Immunobiology

Division Photo

Front Row: F. Finkelman, M. Wills-Karp, M. Jordan
Back Row: L. Grimes, D. Herbert, D. Hildeman

Division Data Summary

Research and Training Details	
Number of Faculty	7
Number of Joint Appointment Faculty	2
Number of Research Fellows	11
Number of Research Students	11
Number of Support Personnel	14
Direct Annual Grant Support	$3,061,205
Direct Annual Industry Support	$47,355
Peer Reviewed Publications	28
Clinical Activities and Training	
Number of Clinical Fellows	3

Significant Publications

Herbert DR, Yang JQ, Hogan SP, Groschwitz K, Khodoun M, Munitz A, Orekov T, Perkins C, Wang Q, Brombacher F, Urban JF Jr, Rothenberg ME, Finkelman FD. Intestinal epithelial cell secretion of RELM-beta protects against gastrointestinal worm infection.J Exp Med. 2009 Dec 21;206(13):2947-57.

In this manuscript, **Drs. Herbert** and **Finkelman** have identified a novel mechanism by which the mammalian host protects itself against intestinal parasitic infections. They have shown that T helper 2 cytokines (IL-4, IL-13) mediate

protection against parasitic infections by inducing the differentiation of normal gut epithelium into goblet cells, which then secrete RELM-b. Once produced, RELM-b prevents hookworms from obtaining nutrients from the host gut epithelium. As a result, they starve and are expelled by the host (Journal of Experimental Medicine, 2009). These insights may lead to the development of therapeutic approaches to inhibit the morbidity associated with these widespread parasitic infection.

Lykens JE, Terrell CE, Zoller EE, Divanovic S, Trompette A, Karp CL, Aliberti J, Flick MJ, Jordan MB. Mice with a selective impairment of IFN-gamma signaling in macrophage lineage cells demonstrate the critical role of IFN-gamma-activated macrophages for the control of protozoan parasitic infections in vivo.J Immunol. 2010 Jan 15;184(2):877-85.

Dr. Jordan and colleagues have reported that direct effects of the T cell cytokine, interferon-gamma, on macrophages is important in the control of multiple protozoan parasites. Specifically, they generated mice called the "macrophages insensitive to IFN-gamma" (MIIG) mice, which express a dominant negative mutant IFN-gamma receptor in CD68+ cells (monocytes, macrophages, dendritic cells, mast cells). Utilizing this unique tool they showed the specific importance of direct, IFN-gamma mediated activation of macrophages in vivo for controlling infection with protozoan parasites (Trypanosoma cruzi, Leishmania major). This finding may have implications for a broad range of intracellular infections.

Lin AA, Wojciechowski SE, Hildeman DA. Androgens suppress antigen-specific T cell responses and IFN-gamma production during intracranial LCMV infection.J Neuroimmunol. 2010 Jul 8, Epub.

In this manuscript, Dr. Hildeman and colleagues investigated the role of sex hormones of the immunopathologic sequelae of CNS viral infection. They found that androgens suppress T cell responses and also affect the quality and quantity of antigen-presenting cells in the CNS. Combined these results provide an explanation for the well known, but poorly understood, sex differences in immunity and autoimmunity.

Unsinger J, McGlynn M, Kasten KR, Hoekzema AS, Watanabe E, Muenzer JT, McDonough JS, Tschoep J, Ferguson TA, McDunn JE, Morre M, Hildeman DA, Caldwell CC, Hotchkiss RS. IL-7 promotes T cell viability, trafficking, and functionality and improves survival in sepsis. J Immunol. 2010 Apr 1;184(7):3768-79.

In this paper, Dr. Hildeman and his collaborators showed that administration of IL-7 prevents morbidity and mortality in a mouse model of sepsis. Further, they showed that IL-7 reverses fundamental immunologic defects in sepsis, i.e., the loss of critical immune effector cells and the subsequent compromised host defenses. These findings suggest that delivery of IL-7 may be beneficial for the treatment of septic patients as well as patients with other conditions where lymphopenia is a problem (e.g. HIV, cancer, bone marrow transplantation).

Saunders V, Breysse P, Clark J, Sproles A, Davila M, Wills-Karp M. Particulate matter-induced airway hyperresponsiveness is lymphocyte dependent..Environ Health Perspect. 2010 May;118(5):640-6.

Exposure to airborne particulate matter (PM), a major component of air pollution, has been associated with increases in both exacerbations of and hospitalizations for asthma. Dr. Wills-Karp and her group explored the mechanisms by which PM may induce the symptoms of asthma. They demonstrate for the first time that particulate matter exposure increases the pathophysiological features of asthma via activation of lymphocyte-dependent pathways. These results provide a plausible biological mechanism for the strong association between PM exposure and the increased severity of asthma.

Division Highlights

Immunobiology Graduate Program

The Immunobiology Graduate Program has initiated an International Graduate Student Exchange Program with Dr. Koehl at the University of Lubeck in Germany. This program would allow students enrolled at UC to spend up to 2 years at the University of Lubeck conducting their thesis research, and vice versa. Several members of the Immunology Graduate Program (Wills-Karp, Hildeman, Finkelman, Hogan, Alberti, Chougnet) visited Lubeck in June to launch this effort. We anticipate that we may enroll students into this exchange program in the Fall term of 2011.

Fred Finkelman, M.D.

Dr. Finkelman and his laboratory study the immunology of T cell mediated disorders including asthma/allergies and parasitic infections. In collaboration with Dr. Herbert, they have recently elucidated the mechanisms by which alternatively activated macrophages prevent the cachexia, neutrophilia, and endotoxemia associated with acute schistosomiasis. Specifically, they showed that a product of alternatively activated macrophages, arginase I protects the host against excessive intestinal injury caused by worm eggs by shifting the immune response from an inflammatory response (IL-12p40) towards an anti-inflammatory response (TGF-B) in the gut (Journal of Immunology, 2009). As *Schistosoma mansoni* currently infects 207 million people worldwide, identification of arginase 1, as a factor that may prevent the

extensive tissue damage associated with this parasitic infection, is an important step in prevention of the morbidity associated with this widespread parasitic infection. Dr. Finkelman received a great honor this year by being named as Treasurer of the Federation of American Societies for Experimental Biology (FASEB).

Lee Grimes, Ph.D.

Dr. Lee Grimes studies the regulation of transcriptional circuits whose dysregulation leads to autoimmunity, neutropenia and leukemia. He and his collaborators have elucidated the mechanistic links between the most frequently mutated gene in severe congenital neutropenia patients (neutrophil elastase) and the Growth factor independent-1 transcription factor (Gfi1). They found that these proteins physically interact through a novel bridging molecule, PFAA55. Interestingly, inhibition of the bridging molecule results in the impairment of the interaction between neutrophil elastase and Gfi1 and disrupts the transcriptional program under Gfi1's control resulting in impaired neutrophil differentiation and proliferation (Mol. Cell Biol, 2009). In collaboration with colleagues in Canada, he has also identified a novel role for Gfi1 in suppressing endotoxin-induced septic shock. Specifically, GfI1 null mice display abnormal macrophage activation leading to the over production of the pro-inflammatory cytokine TNF-a. The mechanism by which Gfi1 suppresses endotoxin-induced inflammation is by binding to the LPS-induced transcription factor, NF-kB, and preventing it from upregulating TNF-a gene expression. Thus, without Gfi1, macrophages have abnormal NF-kB activity, resulting in TNF-a-mediated inflammation (Mol. Cell Biol., 2010). Future work will focus on how to harness Gfi1's ability to control the inflammatory process more broadly.

Jochen Mattner, M.D.

Jochen Mattner, M.D., studies the molecular mechanisms of primary biliary cirrhosis. He has recently illustrated how the common gut bacterium Novosphingobium triggers autoimmune liver disease in mice. Specifically, they showed how the bacterium, due to its unique cell wall antigens, activates NKT cells that provide help for autoreactive B cells. When extended to humans, these findings imply that straightforward antibiotic treatment might prevent or halt the autoimmune process in genetically susceptible individuals. Currently, the laboratory is studying the role of genetic susceptibility factors that may lead to susceptibility to the induction and progression of autoimmune liver disease in response to this bacterial infection.

Marsha Wills-Karp, Ph.D.

Dr. Wills-Karp and her laboratory study the immunopathogenesis of asthma. They have recently identified a novel link between the ancient innate immune mediator, C5a, and a newly identified subset of CD4+ T cells referred to as Th17 cells. Specifically, they demonstrated that the anaphylatoxin, C5a, suppresses the activation of the IL-23/Th17 axis and that dysregulation of this factor leads to the development of a severe form of asthma. This work represents a paradigm shift in our understanding of the role of this innate immune mediator in disease states. As such this work has been accepted for publication in *Nature Immunology*. The identification of this link between the anaphylatoxins and the Th17 arm of the immune response has implications beyond asthma in that several autoimmune diseases such as arthritis, and lupus have previously been shown to be associated with both complement deficiencies and overzealous Th17-mediated immune responses. These results support the development of therapies aimed at modulating complement activation factors in immune diseases. J Immunol. 2009 Aug 15;183(4):2312-20.

Division Collaboration

Collaboration with Allergy/Immunology

Collaborating Faculty: Simon Hogan, Ph.D.

Dr. Finkelman, in collaboration with Dr. Hogan in the Allergy and Immunology Division, demonstrated that mast cells regulate homeostatic intestinal epithelial migration and barrier function by a chymase/Mcpt4-dependent mechanism. (Proc Natl Acad Sci U S A., 2009).

Collaboration with University of Cincinnati College of Medicine

Collaborating Faculty: Charles Caldwell, Ph.D.

Dr. Hildeman collaborated with Drs. Caldwell and Hotchkiss at the University of Cincinnati College of Medicine to demonstrate that a particular T cell-derived cytokines, IL-7, can improve the survival in models of sepsis. This finding may lead to the development of therapeutic strategies to greatly improve survival of septic patients.

Collaboration with National Institutes of Health

Collaborating Faculty: Eirini Manoli, M.D., Ph.D.

Dr. Jordan has collaborated with Dr. Manoli from the National Institute of Health to show that Chediak-Higashi syndrome associated with early developmental delay, results from paternal heterodisomy of chromosome 1. Unmasking of a separate autosomal recessive cause of developmental delay, or an additive effect of the paternal heterodisomy, may explain severe forms of the disease (Am J Med Genet A., 2010).

Collaboration with Hematology/Oncology

Collaborating Faculty: Lisa Filipovich, M.D. and Rebecca Marsh, M.D.

In collaboration with Drs. Filipovich and Marsh in the Division of Hematology/Oncology, Dr. Jordan demonstrated that although XIAP deficiency caused by BIRC4 mutations, has been thought to cause X-linked lymphoproliferative disease (XLP) phenotypes, it is more appropriately classified as X-linked familial hemophagocytic lymphohistiocytosis (Blood, 2010).

Collaboration with Experimental Hematology

Collaborating Faculty: Yi Zheng, Ph.D.

Dr. Grimes, in collaboration with Dr. Zheng in the Division of Experimental Hematology showed that Rho GTPase Cdc42 is

essential for B-lymphocyte development and activation. (Blood, 2009).

Collaboration with Critical Care Medicine

Collaborating Faculty: Kristen Page, M.D.

Dr. Wills-Karp, in collaboration with Dr. Page in the Division of Critical Care Medicine, determined that cockroach antigens initiate immune responses in the lung via activation of the protease-activated 2 receptor in the airway epithelium. This observation suggests that targeting the PAR-2 may be an effective approach to preventing sensitization to these common household allergens (Resp. Res, 2010).

Collaboration with Johns Hopkins University

Collaborating Faculty: Estelle Gauda, M.D. and Gregorio Valdez, Ph.D.

Dr. Wills-Karp in collaboration with colleagues at Johns Hopkins University, Dr. Gauda and Valdez, have shown that caffeine treatment for apnea of prematurity is associated with enhanced production of proinflammatory cytokines in a cohort of preterm infants. These findings may explain the susceptibility of premature infants to inflammation-mediated tissue damage and suggests that other means of ventilatory stimulation should be utilized instead of caffeine. (J Pediatrics, 2010).

Collaboration with Neonatology

Collaborating Faculty: Jeffrey Whitsett, M.D.

Dr. Wills-Karp collaborated with Dr. Whitsett in the Division of Neonatology to demonstrate that the expression of the transcription factor, Foxa2, in the airway epithelium programs Th2 cell-mediated innate immunity in the developing lung through regulating the recruitment and activation of myeloid dendritic cells and Th2 cells in the lung (J Immunol., 2010). This study represents a major advance in our understanding of the origin of a number of respiratory inflammatory diseases (CF, asthma, pulmonary fibrosis).

Collaboration with

Collaborating Faculty:

The Mediator and Cytokine Measurement Core run by the Division of Immunobiology has provided measurements of various biological mediators for numerous investigators at CCHMC (Gastroenterology, Experimental Hematology, Asthma Research, Infectious Disease, Developmental Biology, Molecular Cardiovascular Biology, Molecular Immunology, Allergy/Immunology, Psychiatry, Healthworks, Neonatology and Pulmonary Biology, Adolescent Gynecology) and other institutions (Johns Hopkins University), UCCOM (Internal Medicine,-Infectious Diseases, Neurology, Environmental Health Sciences, Physiology, Surgery, Rheumatology, Pathology, Psychiatry), and Wright State University. We have recently partnered with the Center for Digestive Diseases to offer cytokine/mediator measurements to their members at a reduced cost.

Faculty Members

Marsha Wills-Karp, PhD, Professor ; *Division Director; Director of Immunobiology Graduate Program; Associate Dean for Basic Science and Special Projects - UCCOM; Rieveichl Professor of Pediatrics*
Research Interests: Immunopathogenesis of asthma

Fred Finkelman, MD, Professor ; *McDonald Professor, UC Department of Internal Medicine, Division of Rheumatology and Immunology*
Research Interests: Allergy/Asthma, Intestinal Parasites

H. Leighton Grimes, PhD, Associate Professor ; *Scholar, Leukemia and Lymphoma Society; Director Cancer Pathology Program*
Research Interests: Leukemia/Lymphoma

David A. Hildeman, PhD, Associate Professor ; *Associate Director, Immunobiology Graduate Program*
Research Interests: T-cell Biology

Michael B. Jordan, MD, Assistant Professor
Research Interests: Childhood Immunodeficiency Diseases

Jochen Mattner, MD, Assistant Professor
Research Interests: Autoimmune Liver Diseases

De'Broski Herbert, PhD, Assistant Professor
Research Interests: Inflammatory Bowel Diseases/Intestinal Parasitic Infections

Joint Appointment Faculty Members

Eman Al-Khadra, MD, Assistant Professor
Critical Care Medicine

Kristen Page, PhD, Associate Professor
Critical Care Medicine

Trainees

- **Pulak Tripathi, PhD,** PGY-7, Markey Cancer Center, University of Kentucky, Lexington, Kentucky
- **Vanessa Saunders, BS,** GS-7, Fisk University, Nashville, Tennessee
- **Marat Khodoun, PhD,** PGY-6, National Research Institute of Biotechnology, Moscow, Russia
- **Ian Lewkowich, PhD,** PGY-6, University of Manitoba, Winnipeg Manitoba, Canada
- **Erin Zoller, BS,** GS-6, University of Virginia, Charlottesville, Virginia
- **Chinavenmeni Velu, PhD,** PGY-5, Texas Tech University Medical Center, Amarillo, Texas
- **James Phelan, BS,** GS-5, The Ohio State University, Columbus, Ohio
- **Stephane Lajoie, PhD,** PGY-2, McGill University, Canada
- **Sema Kurtulus, BS,** GS-4, Sabanci University, Istanbul, Turkey
- **Aditya Chaubey, PhD,** PGY-3, Clemson University, Clemson, South Carolina
- **Yuzaburo Inoue, MD/PhD,** PGY-3, Chiba University, Chiba, Japan
- **Theodore Johnson, MD,** PGY-3, Medical College of Georgia, Augusta, Georgia
- **Yusuke Suzuki, PhD,** PGY-3, Kelo University, Tokyo, Japan
- **Robert Thacker, PhD,** PGY-3, The University of Cincinnati, Cincinnati, Ohio
- **Mark Webb, BS,** GS-3, Brigham Young University, Provo, Utah
- **Catherine Hair, BS,** GS-2, Asbury College, Wilmore, Kentucky
- **Stacey Burgess, BS,** GS-2, Marietta College, Marietta, Ohio
- **Jana Raynor, BS,** GS-2, North Georgia College and State University, Dahlonega, Georgia
- **Naina Gour, BS,** GS-2, University of Delhi, Delhi, India
- **Sara Stoffers, BS,** GS-3, University Central Florida, Orlando, Florida
- **Andrew Lindsley, MD/PhD,** PGY-4, Indiana University, Indianapolis, Indiana
- **Brian Ladle, MD/PhD,** PGY-4, Johns Hopkins University
- **Supriya Pokkali, PhD,** PGY-2, Tuberculosis Research Center, Chennai, India

Significant Accomplishments

Doing battle against hookworms

Intestinal parasites known as hookworms infect an estimated 1.3 billion people worldwide. The parasites can affect growth and mental development and can cause congestive heart disease. Debroski Herbert, PhD, and Fred Finkelman, MD, are studying a novel method for preventing these infections.

Herbert's lab focuses on the role of macrophages in the pathogenesis of inflammatory gut disorders such as colitis and parasitic helminth infection. Herbert and Finkelman have identified a novel mechanism, published in 2009 in the *Journal of Experimental Medicine*, by which T helper 2 cytokines protect against intestinal worm infections. In particular, the cytokines IL-13 and IL-4 induce the differentiation of normal gut epithelium into goblet cells, which then secrete RELM-b. Once produced, RELM-b prevents hookworms from obtaining nutrients from the host gut epithelium. As a result, they starve and are expelled by the host. These insights may lead to new therapies with potential major impact on global health.

Exploring a new weapon against sepsis

David Hildeman, PhD, studies the molecular mechanisms regulating the development and maintenance of T cell memory. He has recently discovered that the transcription factor STAT5 is critical for cytokine-driven survival in T cells by elevating the pro-survival molecule Bcl-2. Further, he and his collaborators have recently reported in the Journal of Immunology that a T cell survival cytokine, IL-7, could prevent mortality in a mouse model of sepsis. The research team is exploring the potential utility of IL-7 delivery in the treatment of sepsis.

Novel HLH clinical trial begins

Michael Jordan, MD, has been studying how the immune response regulates itself and how things go wrong when this mechanism is broken, as it is in children with certain types on immune deficiencies. As part of this endeavor, the Jordan lab has translated some of their laboratory findings into a unique clinical trial for children with Hemophagocytic Lymphohistiocytosis (HLH). This trial, now open at Cincinnati Children's, is the first ever initiated by a U.S. investigator to treat HLH. It seeks to test a novel hybrid approach for treating HLH, combining specific immunosuppression and chemotherapy. Results are expected within two to three years

Division Publications

1. Barnes MJ, Aksoylar H, Krebs P, Bourdeau T, Arnold CN, Xia Y, Khovananth K, Engel I, Sovath S, Lampe K, Laws E, Saunders A, Butcher GW, Kronenberg M, Steinbrecher K, Hildeman D, Grimes HL, Beutler B, Hoebe K. Loss of T cell and B cell quiescence precedes the onset of microbial flora-dependent wasting disease and intestinal inflammation in Gimap5-deficient mice. *J Immunol.* 2010; 184: 3743-54.
2. Steinbrecher KA, Horowitz NA, Blevins EA, Barney KA, Shaw MA, Harmel-Laws E, Finkelman FD, Flick MJ, Pinkerton MD, Talmage KE, Kombrinck KW, Witte DP, Palumbo JS. Colitis-associated cancer is dependent on the interplay between the hemostatic and inflammatory systems and supported by integrin alpha(M)beta(2) engagement of fibrinogen. *Cancer Res.* 2010; 70: 2634-43.
3. Unsinger J, McGlynn M, Kasten KR, Hoekzema AS, Watanabe E, Muenzer JT, McDonough JS, Tschoep J, Ferguson TA, McDunn JE, Morre M, Hildeman DA, Caldwell CC, Hotchkiss RS. IL-7 promotes T cell viability, trafficking, and functionality and improves survival in sepsis. *J Immunol.* 2010; 184: 3768-79.
4. Morales-Tirado V, Sojka DK, Katzman SD, Lazarski CA, Finkelman FD, Urban JF, Fowell DJ. Critical requirement for the Wiskott-Aldrich syndrome protein in Th2 effector function. *Blood.* 2010; 115: 3498-507.
5. Finkelman FD, Boyce JA, Vercelli D, Rothenberg ME. Key advances in mechanisms of asthma, allergy, and immunology in 2009. *J Allergy Clin Immunol.* 2010; 125: 312-8.
6. Osterfeld H, Ahrens R, Strait R, Finkelman FD, Renauld JC, Hogan SP. Differential roles for the IL-9/IL-9 receptor alpha-chain pathway in systemic and oral antigen-induced anaphylaxis. *J Allergy Clin Immunol.* 2010; 125: 469-476 e2.
7. Finkelman FD, Hogan SP, Hershey GK, Rothenberg ME, Wills-Karp M. Importance of cytokines in murine allergic airway disease and human asthma. *J Immunol.* 2010; 184: 1663-74.
8. Lykens JE, Terrell CE, Zoller EE, Divanovic S, Trompette A, Karp CL, Aliberti J, Flick MJ, Jordan MB. Mice with a selective impairment of IFN-gamma signaling in macrophage lineage cells demonstrate the critical role of IFN-gamma-activated macrophages for the control of protozoan parasitic infections in vivo. *J Immunol.* 2010; 184: 877-85.
9. Manoli I, Golas G, Westbroek W, Vilboux T, Markello TC, Introne W, Maynard D, Pederson B, Tsilou E, Jordan MB, Hart PS, White JG, Gahl WA, Huizing M. Chediak-Higashi syndrome with early developmental delay resulting from paternal heterodisomy of chromosome 1. *Am J Med Genet A.* 2010; 152A: 1474-83.
10. Chen G, Wan H, Luo F, Zhang L, Xu Y, Lewkowich I, Wills-Karp M, Whitsett JA. Foxa2 programs Th2 cell-mediated innate immunity in the developing lung. *J Immunol.* 2010; 184: 6133-41.
11. Herbert DR, Orekov T, Roloson A, Ilies M, Perkins C, O'Brien W, Cederbaum S, Christianson DW, Zimmermann N, Rothenberg ME, Finkelman FD. Arginase I suppresses IL-12/IL-23p40-driven intestinal inflammation during acute schistosomiasis. *J Immunol.* 2010; 184: 6438-46.
12. Wills-Karp M, Nathan A, Page K, Karp CL. New insights into innate immune mechanisms underlying allergenicity. *Mucosal Immunol.* 2010; 3: 104-10.
13. Page K, Ledford JR, Zhou P, Dienger K, Wills-Karp M. Mucosal sensitization to German cockroach involves protease-activated receptor-2. *Respir Res.* 2010; 11: 62.
14. Saunders V, Breysse P, Clark J, Sproles A, Davila M, Wills-Karp M. Particulate matter-induced airway hyperresponsiveness is lymphocyte dependent. *Environ Health Perspect.* 2010; 118: 640-6.
15. Salipante SJ, Rojas ME, Korkmaz B, Duan Z, Wechsler J, Benson KF, Person RE, Grimes HL, Horwitz MS. Contributions to neutropenia from PFAAP5 (N4BP2L2), a novel protein mediating transcriptional repressor cooperation between Gfi1 and neutrophil elastase. *Mol Cell Biol.* 2009; 29: 4394-405.
16. Madan R, Demircik F, Surianarayanan S, Allen JL, Divanovic S, Trompette A, Yogev N, Gu Y, Khodoun M, Hildeman D, Boespflug N, Fogolin MB, Grobe L, Greweling M, Finkelman FD, Cardin R, Mohrs M, Muller W, Waisman A, Roers A, Karp CL. Nonredundant roles for B cell-derived IL-10 in immune counter-regulation. *J Immunol.* 2009; 183: 2312-20.
17. O'Connell AE, Kerepesi LA, Vandergrift GL, Herbert DR, TJ VANW, Hooper DC, Pearce EJ, Abraham D. IL-4(-/-) mice with lethal Mesocestoides corti infections--reduced Th2 cytokines and alternatively activated macrophages. *Parasite Immunol.* 2009; 31: 741-9.
18. Chen W, Sivaprasad U, Tabata Y, Gibson AM, Stier MT, Finkelman FD, Hershey GK. IL-13R alpha 2 membrane and soluble isoforms differ in humans and mice. *J Immunol.* 2009; 183: 7870-6.
19. Herbert DR, Yang JQ, Hogan SP, Groschwitz K, Khodoun M, Munitz A, Orekov T, Perkins C, Wang Q, Brombacher

F, Urban JF, Jr., Rothenberg ME, Finkelman FD. Intestinal epithelial cell secretion of RELM-beta protects against gastrointestinal worm infection. *J Exp Med.* 2009; 206: 2947-57.

20. Groschwitz KR, Ahrens R, Osterfeld H, Gurish MF, Han X, Abrink M, Finkelman FD, Pejler G, Hogan SP. Mast cells regulate homeostatic intestinal epithelial migration and barrier function by a chymase/Mcpt4-dependent mechanism. *Proc Natl Acad Sci U S A.* 2009; 106: 22381-6.
21. Marsh RA, Villanueva J, Kim MO, Zhang K, Marmer D, Risma KA, Jordan MB, Bleesing JJ, Filipovich AH. Patients with X-linked lymphoproliferative disease due to BIRC4 mutation have normal invariant natural killer T-cell populations. *Clin Immunol.* 2009; 132: 116-23.
22. Mohammed JP, Mattner J. Autoimmune disease triggered by infection with alphaproteobacteria. *Expert Rev Clin Immunol.* 2009; 5: 369-379.
23. Jones TG, Hallgren J, Humbles A, Burwell T, Finkelman FD, Alcaide P, Austen KF, Gurish MF. Antigen-induced increases in pulmonary mast cell progenitor numbers depend on IL-9 and CD1d-restricted NKT cells. *J Immunol.* 2009; 183: 5251-60.
24. Arumugam PI, Urbinati F, Velu CS, Higashimoto T, Grimes HL, Malik P. The 3' region of the chicken hypersensitive site-4 insulator has properties similar to its core and is required for full insulator activity. *PLoS One.* 2009; 4: e6995.
25. Lin AA, Tripathi PK, Sholl A, Jordan MB, Hildeman DA. Gamma interferon signaling in macrophage lineage cells regulates central nervous system inflammation and chemokine production. *J Virol.* 2009; 83: 8604-15.
26. Marsh RA, Villanueva J, Zhang K, Snow AL, Su HC, Madden L, Mody R, Kitchen B, Marmer D, Jordan MB, Risma KA, Filipovich AH, Bleesing JJ. A rapid flow cytometric screening test for X-linked lymphoproliferative disease due to XIAP deficiency. *Cytometry B Clin Cytom.* 2009; 76: 334-44.
27. Nieuwenhuizen N, Herbert DR, Brombacher F, Lopata AL. Differential requirements for interleukin (IL)-4 and IL-13 in protein contact dermatitis induced by Anisakis. *Allergy.* 2009; 64: 1309-18.
28. Page K, Ledford JR, Zhou P, Wills-Karp M. A TLR2 agonist in German cockroach frass activates MMP-9 release and is protective against allergic inflammation in mice. *J Immunol.* 2009; 183: 3400-8.

Grants, Contracts, and Industry Agreements

Grant and Contract Awards		Annual Direct / Project Period Direct
Finkelman, F		
Direct IL-4 and IL-13 Effects on Pulmonary Smooth Muscle in Allergic Airway Disease National Institutes of Health R01 HL 097360	09/01/09 - 08/31/11	$312,500 / $625,000
Grimes, H		
The Molecular Basis of Acute Myeloid Leukemia The Leukemia and Lymphoma Society	10/01/2005 - 06/30/2010	$105,000 / $498,750
Epigenetic Manipulation of Leukemia Alex's Lemonade Stand Foundation	07/01/2009 - 06/30/2011	$99,853 / $200,000
Epigenetic Manipulation of Leukemia National Institutes of Health R21 CA 142601	07/01/2009 - 06/30/2011	$139,714 / $249,714
Molecular Mechanism of Severe Congenital Neutropenia National Institute of Health R01 HL 079574	07/01/2009 - 06/30/2011	$79,314 / $158,628
Hildeman, D		
Homeostasis and Function of Regulatory T Cells In Aging National Institutes of Health R01 AG033057	09/15/2009 - 08/31/2011	$138,584 / $277,168

Transforming Growth Factor Beta in T-Cell Homeostasis and Tolerance
Arizona Board of Regents (National Institutes of Health)
R01 AI 067903 03/01/2007 - 02/28/2011 $21,733 / $83,449

Regulation of Apoptosis in Activated Primary T Cells
National Institutes of Health
R01 AI 057753 12/01/2008 - 11/30/2013 $250,351 / $1,099,212

Mechanisms Underlying IL-7 Driven Protection from Polymicrobial Sepsis
University of Cincinnati
09/16/2009 - 09/15/2010 $7,500 / $7,500

Jordan, M

An Animal Model of Hemophagocytic Lymphohistiocytosis
National Institutes of Health
R01 HL 091769 08/10/2007 - 06/30/2012 $260,000 / $1,250,000

CD 8 T Cell Mediated Disruption of Blood Brain Tight Junction
University of Cincinnati (National Institutes of Health)
R01 NS 060881 08/01/2009 - 07/31/2014 $14,820 / $14,820

An Animal Model of Hemophagocytic Lymphohistiocytosis
National Institutes of Health
R01 HL 091769 07/01/2009 - 06/30/2011 $81,864 / $163,728

Mattner, J

Primary Biliary Cirrhosis: Molecular Genetics and Microbe
National Institutes of Health
R01 DK 084054 06/01/2009 - 05/31/2014 $250,000 / $1,025,000

Wills-Karp, M

Asthma Positional Candidate Genes in Mice and Humans
National Institutes of Health
R01 HL 067736 12/01/2005 - 11/30/2010 $485,500 / $1,221,000

Mechanism of PM Induced Dendrite Cell Activation
The Johns Hopkins University (National Institutes of Health)
P50 ES 015903 09/29/2007 - 06/30/2012 $218,394 / $660,250

Epithelial Regulation of Th2 Immune Responses in the Lung
National Institutes of Health
R01 AI 083315 08/20/2009 - 07/31/2014 $250,000 / $1,247,500

Epithelial Genes in Allergic Inflammation - Project #3
National Institute of Health
U19 AI 070235 09/15/06 - 08/31/11 $196,078 / $975,424

Epithelial Genes in Allergic Inflammation - Project #3
National Institute of Health
U19 AI 070235 08/13/09 - 08/31/11 $100,000 / $100,000

Digestive Health Center: Bench to Bedside Research in Pediatric Digestive Disease
National Institute of Health
P30 DK 078392 06/01/2010 - 05/31/2011 $50,000 / $50,000

Current Year Direct $3,061,205

Industry Contracts

Wills-Karp

Allertein Therapeutics $ 47,355

Current Year Direct Receipts **$47,355**

Funded Collaborative Efforts

Finkelman, F

Intestinal IL-9 Ans Mast Cells in Food-Induced Anaphylaxis
Food Allergy and Anaphylaxis Network
Hogan, S 02/02/09 - 01/31/11 3 %

IL-13 Associated Eosinophil Lung Responses
National Institutes of Health
Rothenberg, M 08/20/09 - 07/31/14 5 %

Grimes, H

IL-13 Associated Eosinophil Lung Responses
National Institutes of Health
Rothenberg, M 08/20/09 - 07/31/14 5 %

Total $3,108,560

Immunobiology Graduate Program

The Immunobiology Graduate Program is an inter-departmental program within the University of Cincinnati that offers PhD and MS degrees in Immunology. The Division of Immunobiology serves as the administrative home of the Graduate Program. The program is governed by the director Dr. Wills-Karp and Associate Director Dr. David Hildeman and a Steering Committee composed of members of several departments/divisions at CCHMC and UC. Dr. Jonathan Katz is the coordinator of the Foundations in Immunology Courses.

The Immunobiology Program provides broadly based instruction in immunology, along with rigorous research training that emphasizes modern approaches to understanding the function of the immune system in health and disease. To this end, the program currently has 45 faculty members from 4 departments and 12 divisions within the College of Medicine and CCHMC. We currently have 34 outstanding students from around the country and abroad. A major milestone achieved this year is the graduation of 5 Ph.D. students and 2 M.S. students. Our students have distinguished themselves already by receiving several travel and research awards (AAAI, Yates Scholarship Award and an NIH F30 Award).

The Program is supported financially by a variety of sources. This year, tuition support was provided through University Graduate Scholarships awarded by the University of Cincinnati. Student stipends were supported through a variety of sources including funds from the University of Cincinnati (UGA), NIH training grants, external grants to their advisors, and funds from Cincinnati Children's Research Foundation. The program anticipates sustained growth over the next few years with a target class size of 10 new students per year.

Immunobiology Graduate Program Students, 2009-2010

Student	Faculty Mentor	Admission Year
Jessica Allen	Christopher Karp	2004
Adora Lin	David Hildeman	2004
Vanessa Saunders	Marsha Wills-Karp	2004
Leah Kottyan	Nives Zimmermann	2005
Xun Zhang	Joerg Koehl	2005
Erin Zoller	Michael Jordan	2005
Katherine Groschwitz	Simon Hogan	2005
Erin Klenk	Robert Colbert	2006
James Phelan	H. Leighton Grimes	2006
Manuel Alvarez	Sherry Thornton	2006
Jill Fritz	Timothy Weaver	2006
Joni Prasad	Jay Degen	2006
Amanda Beichler	Simon Hogan	2007
Cortez McBerry	Julio Aliberti	2007
Rachael Mintz	Gurjit Hershey	2007
Sema Kurtulus	David Hildeman	2007
Ibrahim Aksoylar	Kasper Hoebe	2007
Stacey Burgess	Marsha Wills-Karp	2008
Samuel Vaughn	Thomas Griffin	2008
Isaac Harley	Christopher Karp	2008
Catherine Hair	Marsha Wills-Karp	2008
Jana Raynor	David Hildeman	2008
Stephanie Walters	Christopher Karp	2008
Sara Stoffers	H.Leighton Grimes	2008

Bo Liu	Yui-Hsi Wang	2008
Mark Webb	Marsha Wills-Karp	2008
Nick Boespflug	Christopher Karp	2009
Jordan Downey	Christopher Karp	2009
Naina Gour	Marsha Wills-Karp	2009
Jonathan McNally	Edith Janssen	2009
Maria Fields	Claire Chougnet	2009
Harini Raghu	Matthew Flick	2009
Akash Verma	George Deepe	2009
Yunguan Wang	Fred Finkelman	2009

Student Honors

Jessica L. Allen2009 - Society of Leukocyte Biology Travel Award Winner Tri-Society Annual Conference (SLB, ICS, ISICR), Lisbon, Portugal
2010 - Keystone Symposia Scholarship, The Macrophage: Intersection of Pathogenic and Protective Inflammation. Banff, Alberta
Maria E. Moreno-Fernandez2010 - Underrepresented Minority Scholarship. NIH, Office of AIDS Research. Keystone Symposia, Viral Immunity
Jill M. Fritz2007 - 2009 NIH Cardiovascular and Pulmonary Training Grant
Katherine R. Groschwitz2008 – 2010 NIH F30 DK082113 “Mast cell-mediated intestinal permeability”
Isaac T. W. Harley2008 - 2010 NIH Developmental and Perinatal Endocrinology Training Grant
Leah C. (Nesbitt) Kottyan2009 - Fellow in Training Travel Scholarship, American Academy of Allergy, Asthma and Immunology Annual Meeting
2009 - Graduate Student Research Fellowship, University of Cincinnati
Cortez C. McBerry2008 - 2012 Albert C. Yates Fellowship
Rachael A. Mintz-Cole2009 - Graduate Student Governance Association Competitive Research Award
2010 - Ruth L. Kirchstein National Research Service Award Individual Fellowship
James D. Phelan2010 - Outstanding Poster Award. Midwest Blood Club Symposium
Vanessa C. Saunders2009 – ST*AR (Strategic Training in Allergy Research) Program Recipient. American Academy of Allergy, Asthma and Immunology Annual Meeting
Amanda B. Waddell2009 - 2011 American Gastroenterological Association Foundation Graduate Student Award
Erin E. Zoller2009 - Honorable Mention, Graduate Student Research Forum Poster Competition. University of Cincinnati, College of Medicine. “System Activation of Macrophages by Interferon Gamma Rapidly Induces Severe Anemia and Hemophagocytosis via a Macropinocytic (-like) Process”

Student Publications

Halil I. Aksoylar (2007) Barnes, M., Aksoylar, H., Krebs, P., Bordeau, T., Arnold, C., Xia, Y., Khovananth, K., Engel, I., Sovath, S., Lampe, K., Laws, E., Saunders, A., Butcher, G., Kronenberg, M., Steinbrecher, K., Hildeman, D., Grimes, H., Beutler, B., Hoebe, K. Loss of T cell and B cell quiescence precedes the onset of microbial flora-dependent wasting disease and intestinal inflammation in Gimap5-deficient mice. J. Immunol (2010) 184:3743-54.

Jessica L. Allen (2004, Ph.D. 2010) Divanovic, S., Trompette, A., Petiniot, L., Allen, J., Flick, L., Belkaid, Y., Madan, R., Haky, J., Karp, C. Regulation of TLR4 signaling and the host interface with pathogens and danger: the role of RP105. J. Leukocyte Biol. (2007) 82:265-271.
Madan, R., Demircik, F., Divanovic, S., Trompette, A., Allen, J., Gu, Y., Khoudon, M., Hildeman, D., Cardin, R., Finkelman, F., Mohrs, M., Muller, W., Roers, A., Waisman, A., Karp, C. Non-redundant counter-regulatory roles for B cell-derived IL-10. J. Immunol. (2009) 183:2312-20.
Nicholas D. Boespflug (2009) Madan, R., Demircik, F., Surianarayana, S., Allen, J., Divanovic, D., Trompette, A., Yogev, N., Gu, Y., Khodoun, M., Hildeman, D., Boespflug, N., Fogolin, ,M., Grobe, L., Greweling, M., Finkelman, F., Cardin, R., Mohrs, M., Muller, W., Waisman, A., Roers, A., Karp, C. Non-redundant roles for B cell-derived IL-10 in immune counter-regulation. J. Immunology (2009) 183:2312 -2320.
Maria E. Moreno-Fernandez (2009) Presicce, P., Moreno-Fernandez M., Lages, C., Orsborn, K., Chougnet C. Association of two clones allows for optimal detection of human FOXP3. Cytometry A. (2010) 77(6):571-9.
Naina Gour (2009) Janssen, E., Lemmens, E., Gour, N., Reboulet, R., Green, D., Schoenberger, S., Pinkoski, M. Distinct roles of cytolytic effector molecules for antigen-restricted killing by CTL in vivo. Immunology and Cell Biology (2010) (in press).
Katherine R. Groschwitz (2005) Han, X., Ren X, Jurickova, I., Groschwitz, K., Pasternak, B., Xu, H., Wilson, T., Hogan, S., Denson, L. Regulation of intestinal barrier function by signal transducers and activators of transcription 5b. Gut. (2009) 58(1):49-58.
Groschwitz, K., Hogan, S. Intestinal barrier function: molecular regulation and disease pathogenesis. Journal of Allergy and Clinical Immunology (2009) 124(1):3-20.
Herbert, D., Yang, J., Hogan, S., Groschwitz, K., Khodoun, M., Munitz, A., Orekov, T., Perkins, C., Wang, Q., Brombacher, F., Urban, J. Jr., Rothenberg, M., Finkelman, F. Intestinal epithelial cell secretion of RELMβ protects against gastrointestinal worm infection. Journal of Experimental Medicine (2009) 206(13):2947-57.
Groschwitz, K., Ahrens, R., Osterfeld, H., Gurish, M., Han, X., Abrink, M., Finkelman, F., Pejler, G., Hogan, S. Mast cells regulate homeostatic intestinal epithelial migration and barrier function by a chymase/Mcpt4-dependent mechanism. Proceedings of the National Academy Science (2009) 106(52):22381-6.

Isaac T. W. Harley (2008) Gu, Y., Harley, I., Henderson, L., Aronow, B., Vietor, I., Huber, L., Harley, J., Kilpatrick, J., Langefeld, C., Williams, A., Jegga, A., Chen, J., Wills-Karp, M., Arshad, S., Ewart, S., Thio, C., Flick, L., Filippi, M., Grimes, H., Drumm, M., Cutting, G., Knowles, M., Karp, C. Identification of IFRD1 as a modifier gene for cystic fibrosis lung disease. Nature (2009) 458:1039-1042.
Erin I. Klenk (2006, M.S. 2009) DeLay, M., Turner, M., Klenk, E., Smith, J., Witte, D., Sowders, D., Colbert, R. HLA-B27. Misfolding and the unfolded protein response augment IL-23 production and are associated with Th17 activation in transgenic rats. Arthritis Rheum. (2009) 60(9):2633-43.
Colbert, R., DeLay, M., Klenk, E., Layh-Schmitt, G. From HLA-B27 to spondyloarthritis: a journey through the ER. Immunol Rev. (2010) 233(1): 181-202.
Leah C. (Nesbitt) Kottyan (2005) Kottyan, L., Cao, K., Niese, K., Hedgebeth, M., Caius, Radu, C., Witte, O., Hershey, G., Rothenberg, M., Zimmermann, N. Eosinophil viability is increased by acidic pH in a cAMP- and GPR65- dependent manner. Blood (2009) 114(13), 2774-2782.
Sema Kurtulus (2007) Guimond, M., Veenstra, R., Grindler, D., Zhang, H., Cui, Y., Murphy, R., Kim, S., Na, R., Hennighausen, L., Kurtulus, S., Erman, B., Matzinger, P., Merchant, M., Mackall, C. Interleukin 7 signaling in dendritic cells regulates the homeostatic proliferation and niche size of CD4+ T cells. Nat Immunol. (2009) 10(2):149-57.
Kurtulus, S., Tripathi, P., Opferman, J., Hildeman, D. Contracting the “mus cells” - does down-sizing suit us for diving into the memory pool? Immunological Reviews (2010) 236:54-67.
Tripathi, P., Kurtulus, S., Wojciechowski, S., Sholl, A., Hoebe, K., Morris, S., Finkelman, F., Grimes, H., Hildeman, D. Stat5 is critical to maintain effector CD8+ T cell responses. J. Immunol. (2010) (in press).
Adora A. Lin (2004, Ph.D. 2009) Lin, A., Wojciechowski, S., Hildeman, D. Androgens suppress antigen-specific T cell responses and IFN-□ during intracranial LCMV infection. J Neuroimmunol. (2010) (in press).
Lin, A., Tripathi, P., Sholl, A., Jordan, M., Hildeman, D. Gamma interferon signaling in macrophage lineage cells regulates central nervous system inflammation and chemokine production. J. Virol (2009) 83(17):8604-8615.

Rachael A. Mintz-Cole (2007) Wise-Draper, T., Morris, T., Mintz-Cole, R. A., Wikenheiser-Brokamp, K., Currier, M., Cripe, T., Grosveld, G., Wells, S. Overexpression of the cellular DEK protein promotes epithelial transformation in vitro and in vivo. Cancer Res. (2009) 1;69(5):1792-9.
James D. Phelan (2006) Phelan, J., Cook, T., Gebelein, B., Shroyer, N., Grimes, H. Gfi1 - cells and circuits: unraveling transcriptional networks of development and disease. Curr Opin Hematol (2010) 17(4):300-307.
Vanessa C. Saunders (2004, Ph.D. 2010) Saunders, V., Breysse, P., Clark, J., Sproles, A., Davila, M., Wills-Karp, M. Particulate matter induced airway hyperresponsiveness is lymphocyte dependent. Environ Health Perspect. (2010) 118(5):640-6.
Joni M. (Ullman) Prasad (2006) Mullins, E., Kombrinck, K., Talmage, K., Shaw, M., Witte, D., Ullman (Prasad), J., Degen, S., Sun, W., Flick, M., Degen, J. “Genetic elimination of prothrombin in adult mice is not compatible with survival and results in spontaneous hemorrhagic events in both heart and brain.” Blood (2009) 15;113(3):696-704.
Erin E. Zoller (2005) Lykens, J., Terrell, C., Zoller, E., Divanovic, S., Trompette, A., Karp, C., Aliberti, J., Flick, M., Jordan, M. “Mice with a selective impairment of IFN-gamma signaling in macrophage lineage cells demonstrate the critical role of IFN-gamma-activated macrophages for the control of protozoan parasitic infections in vivo.” J Immunol. (2010) 184(2):877-85.
Xun Zhang (2005, Ph.D. 2009) Zhang, X., Lewkowich, I., Köhl, G., Clark, J., Wills-Karp, M., Köhl, J. A protective role for C5a in the development of allergic asthma associated with altered levels of B7-H1 and B7-DC on plasmacytoid dendritic cells. J. Immunol. (2009) 182:5123–5130.
Zhang, X, Köhl, J. A complex role for complement in allergic asthma. Clin. Immunol. (2010) 6(2):269-77.

Student Presentations

Oral Presentations

Catherine M. Buckingham (2008)
Buckingham, C., Lewkowich, I., Dienger, K., Gerwin, A., Wills-Karp, M. PD-1 independent co-stimulatory role for B7-DC in experimental asthma. Autumn Immunology Conference, Chicago, IL 2009

Katherine R. Groschwitz (2005)
Groschwitz, K., Ahrens, R., Osterfeld, H., Finkelman, F., Rothenberg, M., Abrink, M., Pejler, G., Hogan, S. Mast cell chymase regulates homeostatic intestinal barrier function. American Academy of Allergy, Asthma and Immunology, Washington DC, 2009
Sema Kurtulus (2007)
Kurtulus, S. ‘Bcl-2 maintains KLRG1low CD127high effector and central memory CD8+ T cells by distinct mechanisms’. The American Association of Immunologists, Baltimore, MD 2010
Rachael A. Mintz-Cole (2007)
Mintz-Cole, R., Gibson, A., Reponen, T., Hershey, G. Different mold species induce distinct inflammatory responses in the lungs. Autumn Immunology Conference, Chicago, IL 2009
Mark L. Webb (2008)
Webb, M., Nathan, A., Dienger, K., Wu, D., Wills-Karp, M. House dust mite-induced CCL20 release from bronchial epithelial cells is chloride dependent. Autumn Immunology Conference, Chicago, IL 2009
Erin E. Zoller (2005)
Zoller, E., Lykens, J., Aliberti, J., Filipovich, L., Jordan, M. “Systemic activation of macrophages by interferon-gamma rapidly induces severe anemia and hemophagocytosis.” Federation of Clinical Immunology Societies Annual Meeting. Trainee Satellite Symposium, Boston, MA 2010

Poster Presentations

Jessica L. Allen (2004)
Allen, J., Divanovic, S., Rawlings, D., Finkelman, F., Karp, C. Inhibition by proxy: LPS-driven B cell responses in RP105-deficient mice. Tri-Society Annual Conference (SLB, ICS, ISICR), Lisbon, Portugal 2009
Allen, J., Divanovic, S., Rawlings, D., Finkelman, F., Karp, C. Regulation of TLR signaling by RP105 in myeloid cells and B cells: resolution of an apparent paradox. The Macrophage: Intersection of Pathogenic and Protective Inflammation, Banff, Alberta 2010
Isaac T. W. Harley (2008)
Harley, I., Walters, S., Divanovic, S., Karp, C. The role of Segmented Filamentous Bacteria in the development of diet-induced obesity. University of Cincinnati MD/PhD 25th Anniversary Celebration, Cincinnati, OH 2010
Harley, I., Walters, S., Divanovic, S., Karp, C. The role of segmented filamentous bacteria in the development of diet-induced obesity. University of Cincinnati MD/PhD Spring Retreat, Oxford, OH 2010

Leah C. (Nesbitt) Kottyan (2005)
Kottyan, L., Hedgebeth, M., Niese, K., Cao, K., Hildeman, D., Montrose, M., Rothenberg, M., Zimmermann, N. Eosinophils respond to acidic environments with cAMP production, decreased apoptosis, and a decrease in the expression of pro-apoptotic Bcl-2 family members. American Academy of Allergy, Asthma and Immunology, Washington, DC 2009
Cortez C. McBerry (2007)
McBerry, C., Dias, A., Aliberti, J. PD-1 drives IL-12 dependent immunity against toxoplasma gondii. 14th Annual Woods Hole Immunoparasitology Conference, Woods Hole, MA 2010
Rachael A. Mintz-Cole (2007)
Mintz-Cole, R., Gibson, A., Reponen, T., Hershey, G. Developing a model of mold-induced allergic airway disease. Environmental Health Sciences Fellows Showcase, University of Cincinnati College of Medicine, Cincinnati, OH 2009
Mintz-Cole, R., Gibson, A., Reponen, T., Hershey, G. Different mold species induce distinct inflammatory responses in the lungs. American Academy of Asthma, Allergy, and Immunology, New Orleans, LA 2010
Maria E. Moreno-Fernandez (2009)
Moreno-Fernandez, M., Rueda, C., Chougnet, C. Regulatory T cells control HIV replication in activated T cells through contact-dependent and independent pathways. Keystone Symposia on Molecular and Cellular Biology. Viral Immunity, Banff, Canada 2010
James D. Phelan (2006)
Chaubey, A., Velu, C., Horman, S., Phelan, J., Jegga, A., Guzman, M., Zeleznik-Le, N., Jordan, C., Carroll, M., Gebelein, B., Grimes, H. Epigenetic signaling is required for HoxA9-based leukemic transformation. American Society of Hematology Conference, New Orleans, LA 2009
Jana L. Raynor (2008)
Raynor, J., Lin, A., Sholl, A., Van Kaer, L., Mattner, J., Hoebe, K., Hildeman, D. A regulatory double negative - NKT and NK cell cross-talk regulates viral-specific CD4+ T cell responses. The American Association of Immunologists, Baltimore, MD 2010
Vanessa C. Saunders (2004)
Saunders, V., Dienger, K., Breysse, P., Wills-Karp, M. Ambient particulate matter-induced CCL20 production in airway epithelial cells is NADPH oxidase-dependent. American Academy of Allergy, Asthma and Immunology, Washington DC, 2009
Amanda B. Waddell (2007)
Waddell, A., Ahrens, R., Hogan, S. Resident “M2-like” intestinal macrophages express eotaxin-1 in colonic injury. Digestive Disease Week 2009
Mark L. Webb (2008)
Webb, M., Nathan, A., Dienger, K., Wu, D., Wills-Karp, M. House dust mite-induced CCL20 release from bronchial epithelial cells is chloride transporter dependent. American Thoracic Society, New Orleans, LA 2010