlings, M.D.
- Andrew Oberst, Ph.D.
- Jessica Hamerman, Ph.D.

MILLER, SAMUEL I., M.D.

POSITION/TITLE: Adjunct Professor **JOINED DEPARTMENT:** 05/01/2009
PRIMARY APPOINTMENT: Professor, Dept. of Medicine, Div. of Allergy and Infectious Diseases, and Departments of Microbiology and Genome Sciences

Dr. Miller's laboratory is focused on defining the molecular basis of bacterial pathogenesis and interactions with eukaryotic cells, with a special emphasis on innate immune response to Gram-negative bacteria. Some of Major contributions to science include: defining how Salmonella senses antimicrobial peptides and pH to promote pathogenesis, environmental regulation of Lipid A structure of Gram-negative bacteria to promote resistance to antimicrobial peptides and alter recognition by mammalian LPS receptor complex; definition of structure and function of type III secretion machinery and effector proteins, the definition of important genetic and functional adaptations of Pseudomonas aeruginosa infecting the airways of individuals with cystic fibrosis. Recently, Dr. Miller was involved with the development of technology to define human diversity in innate immune recognition of bacteria, and a development of a biosensor for c-di-GMP to visualize second messenger dynamics in living bacteria.

14	Total Number of Graduated Ph.D. Students
0	Overall Total Number of Current Students
0	Total Number of Current Immunology Students
0	Total Number of Other Current Students
7	Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Guo L, Lim KB, Gunn JS, Bainbridge B, Darveau RP, Hackett M, and Miller SI. Regulation of of lipid A modifications by Salmonella typhimurium virulence genes (phoP/phoQ). Science 1997; 276: 250-253.
2. Guo L, Lim KB, Poduje CM, Daniel M, Gunn JS, Hackett M, Miller SI. Lipid A acylation and bacterial resistance against vertebrate antimicrobial peptides. Cell. 1998; 95:189-198.
3. Gunn JS, Kheng BL, Krueger J, Kim K, Guo L, Hackett M, Miller SI. PmrA-PmrB regulated genes necessary for 4-aminoarabinose lipid A modification and polymyxin resistance. Molecular Microbiology 1998; 27:1171-1182.
4. Bader MW, Sanowar S, Daley ME, Schneider AR, Cho U, Wenqing X, Klevit RE, Moual H, Miller SI. Recognition of antimicrobial peptides by a bacterial sensor kinase. Cell. 2005 Aug 12;122(3):461-72.
5. Yip CK, Kimbrough TG, Felise HB, Vuckovic M, Thomas NA, Pfuetzner RA, Frey EA, Finlay BB, Miller SI, Strynadka NC. Structural characterization of the molecular platform for type III secretion system assembly. Nature. 2005 Jun 2;435(7042):702-7.

ALL PUBLICATIONS (Total Number of Publications: 282)

http://www.ncbi.nlm.nih.gov/sites/myncbi/samuel.miller.1/bibliography/41150984/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1983	Cabot Foundation Fellow
1984	Marine Biology Laboratories Tuition Award
1984-87	National Research Service Award
1987-89	Rockefeller Foundation Award
1987-89	Medical Foundation Fellow (Laboratory of John Mekalanos)

1989-94	Physician Scientist Award
1994	American Society for Clinical Investigation
1997	Squibb Award, Infectious Diseases Society of America
2000	John Spitznagel Lectureship, Emory University, Atlanta GA
2003	Shipley Symposium Lecturer, Harvard Medical School, Boston, MA2004 ASM Division B Award Lecture, New Orleans, LA
2006	American Academy of Microbiology, Fellow
2007	University of Washington, Science in Medicine Lecture, Seattle WA
2007	Marian Koshland Symposium, U. of Chicago
2008	Bruce Stocker Lecturer, Stanford University
2010	American Association of Physicians, Member
2012	Danny Thomas Lecturer and Visiting Professor, St. Jude's Children's Research Hospital

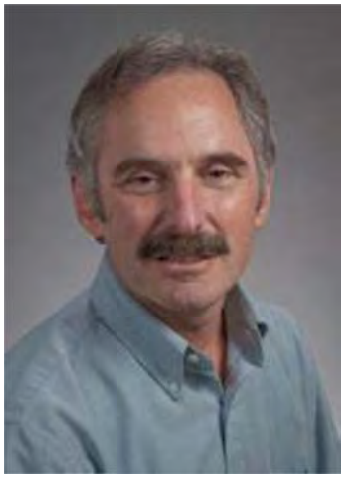
FUNDING/ACTIVE RESEARCH SUPPORT	
R01 AI30479 Title: Role of the PhoP Regulon in Salmonella Virulence	2/1/99 – 7/31/16 (no-cost extension) Role: PI
R01 AI048683 Salmonella pathogenicity island 2 effector proteins Title: The major goal of this project is defining the role of identified SPI2 effectors in Salmonella pathogenesis.	01/15/01 – 02/28/17 (no-cost extension) Role: PI
R565-CR07 (Greenberg) Cystic Fibrosis Foundation Title: Research Development Program – Molecular Biology of Cystic Fibrosis	10/1/07 – 9/30/16 Role: Genomics Core
P30 DK089507 (Ramsey/Greenberg) Title: Translational Research Center to Expedite Novel Therapies in Cystic Fibrosis: Genomics Core	06/01/10 - 05/31/16 Role: Genomics Core
14H17 (Miller/Stappenbeck, co-PIs) Kenneth Rainin Foundation Title: Therapeutic potential and manipulation of a novel microbial receptor that triggers autophagy	1/1/15-12/31/16 Role: Co-PI
U19 AI107775 (Miller) Project 2 & Admin Core Title: Function of Uncharacterized Genes of Acinetobacter baumanii	07/01/13 – 06/30/18 Role: PI
NIH DKR01 (Hoffman/Miller, co-PIs) Title: The relationship of fecal microbiomes and nutritional status in CF	Dec. 2014-Dec. 2019 Role: Co-PI

OTHER COLLABORATIONS:

- Carrie Harwood, Ph.D.
- Lucas Hoffman, Ph.D.
- Colin Manoil, Ph.D.
- David Suskind, Ph.D.
- Judd Walson, Ph.D.
- Brad Cookson, Ph.D.

NEPOM, GERALD T., M.D., PH.D.

POSITION/TITLE: Affiliate Professor **JOINED DEPARTMENT:** 07/01/1989
AFFILIATE INSTITUTE: Benaroya Research Institute at Virginia Mason



Dr. Nepom's research interests are focused on identifying and understanding molecular and genetic mechanisms contributing to triggering of autoimmune disorders. A variety of human T cell profiling tools are combined to evaluate autoreactive T cell lineage and fate determination in the context of other immunological monitoring tools, for predicting disease susceptibility and response to therapy in clinical trials.

6 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

0 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Diagnostic probe for rheumatoid arthritis predisposition, U.S. Patent No. 4,971,902
2. Diagnostic probe for diabetes type I predisposition, U.S. Patent No. 5,039,606
3. Nepom GT, Nepom BS, Antonelli P, Mickelson E, Silver J, Goyert SM, and Hansen JA. The HLA-DR4 family of haplotypes consists of a series of distinct DR and DS molecules. J Exp Med 159:394 404, 1984. PMCID: 2187232.
4. Nepom BS, Palmer J, Kim SJ, Hansen JA, Holbeck SL, and Nepom GT. Specific genomic markers for the HLA-DQ subregion discriminate between DR4+ insulin-dependent diabetes mellitus and DR4+ seropositive juvenile rheumatoid arthritis. J Exp Med 164:345 350, 1986. PMCID: 2188212.
5. Kwok WW, Lotshaw C, Milner ECB, Knitter-Jack N, and Nepom GT. Mutational analysis of the HLA-DQ3.2 insulin-dependent diabetes mellitus susceptibility gene. Proc Natl Acad Sci USA 86:1027 1030, 1989. PMCID: 286614

ALL PUBLICATIONS (Total Number of Publications: 255)

http://www.ncbi.nlm.nih.gov/sites/myncbi/gerald.nepom.1/bibliography/40434072/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

2007-09	President, Federation of Clinical Immunology Societies (FOCIS)
2008	University of Washington Medicine Alumni Association Distinguished Alumnus Award
2009	Juvenile Diabetes Research Foundation David Rumbough Award for Scientific Excellence

FUNDING/ACTIVE RESEARCH SUPPORT	
5 UM1 AI109565-02 (Nepom, G) NIH/NIAID; total award $175,000,000.00 Immune Tolerance Network The Immune Tolerance Network (ITN) is a non-profit, government-funded consortium of researchers working to establish new treatments for diseases of the immune system.	02/01/14-01/31/21 Role: PI
2-PAR-2015-123-Q-R (Nepom, G) JDRF; total award $1,500,000.00 Title: JDRF-ITN Partnership in immune tolerance/profiling immune subsets for biomarkers	04/01/15-3/31/18 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Steve Ziegler, PhD
- Dan Campbell, PhD
- Estelle Bettelli, PhD
- Jessica Hamerman, PhD
- David Rawlings, MD
- Andy Scharenberg, MD

OUKKA, MOHAMED, PH.D.

POSITION/TITLE: Adjunct Associate Professor **JOINED DEPARTMENT:** 09/01/2009
PRIMARY APPOINTMENT: Associate Professor, Dept. of Pediatrics, Seattle Children's Research Institute

Immunology Research Focus: The adaptive immune system is required to clear pathogens. However, under specific conditions, T cells from the adaptive immune system are dysregulated and attack the body's own tissues, leading to the development of autoimmune and graft versus host diseases. Autoimmune diseases represent a major threat to public health with >10 million Americans suffering from autoimmune disorders. Understanding how these diseases can be initiated and regulated is critical to the design of new therapeutics to treat autoimmune diseases.

Inflammatory bowel diseases such as Crohn's disease and ulcerative colitis represent aberrant or dys-regulated immune responses of the gastrointestinal tract, which lead to a state of chronic inflammation. These diseases, which affect more than 1.4 million Americans, are now known to involve variants of a number of different genes. Previous genetic studies uncovered a link between Crohn's and variants of the gene CARD15 (also known as NOD2), but this gene plays a role in only some Crohn's patients, and does not affect the risk for colitis. Recent discovery has linked the gene encoding for interleukin-23 (IL-23) receptor with the development of Crohn's, and it is believed that IL-23 has a much larger effect on these inflammatory diseases, and affects risk for both Crohn's and colitis. However, how IL-23 initiates intestinal inflammation remains unclear. What are the IL-23 producing cells involved in the development of colitis? And more importantly, what signaling pathways regulate the expression of IL-23 in the intestine? Addressing these questions will certainly help us better understand the immune mechanisms that lead to IBD. To understand the role of IL-23 in colitis, we have generated a new mouse model in which the gene encoding for the Green Fluorescent Protein has been knocked-in in the endogenous IL-23R gene locus, using the method of homologous recombination in ES cells. We believe that this mouse will help us dissect precisely the immune mechanisms involved in CD and identify subsets of cells involved in this disease. The IL-23R GFP reporter model will still be useful, since we can track IL-23 expressing cells by using in vivo imaging and study where these cells are recruited in the intestine during the development of colitis. We could also use this reporter mouse to screen for drugs and treatments that turn off IL-23R expression in the intestine in the near future. The results from this study could lead to the design of drugs more appropriate for the treatment of inflammatory diseases than those currently available.

5 Total Number of Graduated Ph.D. Students
0 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
0 Total Number of Other Current Students

2 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Singh AK, Eken A, Fry M, Bettelli E, Oukka M. DOCK8 regulates protective immunity by controlling the function and survival of RORgammat+ ILCs. Nat Commun. 2014;5:4603. PMC 4135384
2. Eken A, Singh AK, Treuting PM, Oukka M. IL-23R+ innate lymphoid cells induce colitis via interleukin-22-dependent mechanism. Mucosal Immunol. 2014 Jan;7(1):143-154. PMC 3834084
3. Riol-Blanco L, Lazarevic V, Awasthi A, Mitsdoerffer M, Wilson BS, Croxford A, Waisman A, Kuchroo VK, Glimcher LH, Oukka M. IL-23 receptor regulates unconventional IL-17-producing T cells that control bacterial infections. J Immunol 2010 184(4):1710-1720. PMCID: PMC2829977
4. Korn T, Mitsdoerffer M, Croxford AL, Awasthi A, Dardalhon VA, Galileos G, Vollmar P, Stritesky GL, Kaplan MH, Waisman A, Kuchroo VK, Oukka M. IL-6 controls Th17 immunity in vivo by inhibiting the conversion of conventional T cells into Foxp3+ regulatory T cells. Proc Natl Acad Sci U S A 2008;105(47):18460-18465.

5. Quintana F, Basso1 A, Iglesias A, Korn T, Farez M, Bettelli E, Caccamo M, Oukka M Weiner H.L. Control of T(reg) and T(H)17 cell differentiation by the aryl hydrocarbon receptor. Nature. 2008 May1; 453: 65-71. PMID: 18362915

ALL PUBLICATIONS (Total Number of Publications: 76)

http://www.ncbi.nlm.nih.gov/sites/myncbi/mohamed.oukka.1/bibliography/40596823/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1992-1994	French Research Ministry special Fellow (MRT).
1995	Association Pour la Recherche contre le Cancer Fellowship Award
1996	Association Pour la Recherche contre le Cancer Postdoctoral Fellow
1997	INSERM (France) Postdoctoral Fellowship
1998	Les Amis des sciences special Fellowship (France)
2000-2002	Irvington Institute for Immunological Research Fellowship
2015	Thomson Reuters' list of The World's Most Influential Scientific Minds for 2015

FUNDING/ACTIVE RESEARCH SUPPORT	
RG 5044-A-2 (Oukka) National Multiple Sclerosis Society Role of Scaffolding Proteins in the Generation of Th17 Cells and in the Pathogenesis of EAE	10/01/2013 - 09/30/2016 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- David Rawlings, M.D.
- Andy Scharenberg, M.D.
- Estelle Bettelli, Ph.D.
- Steve Ziegler, Ph.D.
- Ed Clark, Ph.D.

RAWLINGS, DAVID J., M.D.

POSITION/TITLE: Adjunct Professor **JOINED DEPARTMENT:** 08/01/2001
PRIMARY APPOINTMENT: Professor, Dept. of Pediatrics; Chief of the Div. of Immunology. at Seattle Children's Research Institute

Dr. Rawlings' primary research interests include dysregulated B cell development and signaling leading to immunodeficiency, autoimmunity or lymphoid malignancies, and the development of gene therapy for primary immune deficiency diseases. His laboratory uses expertise in basic and clinical immunology, signal transduction and lymphocyte developmental biology to understand how altered signals can lead to immunologic disease, with the ultimate goal of developing translational therapies capable of specifically modulating these disorders. Dr. Rawlings is a member of multiple regional and national organizations, an NIH study section member and ad hoc reviewer for various grant programs and immunology journals. He also co-directs the Northwest Genome Engineering Consortium, a research program funded as part of the NIH Roadmap for Medical Research focused on developing enzymatic reagents and delivery methods for site-specific gene repair in hematopoietic stem cells.

19 Total Number of Graduated Ph.D. Students
4 Overall Total Number of Current Students
3 Total Number of Current Immunology Students
1 Total Number of Other Current Students
1 M3D

3 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Rawlings DJ, Saffran DC, Tsukada S, Largaespada DA, Grimaldi JC, Cohen L, Mohr RN, Bazan JF, Howard M, Copeland NG, Jenkins NA and Witte ON. Mutation of unique region of Bruton's tyrosine kinase in immunodeficient XID mice. (1993) Science 261:358-361. PMID:8332901 [PubMed - indexed for MEDLINE]
2. Sommer K, Guo B, Pomerantz JL, Bandaranayake AD, Moreno-Garcia ME, Ovechkina YL, Rawlings DJ. Phosphorylation of the CARMA1 Linker Controls NF-κB Activation. (2005) Immunity 23 (6): 561-574. PMID:16356855 [PubMed - indexed for MEDLINE]
3. Dai X, James RG, Habib T, Singh S, Jackson S, Khim S, Moon RT, Liggitt D, Wolf-Yadlin A, Buckner JH, Rawlings, DJ. A Disease-associated PTPN22 Variant Promotes Systemic Autoimmunity in Murine Models. (2013) J Clin Invest. 123(5): 2024-36. PMCID: PMC3638909
4. Astrakhan A, Sather BD, Ryu BY, Khim S, Singh S, Humblet-Baron, Ochs HD, Miao CH, Rawlings DJ. Ubiquitous high-level gene expression in hematopoietic lineages provides effective lentiviral gene therapy of murine Wiskott-Aldrich Syndrome. (2012) Blood. 119(19): 4395-407. PMCID: PMC3362358
5. Sather BD, Romano Ibarra G, Sommer K, Curinga G, Hale M , Khan I, Singh S, Song Y, Gwiazda KS, Sahni J, Jarjour J, Astrakhan A, Wagner T, Scharenberg AM, Rawlings DJ. Efficient Modification of CCR5 in Primary Human Hematopoietic Cells using a megaTAL Nuclease and AAV Donor Template. (2015) Sci Trans Med. 7(307)ra156. PMID: 26424571

ALL PUBLICATIONS (Total Number of Publications: 158)

http://www.ncbi.nlm.nih.gov/sites/myncbi/david.rawlings.1/bibliography/40450221/public/?sort=date&direction=ascending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1990-2004	Leukemia & Lymphoma Society, Scholar Award
1997-2000	James S. McDonnell Scholar
2001-present	Elected to American Society for Clinical Investigation, Member
2007-present	Elected to Association of American Physicians, Member
2008-present	Children's Guild Association Endowed Chair in Pediatric Immunology
2015	Seattle Business Magazine - WA State Leaders in Health Care, Award for Leader in Medical Research

FUNDING/ACTIVE RESEARCH SUPPORT	
5 R01 AI084457-09 (Rawlings) NIH/NIAID Title: Lentiviral Gene Therapy of X-Linked Agammaglobulinemia	04/01/2014 – 03/31/2016 Role: PI
2 U54 AI112983-06 (Cowan) NIH/NIAID Title: Primary Immune Deficiency Treatment Consortium	09/01/2014 – 08/31/2016 Role: Co-I
5 P01 AI097100-04 (Rawlings & Kiem) NIH/NIAID Title: Foamy Viral Gene Therapy for X-linked Severe Combined Immune Deficiency (SCID-X1) Core A: Administrative	08/07/2012 – 07/31/2017 Role: Program PI; Project 1 Leader; Core A Leader
HEM-2014-011 (Rawlings) Bayer HealthCare Induction of long-term tolerance to factor VIII in hemophilia with pre-existing inhibitory antibodies	06/01/2015 – 05/31/2017 Role: PI
Sponsored Research Agreement (Rawlings) Bluebird bio, Inc. Sponsored Research Agreement Optimizing gene editing within primary human T cell and HSC using co-delivery of nucleases ad DNA repair templates.	06/04/2015 – 06/05/2018 Role: PI
1 R01 AI118500-01A1 (Wagner) NIH/NIAID Title: Engineering T-cells with optimized anti-HIV chimeric antigen receptors and CCR5 disruption as a strategy to target HIV-infected cells	06/15/2015 – 05/30/2019 Role: Co-Investigator
2016PG-T1D039 (Rawlings) The Leona M. and Harry B. Helmsley Charitable Trust Title: Durable regulatory cell therapy of T1D using gene editing	01/01/2016 – 12/31/2017 Role: PI
1-16-VSN-26 (Scharenberg) American Diabetes Association Title: Regulatory T-cell stabilization via gene editing as novel therapy for Type I diabetes	01/01/2016 – 12/31/2020 Role: Other Significant Contributor
1 R01HL128139-01 (Miao) NIH/NHLBI Title: Development of clinically feasible Ultrasound-mediated gene therapy for hemophilia	08/01/2015 – 03/31/2019 Role: Co-I
1 P01 HL122173-01A1 (Storb) NIH/NHLBI Title: Cell and Gene Therapy For Nonmalignant Blood Disorders	07/01/2015 – 06/30/2020 Role: Co-I; Project Leader - Core A
1 U19 AI109632-01 (Stamatatos) NIH/NIAID Title: Eliciting VRC01-like bNAbs by Specifically Designed Env Immunogens	03/05/2014 – 02/28/2021 Role: Co-I

IMMUN. COLLABORATIONS:

- Daniel Campbell, Ph.D.
- Edward Clark, Ph.D.
- Jessica Hamerman, Ph.D.
- Keith Elkon, M.D.
- Pamela Fink, Ph.D.
- Michael Gale, Ph.D.
- Adam Lacy-Hulbert, Ph.D.
- Gerald Neopm, Ph.D.
- Mohamed Oukka, Ph.D.
- Marion Pepper, Ph.D.
- Andrew Scharenberg, M.D.
- Daniel Stetson, Ph.D.
- Roland Strong, Ph.D.
- Steven Ziegler, Ph.D.

OTHER COLLABORATIONS:

- Dennis Lindell, Ph.D.
- Carla Greenbaum, Ph.D.
- Hans Ochs, Ph.D.
- Jane Buckner, Ph.D.
- Troy Torgerson, Ph.D.
- Suzanne Skoda-Smith, Ph.D.

RIDDELL, STANLEY R., M.D.

POSITION/TITLE: Adjunct Professor **JOINED DEPARTMENT:** 11/01/2015
PRIMARY APPOINTMENT: Professor, Dept. of Medicine, Division of Medical Oncology

Dr. Riddell led the first human trial of adoptively transferred T cell clones to prevent cytomegalovirus infection after allogeneic HCT, and developed four subsequent trials of T cell therapy, including the first efforts to treat relapsed leukemia post-HCT and to use synthetic chimeric antigen receptor (CAR)-modified T cells of defined subset composition. The Riddell Laboratory continues to focus on understanding the contributions of distinct T cell subsets to protective immunity against pathogens and tumors; identifying antigenic determinants on diseased cells and designing receptors to recognize them; the development of adoptive T cell therapies for viral diseases and cancers using unmodified and genetically modified antigen-specific T cells of defined compositions; and the development of preclinical models for evaluating principles of safe and effective T cell therapy.

Dr. Riddell's team has developed new techniques for isolation, expansion, genetic modification and reinfusion of T cells, and for monitoring safety, persistence, migration and function after transfer. Many of these innovative methods are now widely used. Demonstrations that naïve and memory T cell subsets can have superior persistence and efficacy after adoptive transfer informed new methods to rapidly isolate defined cell populations for clinical trials using T cells modified with specific CARs or T cell receptors (TCRs).

3 Total Number of Graduated Ph.D. Students
1 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
1 Total Number of Other Current Students

6 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Riddell SR, Rabin M, Geballe AP, Britt WJ, Greenberg PD. Class I MHC-restricted cytotoxic T lymphocyte recognition of cells infected with human cytomegalovirus does not require endogenous viral gene expression. Journal of Immunology 146:2795-2804, 1991.
2. Bonnet D, Warren EH, Greenberg PD, Dick J, Riddell SR CD8+ minor histocompatibility antigen-specific cytotoxic T lymphocyte clones eliminate acute myeloid leukemia stem cells. Proceedings of the National Academy of Sciences 96:8639-8644, 1999.
3. Hudecek M, Lupo-Stanghellini MT, Kosasih PL, Sommermeyer D, Jensen MC, Rader C, Riddell SR. Receptor affinity and extracellular domain modifications affect tumor recognition by ROR1-specific chimeric antigen receptor T-cells. Clinical Cancer Research 19:3153-64, 2013.
4. Berger C, Jensen MJ, Lansdorp P, Riddell SR. Adoptive transfer of effector CD8+ T cells derived from central memory cells establishes persistent T cell memory in primates. Journal of Clinical Investigation 118:294-305, 2008.
5. Riddell SR, Watanabe KS, Goodrich JM, Li C-R, Agha ME Greenberg P.D. Restoration of viral immunity in immunocompromised humans by adoptive transfer of T cell clones. Science 257:238-241, 1992.

ALL PUBLICATIONS (Total Number of Publications: 177)

http://www.ncbi.nlm.nih.gov/pubmed/?term=Riddell+SR

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1985-1987	McEachern Fellowship, Canadian Cancer Society
1988-1991	Leukemia Society of America Fellowship
1991-1994	Leukemia Society of America Special Fellowship
1992	Cancer Research Institute Partridge Foundation Investigator Award
2008	Fellow of the American College of Physicians (elected)
2009-2013	Hans Fischer Senior Fellow, Institute for Advanced Study
2010	International Society for Biological Therapy Team Science Award, 2
2010	Association of American Physicians (Elected)

FUNDING/ACTIVE RESEARCH SUPPORT	
R01 HL121568-01A1 (Riddell, S.; Co-PI Bleakley, M.) NIH/NHLBI Title: Naïve T cell depletion to prevent graft-versus-host disease	4/1/2014 – 3/31/2019 Role: PI
R01 CA136551-06A1 (Riddell, S.; Co-PI: Jensen, M.) NIH/NCI Title: Targeted therapy of ALL with gene-modified central memory T Cell	9/1/2014 – 8/31/2019 Role: PI
R01 CA114536-10 (Riddell, S.) NIH/NCI (no cost extension; renewal scored 14, 3 percentile) Strategies to improve the adoptive transfer of T cells	7/1/2010 – 6/30/2016 Dr. Riddell serves as the PI.
P50 CA138293-04 (Porter, P.) NIH/NCI Seattle Cancer Consortium Breast SPORE Sub-Project 2 (Project Leader: Riddell, S.) Targeted Therapy of Breast Cancer with Central Memory T cells	9/15/2010 – 8/31/2015 Role: Sub-Project 2 Leader
P50 CA107399-03 (Forman, S.) NIH/NCI City of Hope Lymphoma SPORE Subcontract PI: Riddell, S. This project is performing comprehensive immunologic monitoring on patients receiving CD19 CAR-T cells for lymphoma treatment.	9/23/2011 - 08/31/2016 Role: Subcontract PI
SU2C-AACR-DT10 (Ribas, T.; Co-PI: Yee, C.) AACR/Stand Up To Cancer Dream Team Adoptive Cell Transfer for Cancer Treatment Subcontract: PI: Greenberg, P.	3/1/2013 - 02/29/2016 Role: Co-PI
Washington Life Sciences Development Fund (Jensen, M.) Washington State Cancer Immunotherapy Initiative Subcontract PI: Riddell, S. This project is analyzing immunologic biomarkers of efficacy in patients receiving CD19 CAR-T cells on pediatric and adult clinical trials.	2/1/2014 - 1/31/2017 Role: Dr. Riddell is PI of the FHCRC site.
U01 CA176270-02 (McIntosh, M.; Co-PI: Warren, E.) NIH/NCI Profiling cancer neoantigen repertoires and validating immunotherapy targets	5/1/2013 – 4/30/2017
U54 AR065139-01A1 (Chamberlain, J.) NIH/NICHD Sen Paul D. Wellstone Muscular Dystrophy Cooperative Research Center: Seattle Dr. Riddell is analyzing mechanisms of disease pathogenesis in FSHD.	5/7/2014 – 4/30/2018 Role: Co-I on Project 2,

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Phil Greenberg, M.D.

SCHARENBERG, ANDREW M., M.D.

POSITION/TITLE: Adjunct Professor **JOINED DEPARTMENT:** 02/01/2001
PRIMARY APPOINTMENT: Professor, Dept. of Pediatrics; PI at Seattle Children's Research Institute

The Scharenberg laboratory has two major areas of interest: Mg2+ transport and cation channel function in the immune system, and the development of cell engineering technology. Current effort is centered in two areas:1) Mg2+ transport and cation channel function. We have characterized novel divalent cation entry pathways mediated by TRPM7 and SLC41A1, and have shown that these proteins play important roles in Mg2+ homeostasis and control of cell proliferation. With the recent demonstration that a 3rd class of Mg2+ transporters, the MAGT1 family, plays a key role in early TCR signaling, we have begun to dissect the differing roles and functions of each Mg2+ transport pathway in lymphocyte physiology using a unique suite of Mg2+ transport reagents, electrophysiology, atomic mass spectrometry, and cell engineering technology. 2) Development of cell engineering technology.a) We have had a longstanding interest in developing gene repair methods for hematopoietic genetic diseases, and working within the Northwest Genome Engineering Consortium, we have pioneered homing endonuclease engineering technology for this purpose. Present efforts are centered on optimizing nuclease and repair template delivery to primary and pluripotent stem cells using viral vectors and advanced electroporation methods, and on implementing gene repair in primary cells and animal models. b) Two recent reports this past summer demonstrated that adoptive cell therapy for cancer has the potential for curative therapy of a range of malignancies for which present standard therapies are limited capacity. Our group is working with Dave Rawlings laboratory at the Center for Immunity and Immunotherapies and Michael Jensen's laboratory at the Center for Childhood Cancer to apply a variety of cell engineering tools, including TAL effector nucleases, homing endonucleases, lentiviral and foamy viral gene transfer vectors, and advanced electroporation techniques to develop the next generation of safe and controlled adoptive cell therapies.

10	Total Number of Graduated Ph.D. Students
1	Overall Total Number of Current Students
1	Total Number of Current Immunology Students
0	Total Number of Other Current Students
2	Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. ADP-ribose gating of the calcium-permeable LTRPC2 channel revealed by Nudix motif homology.Perraud AL, Fleig A, Dunn CA, Bagley LA, Launay P, Schmitz C, Stokes AJ, Zhu Q, Bessman MJ, Penner R, Kinet JP, Scharenberg AM.Nature. 2001 May 31;411(6837):595-9.
2. LTRPC7 is a Mg.ATP-regulated divalent cation channel required for cell viability. Nadler MJ, Hermosura MC, Inabe K, Perraud AL, Zhu Q, Stokes AJ, Kurosaki T, Kinet JP, Penner R, Scharenberg AM, Fleig A. Nature. 2001 May 31;411(6837):590-5. Erratum in: Nature 2001 Aug 9;412(6847):660.
3. Regulation of vertebrate cellular Mg2+ homeostasis by TRPM7. Schmitz C, Perraud AL, Johnson CO, Inabe K, Smith MK, Penner R, Kurosaki T, Fleig A, Scharenberg AM. Cell. 2003 Jul 25;114(2):191-200
4. Coupling endonucleases with DNA end-processing enzymes to drive gene disruption. Certo MT, Gwiazda KS, Kuhar R, Sather B, Curinga G, Mandt T, Brault M, Lambert AR, Baxter SK, Jacoby K, Ryu BY, Kiem HP, Gouble A, Paques F, Rawlings DJ, Scharenberg AM. Nat Methods. 2012 Oct;9(10):973-5. doi: 10.1038/nmeth.2177. Epub 2012 Sep 2.
5. Efficient modification of CCR5 in primary human hematopoietic cells using a megaTAL nuclease and AAV donor template. Sather BD, Romano Ibarra GS, Sommer K, Curinga G, Hale M, Khan IF, Singh S, Song Y, Gwiazda K, Sahni J, Jarjour J, Astrakhan A, Wagner TA, Scharenberg AM, Rawlings DJ. Sci Transl Med. 2015 Sep 30;7(307):307ra156. doi: 10.1126/scitranslmed.aac5530.

ALL PUBLICATIONS (Total Number of Publications: 100)

http://www.ncbi.nlm.nih.gov/sites/myncbi/collections/bibliography/40451613/

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

College	Phi Beta Kappa, summa cum laude with Honors
Medical School	AOA, HHMI/NIH Research Scholar Fellowship, M.D. with distinction
Post-graduate	Denny Resident Award, Pediatric Scientist Development Fellowship, AAAAI Extramural Research Trust Award, BIDMC Research Investment Award, BIDMC, Fireman Fellowship, APS/SPR Young Investigator Award 2002.
2016	ADA Pathways Visionary Award.

FUNDING/ACTIVE RESEARCH SUPPORT	
Pathways Visionary Award American Diabetes Association Regulatory T-cell Stabilization Through Gene Editing	01/01/2016 – 12/31/2020 Role: PI
LBEE P03146 (Burt) Imperial College/FNIH Homing Endonuclease Genes: New Tools for Population	08/01/2010 – 07/31/2016 Role: PI
5 U19 AI096111-02 (Jerome) FHCRC/NIH/NIAID Targeted Modification of Host and Proviral DNA to treat Latent HIV Infection	07/01/2011 – 06/30/2016 Role: Co-I
5 P01AI097100-04 (Rawlings & Kiem) NIH/NIAID Foamy Viral Gene Therapy for X-linked Severe Combined Immune Deficiency (SCID-X1). Project 1: Pre-clinical modeling of foamy viral gene therapy for murine and human SCID-X1	08/07/2012 – 07/31/2017 Role: Co-I
Sponsored Research Agreement (Rawlings, Scharenberg) Bluebird bio, Inc. This aim of the research agreement is focused on optimizing mRNA production and use of mRNA/AAV-based methods for recombination-based gene editing in T-cells and hematopoietic stem cells.	06/04/2015 – 06/05/2018 Role: Co-I
1 R01 AI118500-01A1 (Wagner) NIH Engineering T-cells with optimized anti-HIV chimeric antigen receptors and CCR5 disruption as a strategy to target HIV-infected cells	06/15/2015 – 05/30/2019 Role: Co-I

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- David Rawlings, M.D.

STRONG, ROLAND, PH.D.

POSITION/TITLE: Affiliate Professor **JOINED DEPARTMENT:** 08/01/1994

Structural molecular immunology, vaccinology & translational biophysics: using biophysical approaches to study NK, T, and B cell receptors, understand immunorecognition of siderophores, further prophylactic and therapeutic vaccine development, and engineer targeted immunotheranostics. Vaccines are the most effective, and most cost-effective, health interventions ever devised by humanity, but efforts to develop prophylactic HIV vaccines remain stymied by the multiplex immunoevasion strategies of the virus. We continue to collaborate on innovative means to engineer novel immunogens to elicit protective humoral responses, further understand the biophysics of the process of antibody ontogeny, and determine the molecular-level mechanism of antibody-mediated virus neutralization. Allogeneic hematopoietic cell transplantation (HCT) is an effective therapy for life-threatening, non-malignant disorders of the hematopoietic and immune systems. However, major limitations of allogeneic HCT in patients with nonmalignant disorders have been host-versus-graft reactions (graft rejection) and immune reactions of donor lymphocytes against host antigens, also called graft-versus-host disease (GVHD), both of which can be fatal. HCT recipients are generally treated with long term immunosuppressive regimens which weakens host immune responses to pathogens, thereby increasing the risk of serious infections – and is not uniformly successful in controlling GVHD. CD28 and CTLA-4 are leukocyte cell-surface costimulatory receptors that profoundly influence the course of immune responses: CD28 magnifies the effects of TCR signaling and enhances both cell cycle progression and T cell survival; CTLA-4 (CD152) provides opposing inhibitory signals. CD28 and CTLA-4 bind the shared, related ligands B7.1 (CD80) and B7.2 (CD86).

10 Total Number of Graduated Ph.D. Students
1 Overall Total Number of Current Students
0 Total Number of Current Immunology Students
1 Total Number of Other Current Students
1 MCB

1 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Allred, B. E., Rupert, P. B., Gauny, S. S., An, D. D., Ralston, C. Y., Sturzbecher-Hoehne, M., Strong, R. K., & Abergel, R. J. (2015) 'Siderocalin-mediated recognition, sensitization, and cellular uptake of actinides' Proceedings of the National Academy of Sciences USA 112, pp. 10342-7 PMC4547258
2. Finton, K. A. K., Friend, D., Jaffe, J., Gewe, M., Holmes, M. A., Larman, H. B., Stuart, A., Larimore, K., Greenberg, P. D., Elledge, S. J., Stamatatos, L. & Strong, R. K. (2014) 'Ontogeny of recognition specificity and functionality for the broadly neutralizing anti-HIV antibody 4E10' PLoS Pathogens 10, pp. e1004403 PMC4177983
3. Finton, K. A. K., Larimore, K., Larman, H. B., Friend, D., Correnti, C., Rupert, P. B., Elledge, S. J., Greenberg, P. D. & Strong, R. K. (2013) 'Autoreactivity and exceptional CDR plasticity (but not unusual polyspecificity) hinder elicitation of the anti-HIV antibody 4E10' PLoS Pathogens 9, e1003639 PMC3784475
4. Correnti*, C., Richardson*, V., Sia*, A. K., Bandaranayake, A. D., Ruiz, M., Rahmanto, Y. S., Kovacevic, Ž., Clifton, M. C., Holmes, M. A., Kaiser, B. K., Barasch, J., Raymond, K. N., Richardson†, D. R. & Strong†, R. K. (2012) 'Siderocalin/Lcn2/NGAL/24p3 Does Not Drive Apoptosis Through Gentisic Acid Mediated Iron Withdrawal in Hematopoietic Cell Lines' PLoS ONE 7, e43696 PMC3424236

5. Correnti, C., Clifton, M. C., Abergel, R. J., Allred, B., Hoette, T. M., Ruiz, M., Cancedda, R., Raymond, K. N., Descalzi, F. & Strong, R. K. (2011) 'Galline Ex-FABP is an Antibacterial Siderocalin and a Lysophosphatidic Acid Sensor Functioning through Dual Ligand Specificities' Structure 19, pp. 1796-1806 PMC3240821

ALL PUBLICATIONS (Total Number of Publications: 90)

http://www.ncbi.nlm.nih.gov/pubmed?cmd=PureSearch&term=strong+rk%5BAuthor%5D

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1992 - 1994	American Cancer Society Postdoctoral Fellow
1998 - 2002	Associate Editor, Journal of Immunology
2000 - present	Member, American Association of Immunologists
2005 - 2009	Chartered Member, Cellular and Molecular Immunology (CMI-A) Study Section
2009 - 2012	Member, Editorial Board, 'Self/Nonself – Immune Recognition and Signaling'
2010 - 2012	Member, NIH College of CSR Reviewers
2013 - 2015	Member, Editorial Board, 'Immunonics'
2015 - present	Review Editor, 'Frontiers in HIV and AIDS'

OTHER COLLABORATIONS:

- Rebecca Abergel (Lawrence Berkeley National Laboratory)
- Veronika Groh (FHCRC – CRD)
- Jim Olson (FHCRC – CRD)
- Martin Prlic (FHCRC – VIDD)
- Leo Stamatatos (FHCRC – VIDD)
- Rainer Storb (FHCRC – CRD)
- Richard Zager (FHCRC – CRD)

URDAHL, KEVIN B., PH.D.

POSITION/TITLE: Affiliate Associate Professor **JOINED DEPARTMENT:** 06/16/2014
AFFILIATE INSTITUTE: Center for Infectious Disease Research

The Urdahl lab is interested in understanding the factors that impede T cell-mediated immune protection during persistent Mtb infection. We have recently discovered that Foxp3-expressing regulatory T cells (T regs) restrict Mtb eradication, and pathogen-specific T regs are extremely potent in mediating this activity. Even small numbers of Mtb-specific T regs delay the arrival of effector T cells in the lung, the primary site of Mtb infection, and cause an increased bacterial burden. Future research will seek to elucidate how Mtb-specific T regs are induced and to define their precise roles and activities at different stages of infection. A key question that drives these studies is whether T reg function can be safely manipulated to prevent or treat tuberculosis.

We are also interested in understanding T cell subsets that promote protection against tuberculosis. Using recently developed MHC class I and II tetramers, we can monitor the function of Mtb-specific CD8+ and CD4+ T cells throughout the course of infection. We seek to determine the lineage relationships between Mtb-specific T cells with different functional capacities, including proliferation, IFN-γ production, IL-17 production, and Foxp3 expression. We plan to investigate how variations in innate immune responses help shape the subsequent T cell responses to Mtb. These studies will provide insights into how long-lived populations of protective T cell subsets are induced and maintained during persistent Mtb infection, and should help to inform novel immunization strategies.

3 Total Number of Graduated Ph.D. Students
1 Overall Total Number of Current Students
1 Total Number of Current Immunology Students
0 Total Number of Other Current Students

2 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Jenkins MK, Taylor PS, Norton SD, and **Urdahl KB**. 1991. CD28 delivers a costimulatory signal involved in antigen- specific IL-2 production by human T cells. J. Immunol. 147:2461-66. PMID: 11717561. PMCID: N/A
2. **Urdahl KB**, Sun JC, Bevan MJ. Positive selection of MHC class Ib-restricted CD8(+) T cells on hematopoietic cells. Nat Immunol. 2002 Aug;3(8):772-9. PMC2782383
3. Scott-Browne JP, Shafiani S, Tucker-Heard G, Ishida-Tsubota K, Fontenot JD, Rudensky AY, Bevan MJ, **Urdahl KB**. Expansion and function of Foxp3-expressing T regulatory cells during tuberculosis. J Exp Med. 2007 Sep 3;204(9):2159-69. PubMed PMID: 17709423; PubMed Central PMCID: PMC2118702.
4. Shafiani S, Tucker-Heard G, Kariyone A, Takatsu K, **Urdahl KB**. Pathogen-specific regulatory T cells delay the arrival of effector T cells in the lung during early tuberculosis. J Exp Med. 2010 Jul 5;207(7):1409-20. PubMed PMID: 20547826; PubMed Central PMCID: PMC2901066.
5. Moguche AO, Shafiani S, Clemons C, Larson RP, Dinh C, Higdon LE, Cambier CJ, Sissons JR, Gallegos AM, Fink PJ, **Urdahl KB**. ICOS and Bcl6-dependent pathways maintain a CD4 T cell population with memory-like properties during tuberculosis. J Exp Med. 2015 May 4;212(5):715-28. PMC4419347.

ALL PUBLICATIONS (Total Number of Publications: 27)

http://www.ncbi.nlm.nih.gov/sites/myncbi/kevin.urdahl.1/bibliography/40455188/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

1987 MD/PhD. Fellowship, Mayo Foundation Endowment for Medical Education and Research
1991 Immunology Training Grant Fellowship, NIH
1992 Graduate School Dissertation Fellowship, University of Minnesota
1992 J. Thomas Livermore Award, Medical Student Research Award, Hematology
1993 Graduate Medical Research Award, Microbiology, Bacener
1999 Program Fellowship, 1999 Pediatric Scientist Development Program
2002 Training Grant Fellowship, Pediatric Immunology
2003 Research Center Scholar, Child Health Research Center
2003 Career Award in the Biological Sciences, Burroughs Wellcome
2003 K08 Career Development Award, National Institutes of Health

FUNDING/ACTIVE RESEARCH SUPPORT	
U19 AI106761 Aderem/Sherman (PI) Title: Omics for TB Disease Progression (OTB)	06/21/13-05/31/18 Role: Co-Leader Project 1
R01 AI076327 Title: T Regulatory Cells and Immunity in Tuberculosis	12/01/07-01/31/19 Role: PI
R01 AI100018 Title: Myeloid-derived Suppressor Cells (MDSC) Suppress Infant Immune Responses	04/01/12-03/31/17 Role: PI
R01 AI100018-04 REVISED Title: Collaborative Supp for Myeloid-derived Suppressor cells (MDSC) suppress infant immune responses	08/25/15-03/31/16 Role: PI
R21 AI111586 Title: Immune-mediated elimination of antigen-specific Tregs during infection and cancer	05/01/14-04/30/16 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Alan Aderem, PhD
- Daniel Campbell, PhD
- Jessica Hamerman, PhD
- Planning collaboration with Michael Gerner, PhD

ZIEGLER, STEVEN F. PH.D.

POSITION/TITLE: Affiliate Professor **JOINED DEPARTMENT:** 06/10/1997
AFFILIATE INSTITUTE: Benaroya Research Institute at Virginia Mason

The laboratory is interested in the underlying mechanisms that control the development and function of the immune system. The lab works on two areas: FoxP3 and the control of CD4+CD25+ regulatory T cell development and function. The forkhead-family transcription factor FoxP3 has been implicated in the development and function of CD4+CD25+ regulatory T cells (Tregs). In the mouse, FoxP3 expression is both necessary and sufficient for generating Tregs, while FoxP3 expression has been shown to correlate with Treg function in humans. My laboratory is taking several approaches to better understand the role of this protein.

1. Structure/function analysis of FoxP3. We have taken advantage of mutations in the FoxP3 gene found in human patients with IPEX (Immune dysfunction/ Polyendocrinopathy/Enteropathy/X-linked) syndrome to study the function of FoxP3. Using these mutations, as well as deletions, we have isolated and characterized several FOXP3-interacting proteins, and are now studying the role of these proteins in FOXP3 function. 2. Consequences of ectopic FoxP3 expression. Previous work has shown that introduction of FoxP3 into conventional mouse T cells converts these T cells to a Treg-like phenotype. We have developed mice that express tetracycline-inducible FoxP3 transgenes in order to assess whether constant FoxP3 expression is needed for Treg function. We have just developed these mice, and preliminary data suggests that T cell phenotype correlates with expression of the inducible transgene.

9 Total Number of Graduated Ph.D. Students
2 Overall Total Number of Current Students
1 Total Number of Current Immunology Students
1 Total Number of Other Current Students
1 Microbiology

6 Total Number of Current Postdoctoral Fellows

SELECTED PUBLICATIONS (GREATEST IMPACT):

1. Kitajima M, Lee HC, Nakayama T, Ziegler SF. TSLP enhances the function of helper type 2 cells. Eur J Immunol. 2011 Jul;41(7):1862-71. doi: 10.1002/eji.201041195. Epub 2011 Jun 7.
2. Thompson LJ, Valladao AC, Ziegler SF. Cutting edge: De novo induction of functional Foxp3+ regulatory CD4 T cells in response to tissue-restricted self-antigen. J Immunol. 2011 Apr 15;186(8):4551-5. Epub 2011 Mar 14.
3. Ziegler SF. The role of thymic stromal lymphopoietin (TSLP) in allergic disorders. Curr Opin Immunol. 2010 Dec;22(6):795-9. Epub 2010 Nov 23. Review.
4. Wesley JD, Sather BD, Perdue NR, Ziegler SF, Campbell DJ. Cellular requirements for diabetes induction in DO11.10xRIPmOVA mice. J Immunol. 2010 Oct 15;185(8):4760-8. Epub 2010 Sep 20.
5. Ziegler SF, Artis D. Sensing the outside world: TSLP regulates barrier immunity. Nat Immunol. 2010 Apr;11(4):289-93. Review.

ALL PUBLICATIONS (Total Number of Publications: 174)

http://www.ncbi.nlm.nih.gov/sites/myncbi/steven.ziegler.1/bibliography/40649593/public/?sort=date&direction=descending

SELECTED HONORS, EDITORIAL AND REVIEW COMMITTEES AND PROF. SOCIETIES:

2002-2005	Molecular Immunology Study Section, Arthritis Foundation.
2004-2008	American Diabetes Association Immunology Study Section
2006-2008	Assistant Editor, The Journal of Immunology
2008-2013	Section Editor, The Journal of Immunology
2011-Present	Associate Editor, Clinical Immunology
2013-Present	Deputy Editor, The Journal of Immunology
2009-2013	Standing Member, HAI Study Section, NIH
2013	Elliot F. Ellis Lectureship, AAAAI Annual Meeting

FUNDING/ACTIVE RESEARCH SUPPORT	
1 R01 AI108463-01 (Ziegler) NIH-NIAID Title: c-Ski and the regulation of CD4 T cell-mediated autoimmunity and tolerance	08/01/14 – 07/30/18 Role: PI
5 R01 NS081687-03 (Ziegler, Bettelli) NIH-NINDS Title: Molecular mechanisms of Th17 plasticity in MS	05/13/2013 – 11/30/2017 Role: CO-I
1R01AI112323-01A1 (Ziegler) NIH-NIAID Title: A FOXP3 complex that controls human regulatory T cell function	08/01/14 – 03/31/2020 Role: PI
Sponsor Number Pending (Bluestone) JDRF Title: JDRF Collaborative Center for Treg Biology	06/01/14 – 05/31/16 Role: CO-I
5 R01 AR059058-05 (Woodfolk/Ziegler) NIH-NIAMS Title: Regulation of TSLP receptor expression and function in eczema in mice and man	04/01/11 – 03/31/16 Role: CO-I
5 P30 DK017047-38 (Kahn) – THIS AWARD NIH-NIDDK Diabetes Research Center, Core E: Immunology and Inflammation Core *Dr. Ziegler's role involvement in this project began 08/19/13 and is expected to end 11/30/16.	12/01/06 – 11/30/17 Role: Project PI
5 R01 AI068731-10 (Ziegler) NIH-NIAID Title: TSLP and the Pathophysiology of Asthma	02/01/06 – 01/31/17 Role: PI
5 R01 CA182783-02 (Ziegler) NIH-NCI/NIAID Title: Control of tumor growth and metastasis by the cytokine TSLP	04/01/14 – 03/31/19 Role: PI

COLLABORATIONS WITH OTHER IMMUNOLOGY FACULTY:

- Estelle Bettelli, PhD
- Adam Lacy-Hulbert, PhD
- Daniel Campbell, PhD
- Jessica Hamerman, PhD
- Mohamed Oukka, PhD
- Marion Pepper, PhD