

# NEWSLETTER

## Stress and disease....a response to stress can promote a cascade of events underlying disease predisposition

Dr. **Tracy L. Bale** is an associate professor of neuroscience in the Department of Animal Biology and the director of the Neuroscience Center in the School of Veterinary Medicine (SOVM) and currently serves as the vice chair of the Neuroscience Graduate Group in the School of Medicine (SOM). Dr. Bale received her Ph.D in



pharmacology/neurobiology from the University of Washington in Seattle in 1997 where she specialized in neuroendocrinology, focusing on the central regulation of the oxytocin receptor. She then completed her postdoctoral training at the Salk Institute in La Jolla, California working with Dr. Wylie Vale on stress neuroendocrinology.

*continued on page 2*

### **COLIN PARRISH will give the MARSHAK LECTURE at ANNUAL FACULTY RESEARCH RETREAT**

**Colin Parrish, PhD.** is the John M. Olin Professor of Virology in the Baker Institute for Animal Health, College of Veterinary Medicine at Cornell University. The basic and applied work of his laboratory is concerned with the study of viral diseases of dogs and cats, concentrating on an analysis of parvoviruses of dogs, cats, raccoons, mink, and other carnivores, as well as studies to characterize the minute virus of canines. Dr. Parrish will deliver the **Marshak Lecture**

entitled “The emergence of new epidemic viruses by host shifting: mechanisms and the co-evolution of the viruses and their hosts” on Friday, June 10th at New Bolton Center, Kennett Square, Pennsylvania. Faculty are invited to register to attend and also to submit abstracts online at the School of Veterinary Medicine homepage: [www.vet.upenn.edu/](http://www.vet.upenn.edu/).

Penn Vet’s annual **Phi Zeta Student Research Day** was held on Thursday, March 31st in the Hill Pavilion. Faculty judges selected the following students as winners of the oral presentation and ‘best poster’ awards:

#### **VMD Oral Presentations**

First Place: Claire Wiley

Second: Hope Douglas

Third: John Litterine-Kaufman

#### **Dual Degree Oral Presentations**

First Place: Gregory Rak

Second: Brittany Gregory

Third: Irene Bukh

#### **Best Posters**

First Place: Megan Hays

Second: Stephen Artim

Third: Andrew Stas

There were a total of 41 abstracts presented as talks or in poster format. See Page 3.



*Stress & Disease continued....continued from Page 1*

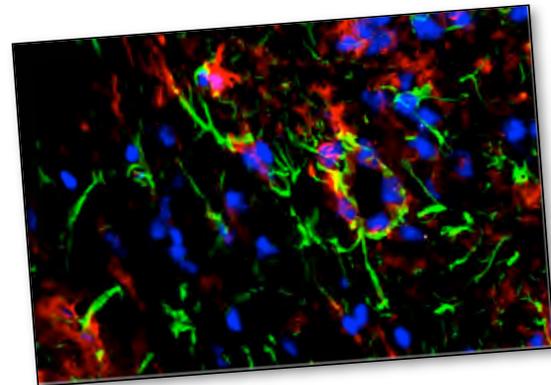
Dr. Bale joined Penn Vet in 2003, and was promoted to Associate Professor in 2009. Her research interests are centered on the role of stress dysregulation in disease, including the development of mouse models relevant to neuropsychiatric disease and obesity. Her lab currently focuses on the interaction of genes and the environment, assessing epigenetic mechanisms in disease programming.

developmental programming and maturation, and “sensitive periods” during which perturbations may be disruptive have not yet been identified. In addition, mental health disorders, including major depressive disorder, anxiety, and eating disorders affect 26.2% of American adults, and are currently the leading cause of disability in this country.

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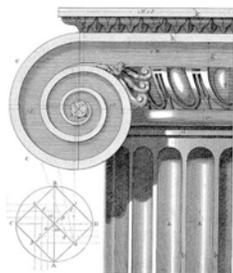
**Stress and Disease: Fighting the war on mental health**

Although stress has been linked to many disease states, stress does not cause disease. Rather, it is how we respond (or fail to respond) to stress that leads to disease predisposition. To further characterize the developmental and/or environmental factors that regulate our genes’ sensitivity to stress, the Bale lab focuses on developing models of disease utilizing both fetal antecedents and adult genetic mouse lines in which normal stress pathways have been disrupted. Such studies are of particular significance because stress pathway dysregulation is the most pervasive symptom in neuropsychiatric disease, yet we understand little about its



Massive increases in astrocytes and microglia in the serotonergic raphe nucleus in the brain following Toxoplasmosis infection. Long-term changes in stress responsivity were detected in these mice.

**BIOGRAPHICAL SKETCH MODIFIED IN NIH GRANT APPLICATION**



There is a modification of the **NIH Biosketch** beginning with applications submitted for the May 25,

2011 deadline and subsequent dates. Because information in the biosketch is factored into the overall merit and technical rating for each grant application, the NIH is recognizing that personal issues can affect career

advancement and productivity. These considerations have shaped the implementation of the Early Stage Investigator Policy. Such factors can occur at any point in a scientist’s career and include family care responsibilities, illness, disability, military service and other personal issues. This modification of the Biographical Sketch will permit Program Directors/Principal Investigators and other senior/key staff to describe personal circumstances that may have reduced product-ivity. Peer reviewers and others

will then have more complete information on which to base their assessment of qualifications and productivity relevant to the proposed role on the project. The new biosketch instructions will include a modification of the personal statement section to remind applicants that they can provide a description of personal issues that may have reduced productivity.

To read more go to:

[NOT-OD-11-045](#)

**FAMILY GRANT PROGRAM FOR PhD Students**

Provost Vincent Price and Vice Provost for Education Andrew Binns announced the creation of a Family Grant Program for PhD Students, which will provide need-based grants to Penn PhD students with children. For more information about Penn's resources for students with children, please visit: [www.gsc.upenn.edu/kids/resources.php](http://www.gsc.upenn.edu/kids/resources.php)



STUDENT RESEARCH DAY 2011

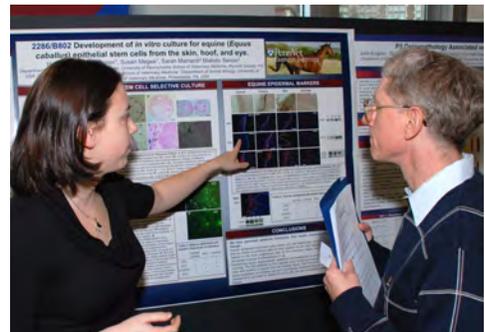
On Thursday afternoon, March 31, students, faculty, and alumni, enjoyed a full program of research presentations by selected VMD and VMD/PhD students and a keynote address by Kenneth Simpson, BVM&S, PhD, professor of medicine, and chief, Small Animal Medicine at the College of Veterinary Medicine of Cornell University. Dr. Simpson spoke on “host-bacterial interactions in the gastrointestinal tract: a cross species approach”. Claire Wiley’s (V’2013) presentation was on a “genome wide association study of protein losing nephropathy in Soft-coated Wheaten Terriers” (mentors M Littman and P Henthorn). Hope Douglas’ (V’2013) talk was entitled “an analysis of PARP1 activity and PARP1 inhibitors in equine peripheral blood mononuclear cells (mentors L Southwood and R Meyer). John Litterine-Kaufman (V’2013) spoke on “detecting mitochondrial oxidative damage towards a cellular model of myocardial infarction (mentor B Kaufman). Gregory Rak (V’2012) spoke on “NK cell lytic granule secretion through the actin network at the immunological synapse (mentor Jordan Orange). Brittany Gregory’s (V’2014) talk was on “regulation of gene expression by the



histone demethylase KDM4C (mentor Vivian Cheung) and Irene Bukh’s (V’2016) talk was on “understanding the immunological mechanisms for enhanced HIV-1 acquisition after adenoviral-based vector vaccination in the STEP study (mentor M Betts). A poster session complemented the program (see oral and ‘best’ poster awards on page 1).



Gregory Rak, Presenter



Sarah Mainardi & Dieter Schifferli



Igor Brodsky

**NEW FACULTY at PENN VET**

The Department of Pathobiology has welcomed **Igor Brodsky, PhD** as an assistant professor. Igor comes to Penn from Yale University, where he did his postdoctoral training in the laboratory of Ruslan Medzhitov. His research focuses on the interplay of bacterial virulence mechanisms and host innate immune recognition strategies. In particular, he is interested in understanding how bacterial pathogens are detected by host cells as well as strategies utilized by bacterial pathogens to evade innate immune recognition. **Christopher Lengner, PhD**, joined the Department of Animal Biology as an assistant professor in early February 2011. He was formerly with Rudolf Jaenisch's group at the Whitehead Institute and MIT. He is interested in the mechanisms by which both somatic and embryonic stem cells acquire and maintain developmental potency. His group is also exploring how deregulation of these mechanisms can contribute to oncogenic transformation and tumorigenesis, and how they can learn to manipulate these mechanisms for application in disease modeling and regenerative medicine. The Brodsky and Lengner laboratories are located on the third floor of Rosenthal in newly renovated space.



Christopher Lengner

**Center for Technology Transfer..... What is a provisional application?**

A provisional application allows the applicant to establish a filing date by "locking in" potential patent rights while the invention is further developed. It does not mature into an issued patent, and automatically expires one year after it is filed. A non-provisional application must be filed, claiming benefit of the provisional prior to its expiration. <http://www.ctt.upenn.edu>

*Stress & Disease continued*

Our current obesity epidemic affects over 30% of adults in most states, adding substantially to our health care costs. Despite these incredible statistics, treatment efficacy remains poor, likely due to our lack of understanding of disease etiology. Ultimately, disease onset is the intersection of an underlying vulnerability with the presentation of an insult. However, in mental health research, there has been an overwhelming focus on perturbations relating to disease onset while the predisposing factors remain virtually unknown. To address these issues, the Bale laboratory focuses on multiple lines of investigation that provide insight into the timing and sex specificity of early life events promoting disease susceptibility, the maturation of central pathways during key periods of development, and the epigenetic mechanisms involved in long-term effects following stress exposure.

**Stress and Neuropsychiatric Disorders** Maternal stress during pregnancy is strongly associated with an increased incidence of neurodevelopmental disorders, including depression, anxiety, schizophrenia, and autism. In studies funded by NIMH, the Bale lab provided the first insight into the temporal specificity of prenatal stress exposure in programming the long-term stress responsivity in offspring (Mueller and Bale, 2006, 2007, 2008). In determining the specific gestational window of vulnerability, they found that males exposed to stress very early

in gestation showed heightened stress responsivity, with increases in passive coping behaviors, exaggerated stress hormone responses to acute stress experiences, and increased sensitivity to acute antidepressant treatment. Utilizing bisulfite pyrosequencing of the stress genes, corticotropin releasing factor (CRF) and glucocorticoid receptor (GR), they found a correlation between DNA methylation patterns and gene expression levels in these stress-sensitive males, supporting an effect of early prenatal stress on programming of the epigenome. As most neurodevelopmental diseases present with a sex bias, the Bale laboratory next hypothesized that for gestational stress to have disparate effects on male and female fetuses in the same uterus, sex differences at the level of the placenta are likely involved. Analyses of genes important in growth, development and nutrient transport revealed profound sex-specific differences in stress responses. Current examination of these effects on a larger Array scale across stages of gestation and incorporating proteomic analyses in the amniotic fluid are in progress to identify potential translational biomarkers predictive of at-risk pregnancies, particularly for neurodevelopmental disorders such as autism and schizophrenia.

Dr. Bale's laboratory has further examined the potential heritability of the stress dysregulated phenotype – *can-affected fathers pass on the effect to their sons?* *continued on page 5*

**Research Event**

**11th Annual Herpesvirus Symposium**

When: Wednesday, June 8, 2011

Time: 8:30 AM

Where: BRB lobby & auditorium

Plenary Speakers:

Teresa Compton, PhD, Novartis Institutes of Biomedical Research

**Roselyn J. Eisenberg, PhD, University of Pennsylvania, Veterinary Medicine**

Paul R. Kinchington, PhD, University of Pittsburgh School of Medicine

Edward Mocarski, MD, PhD Emory University, Emory Vaccine Center

Domenico Tortorella, PhD, Mount Sinai School of Medicine.

Register on-line:

[www.uphs.upenn.edu/idd](http://www.uphs.upenn.edu/idd)

**Recent Publications**



Maternal High-Fat Diet Effects on Third-Generation Female Body Size via the Paternal Lineage. Dunn, G.A., and **Tracy Bale**. (2011).

*Endocrinology*. Mar 29. [Epub ahead of print]



Classification of Canine Malignant Lymphomas According to the World Health Organization Criteria (2011) Valli *et al* (**Amy Durham**) *Vet Pathol*

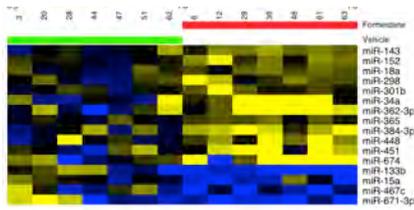
48: 198-211,



Ligand-stimulated downregulation of the alpha interferon receptor: role of protein kinase D2 (2011) Zheng, H, Qian J, Varghese B, Baker, DP, and **Serge Fuchs**

*Mol Cell Biol*. 31(4):710-20.

*Stress & Disease continued*



Robust changes in the brain miRNA environment following inhibition of brain masculinization at birth. Male mice given a single injection of Formestane, an aromatase inhibitor (red line), showed a dramatic change from control males (green line) in miRNA expression levels.

Indeed, their studies found that second generation male offspring exhibit the same pattern of heightened stress sensitivity and reduced learning and memory performance as their fathers. These results are intriguing as they point to prenatal stress programming of the epigenome. In additional studies elucidating prenatal stress-induced changes in the microRNA environment, they have also identified alterations in several developmentally important miRs and their target genes in second generation male brains. Future studies in the Bale laboratory hope to identify epigenetic mechanisms in the male germline that are contributing to these heritable traits.

Finally, clinical studies reveal that stress experiences in adulthood are strongly associated with onset of depression, again supporting an intersection between genetic vulnerability and perturbation in disease etiology. In studies funded by NIMH, Dr. Bale's laboratory has utilized a genetic mouse model of increased stress sensitivity to identify specific molecular and biochemical markers that may predict 'inappropriate' stress responses. Their studies found that

these mice failed to upregulate anti-apoptotic genes during chronic periods of stress specifically within the raphe nucleus, a brain region critical in generating the mood-altering neurotransmitter, serotonin. Of great importance, they detected significant cell death within the raphe of the stress-sensitive mice following chronic stress exposure. These results indicate that appropriate homeostatic responses to stress are critical to prevent cell death, and that a failure to respond appropriately may be related to affective disorder onset and treatment resistance (McEuen *et al.*, 2008). In related studies, the Bale group is currently focused on the influence of neuro-inflammation in stress-induced alterations in the brain. The Bale laboratory is collaborating with several SOVM labs to determine the pathways and mechanisms involved, including examining NF-kB signaling with Dr. Michael May's laboratory and utilizing a toxoplasmosis infection model with Dr. Chris Hunter's laboratory.

**Stress and Obesity** Obesity currently occurs at epidemic rates in this country. Similar to its involvement in affective disorder presentation, stress has an important role in directing motivational behaviors associated with weight gain and development of obesity. Anhedonia is a key endophenotype of depression, and supports a strong link between affective disorders and causes of obesity in dysregulation of reward neurocircuitry. Behavioral treatment of obesity has a 95% failure rate, likely due in part to the stress experienced during a

*continued on page 6*

**Ralph Brinster to deliver the Cuozzo Memorial Lecture**

On June 13-14, 2011 a Conference on Reproduction and Regeneration will be held at the Translational Research Center, 3400 Civic Center Boulevard. The Conference is sponsored by Molecular Reproduction & Development (Wiley-Blackwell), The Center for Research on Reproduction and Women's Health; and the Institute for Regenerative Medicine, University of Pennsylvania. Several Penn Vet Faculty hold membership in the Center for Research on Reproduction and Women's Health and Penn's Institute for Regenerative Medicine. The Conference begins on Monday, June 13th at 8:30 a.m. with presentations on Regenerative Medicine and Stem Cell Research and Gamete Research followed by the **32<sup>nd</sup> Annual James M. Cuozzo Memorial lecture** at 4:00 p.m. by **Ralph Brinster, VMD, Ph.D.**, Richard King Mellon Professor of Reproductive Physiology, **School of Veterinary Medicine, University of Pennsylvania.**

A poster session and reception will follow. The sessions will resume on Tuesday June 14<sup>th</sup> with presentations by invited investigators and post-doctoral fellows. Abstracts are due by May 15. For further information call Donna Adamoli at 215 573-5446

To register for the retreat, please click to: <http://www.med.upenn.edu/crrwh/registration.shtml>

*Stress & Disease continued*

reduction in dietary palatability. In support, the Bale laboratory developed a model of high fat diet withdrawal in which molecular, biochemical, physiological and behavioral evidence indicated that an increased stress-state was precipitated by a diminished reward output (Teegarden and Bale, 2007). In addition, they demonstrated that the long-term effects of stress induced by caloric restriction or high fat diet withdrawal were mediated via epigenetic changes in central stress genes that enhanced sensitivity to future stress and increased stress-mediated binge behaviors (Pankevich *et al.*, 2010).

In consideration of the current obesity epidemic, Dr. Bale's laboratory has also developed models examining the long-term effects on offspring exposed to maternal obesity throughout pregnancy. These studies have identified programming effects on insulin sensitivity and longitudinal growth that are detected through the third generation, that can be transmitted via the paternal lineage (Dunn and Bale, 2009, 2011). In a collaboration with Adrian Leu in Penn Vet's Center for Animal Transgenesis and Germ Cell Research, Dr. Bale's laboratory has been investigating the potential epigenetic programming of these transgenerational outcomes. MicroRNAs identified in the sperm of first generation males are being microinjected into fertilized eggs to recapitulate the predicted phenotype. Future studies will attempt to identify the immediate gene targets of these miRNAs. Dr. Bale's research is supported by NIH MH073030, MH087597, &

MH091258. Her laboratory and office are located in Old Vet 201E.

**Selected publications**

Dunn, G.A., and Bale, T.L. (2009). Maternal high-fat diet promotes body length increases and insulin insensitivity in second-generation mice. *Endocrinology* 150, 4999-5009.

Dunn, G.A., and Bale, T.L. (2011). Maternal High-Fat Diet Effects on Third-Generation Female Body Size via the Paternal Lineage. *Endocrinology*. 2011 Mar 29. [Epub ahead of print]

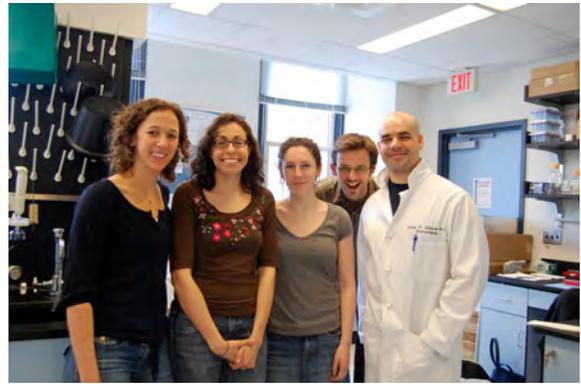
McEuen, J.G., Beck, S.G., and Bale, T.L. (2008). Failure to mount adaptive responses to stress results in dysregulation and cell death in the midbrain raphe. *J Neurosci* 28, 8169-8177.

Mueller, B.R., and Bale, T.L. (2006). Impact of prenatal stress on long term body weight is dependent on timing and maternal sensitivity. *Physiol Behav* 88, 605-614.

Mueller, B.R., and Bale, T.L. (2007). Early prenatal stress impact on coping strategies and learning performance is sex dependent. *Physiol Behav* 91, 55-65.

Mueller, B.R., and Bale, T.L. (2008). Sex-specific programming of offspring emotionality after stress early in pregnancy. *J Neurosci* 28, 9055-9065.

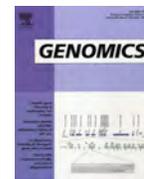
Pankevich, D.E., Teegarden, S.L., Hedin, A.D., Jensen, C.L., and Bale, T.L. (2010). Caloric restriction experience reprograms stress and orexigenic pathways and promotes binge eating. *J Neurosci* 30, 16399-16407.



Bale Laboratory

Teegarden, S.L., and Bale, T.L. (2007). Decreases in Dietary Preference Produce Increased Emotionality and Risk for Dietary Relapse. *Biol Psychiatry*. 61(9):1021-9

**Recent Publications**



Exonic SINE insertion in STK38L causes canine early retinal degeneration (erd) (2010) O Goldstein, AV Kukekova, **Gustavo Aguirre**, and GM Acland. *Genomics* 96: (6)

362-368



Development, Anatomy, Histology, Lymphatic Drainage, Clinical Features, and Cell Differentiation Markers of Canine Mammary Gland Neoplasms (2011) Sorenmo, K.U., Rasotto,

R., Zappulli, V., **Goldschmidt, M.H.** *Vet Pathol* 48: 85-97



Meyer-Ficca ML, Ihara M, Lonchar JD, Meistrich ML, Austin CA, **Meyer Ralph.** 2011 Poly(ADP-ribose) polymerases PARP1 and PARP2 modulate topo-

isomerase II beta (TOP2B) function during chromatin condensation in murine spermiogenesis. *Biol Reprod.* 2011 Jan 12, Epub plus editorial by Ward WS in *Biol Reprod*

**Recent awards & honors**

**Roberta DiTerlizzi**

subcontract to Iowa State  
9/1/10-8/31/13  
Solving problems in sustainable  
agriculture and food safety  
\$122,525

**Beena John**

NIH R21 AI090234  
Real time imaging of tolerance  
induction by mucosal DCs  
9/15/10-8/31/12 \$275,000

**Brett Kaufman**

Diabetes and Endocrinology Reseach  
Center (DERC)  
An expanding role for mitochondrial  
DNA copy number regulation in beta  
cell adaptation  
4/1/2011-3/31/2012 \$80,000

**Christopher Lengner**

American Cancer Society  
Control of Stem cell-driven intestinal  
tumorigenesis by Musashi RNA  
binding proteins  
2/1/2011-12/31/2011 \$30,000

**Ralph Meyer**

NIH U54HD068157-01, Targeting  
ADP-ribose polymer Dependent  
Epigenetic Events in the Male Germ  
Line 5/01/2011-4/31/2016  
Annual Direct for Dr Meyer's project:  
\$125,000

**Charles Vite**

NIH R01-NS-073661-01  
Intrathecal cyclodextrin therapy of  
feline Niemann-Pick type C disease  
4/1/11-3/31/16  
\$1,750,000

**Charles Vite**

Johnson & Johnson Pharmaceutical  
Research  
Quantitative Tissue Distribution  
Using Whole-Body Autoradiography  
Following a Single Intrathecal Dose of  
[14C]Cyclodextrin to Domestic Cats  
3/9/11-3/8/13  
\$24,773

**Phil Scott**

Elected to  
Fellowship in the  
American  
Academy of  
Microbiology  
(2011)



**Chris Hunter**

was elected to  
Fellowship in the  
Royal Society of  
Edinburgh  
(Scotland's Natl.  
Academy of  
Science & Letters  
(2011)



**Penn Vet Imaging Core**

The Penn Vet Imaging Core has  
an active seminar program held in  
220 Hill Pavilion at noon:

**Mon, Apr 11, 2011 12 noon-**

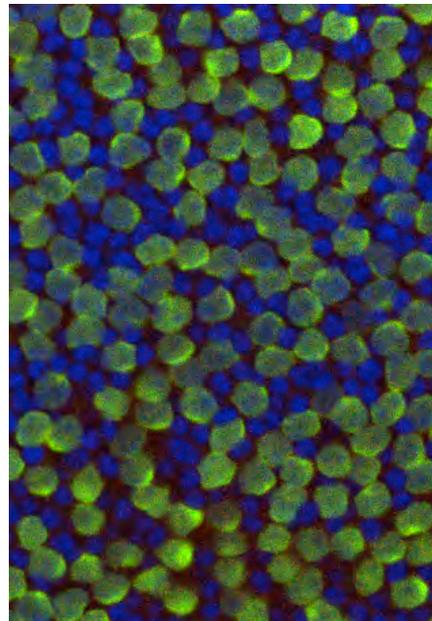
Tajie Harris, PhD  
Postdoctoral fellow in C Hunter's  
Laboratory, Department of  
Pathobiology  
"Multi-photon imaging of CD8+ T cell  
migration in the CNS"

**Thursday, May 5, 2011 12 noon-**

Joshua Steinberg, MD  
Postdoctoral Fellow in T. Laufer's  
Laboratory  
Section of Allergy and Immunology  
School of Medicine  
"CD4+ T cell migration upon  
activation by differing Dendritic cell  
subsets"

**Thursday, Jun 9, 2011 12 noon-**

Britta George, MD  
Visiting Scholar, in L Holzman  
Laboratory  
"DM-Renal-Electrolyte and  
Hypertension" School of Medicine  
"Imaging the nephrin receptor  
complex and nephrin-induced  
cytoskeletal dynamics in kidney  
podocytes"



Somata of canine cone photoreceptors (in green)  
imaged by confocal microscopy (Wm Beltran)

**Recent Publications**

*Utilizing the* **PENN Vet  
Imaging Core Facility**

**Using two-photon microscopy:**

Norose K, Kikumura A, Luster AD,  
**Hunter CA, Harris TH** (2011) CXCL10  
is required to maintain T-cell populations  
and to control parasite replication during  
chronic ocular toxoplasmosis. *Invest.  
Ophthalmol Vis Sci* 52: 389-398.

**Using: spinning disk confocal  
Microscopy**

Kurischko C, Kim HK, Kuravi VK,  
Pratzka J, **Luca FC** (2011) The yeast Cbkr1  
kinase regulates mRNA localization via  
the mRNA-binding protein Ssd1. *The  
Journal of Cell Biology* 192: 583-598.

**Using: wide field histology  
microscopy**

Sonnenberg GF, Monticelli LA, Elloso  
MM, Fouser LA, **Artis D** (2011) CD4(+) Lymphoid Tissue-Inducer Cells Promote  
Innate Immunity in the Gut. *Immunity* 34:  
122-134.

**University Avenue:  
a crossroad for  
collaborative research**



Drs. Kathryn Rook and Daniel Morris

Faculty researchers in the School of Veterinary Medicine continue to forge collaborative research projects with their colleagues in the School of Medicine. One such collaboration was in the making for many years. **Daniel Morris, DVM, MPH**, associate professor and chief of dermatology at Penn Vet, met **Alain Rook, MD** in 1998. Dr. Rook, a professor in the Department of Dermatology in the School of Medicine, University of Pennsylvania, showed an interest in comparative dermatology, and saw a partnership with veterinary dermatologists as a potential resource for advancing dermatologic research on both sides of University Avenue. Dr. Rook, whose laboratory works on T-cell lymphoma, had previously hosted a School of Veterinary Medicine resident during the fellowship year and was specifically interested in developing a collaboration to study the

immunopathology of T-cell lymphoma in dogs. Coincidentally, Dr. Rook's daughter **Kathryn (Katie) Rook, VMD**, was a Penn Vet student and showed an interest in cutaneous oncology. When Katie began her dermatology residency at Penn Vet, Dr. Morris, whose primary research interests involve cutaneous infectious diseases and zoonoses,

became her mentor. The fortuitous working relationship between Drs. Morris and Rook and resident Katie provided the impetus to move forward with a joint project on cutaneous T-cell lymphoma (CTCL) in dogs, a relatively rare but potentially fatal disease in both dogs and humans. Katie spearheaded the oncology project on her own, showing initiative and foresight.

The rarity of CTCL makes it difficult to study with one institution's caseload. Therefore, Dr. Morris and colleagues have recruited cases (tissue and blood samples) from veterinary colleagues across the country. Although current knowledge of the immunophenotype of CTCL in dogs is limited, it appears that the most common subtype in dogs is a reasonable homologue to a rare variant of this cancer in people. While people with the more

common variant have a good prognosis for long-term survival, people with the rare variant exhibit rapid disease progression and have a poor prognosis, a phenotype common to dogs with CTCL. Therefore, the naturally occurring disease in dogs should be a valuable translational model in which to study the immunopathogenesis and identify therapeutic targets for this devastating form of human CTCL. With her combined interests in dermatology, oncology and immunology and the expertise of her father's lab, this project should allow Katie and the research team to move toward a greater understanding of cutaneous T-cell lymphoma, which may, in the future, lead to better treatment options for the patients at Ryan Veterinary Hospital and beyond. This is translational medicine at its best!

The **Penn Vet Research Newsletter** is distributed quarterly. Suggestions, requests, comments, and story ideas should be directed to:

[resnews@vet.upenn.edu](mailto:resnews@vet.upenn.edu)

Office of the Associate Dean  
for Research  
Phillip Scott, Ph.D.  
University of Pennsylvania  
School of Veterinary Medicine  
380 S University Avenue, Suite  
310B Hill Pavilion  
Philadelphia PA 19104-4539