BMS HERALD

Spring/Summer 2016 | Volume 4

IOWA STATE UNIVERSITY
Department of Biomedical Sciences

HIRUNI HARISCHANDRA *Cover Design*
SARAH MIENTKA *Medical Illustrator*

A MESSAGE FROM THE CHAIR

As the new academic year begins here at Iowa State University and students once again fill the halls and classrooms at the College of Veterinary Medicine, it's appropriate to reflect on the accomplishments of the past year.

BMS has the largest basic science teaching responsibility in the college and our faculty are strongly committed to providing a high quality teaching / training experience to our professional students. We continue to find ways to improve through the recruitment of new faculty in anatomy and physiology, pharmacology, and a new Senior Lecturer who will assist us with our MS non-thesis program and the horizontal and vertical integration of the professional curriculum. Faculty are adopting modern teaching tools and have excelled in publishing new books in physiology and neuroanatomy. Facilities in the department are currently being upgraded and improved. A new microscopy imaging core facility, with confocal and fluorescence microscopes, has been developed for the department. The anatomy lab has state-of-the-art audio-visual and student use space upgrades. Additional renovations are planned for later this year. These improvements and additions are expected to synergize our commitments to the BMS teaching and research missions.

Our department has made a significant impact in graduate education at both the college and university level. The BMS graduate program is home to about 75 graduate students, making up more than half of those within the entire college. This is a wonderful achievement for our department. Our PhD students consistently win competitive awards at national meetings, and they are getting recruited by top institutions for their postdoctoral training. Recently, our graduate students established a student organization within the graduate college, and some of them serve in leadership positions as student representatives for their student organizations and national scientific societies. Our unique professional MS program in BMS has been steadily growing. We proudly graduated over 65 professional MS students in the last three years. The combination of intense course work, hands-on lab experience and a creative component has been serving our graduates well in achieving their career goals. Student outcomes indicate that our MS program is meeting its primary goal by placing our students in various professional programs including DVM, MD, DO, DDS and PhD programs. Students have also secured private sector jobs in the pharmaceutical industry and other health-related companies. Another positive impact of our new MS program is that it provides our PhD students with teaching experience, which broadens their career opportunities in academia. Graduate teaching assistantships in turn reduce research overhead and help PIs sustain research programs. Our department will continue striving to build a premier professional MS program at Iowa State. We will explore new opportunities that closely align with our MS program and will elevate our departmental stature among other basic science departments in peer veterinary schools.

We are continuing our upward trajectory in biomedical research by securing highly competitive NIH funding and publishing peer-reviewed papers in top journals. As extramural funding has become increasingly competitive, we are devising strategies to promote cutting-edge research collaborations among our faculty. I also applaud our BMS faculty members who continue to serve on grant review panels, editorial boards and professional societies.

Our faculty, staff, and students have demonstrated commitment to the progress being made in the department and we expect this semester to be the start of another successful year for Biomedical Sciences.

Anumantha G. Kanthasamy, Chair

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2008 Vet Med

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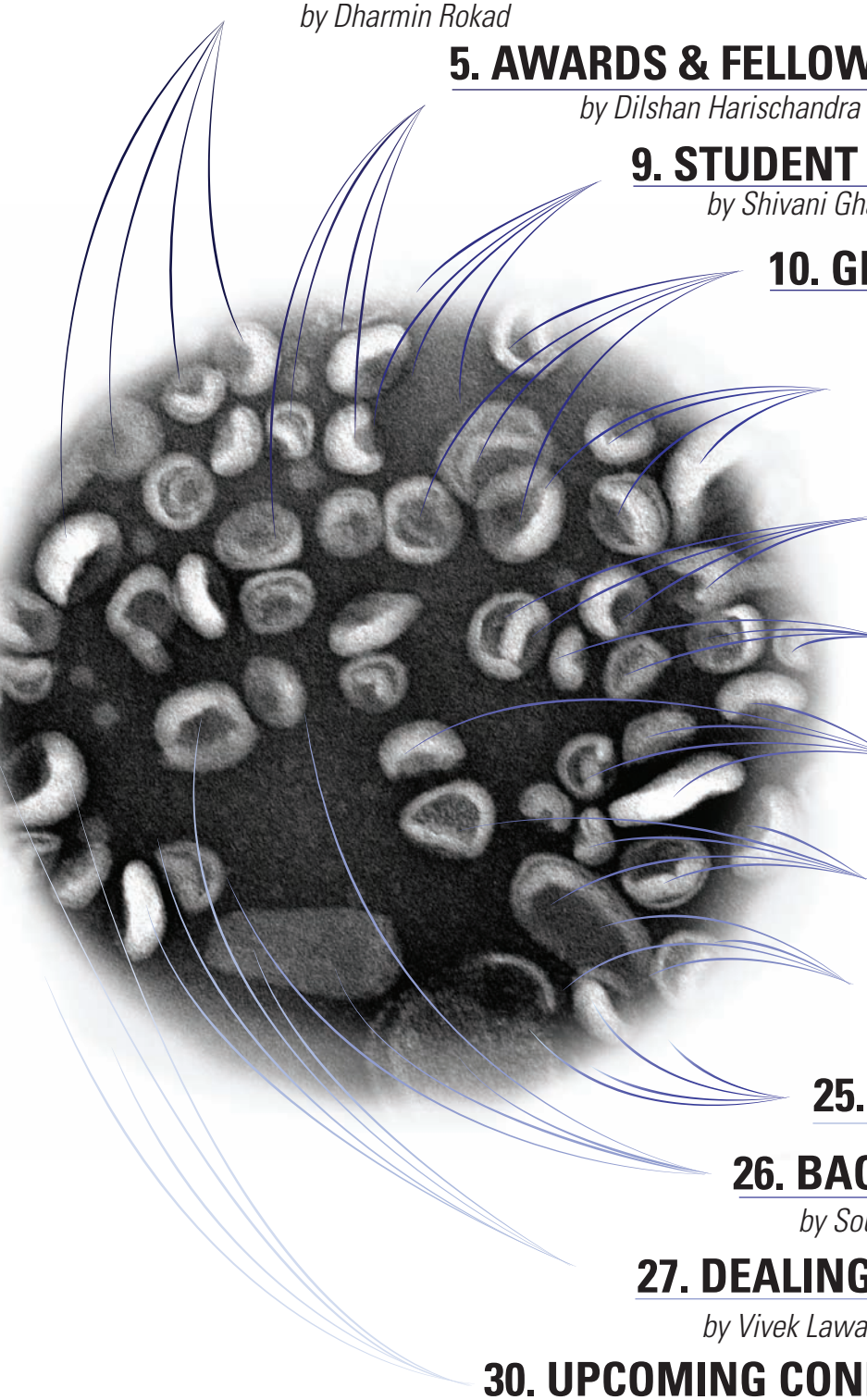


NEW **FACES**

by Dhramin Rokad

Michael D. Kleinhenz

Michael is a Graduate Research Assistant in the department of Veterinary Diagnostic and Production Animal Medicine (VDPAM). He works in the Pharmacology Analytical Support Team (PhAST) Lab under Dr. Coetzee. He has an A.S., B.S. in Agriculture and DVM all from Ohio State University. He also has completed an AVBP residency in Dairy Production Medicine for ISU. His research is focused on the pharmacology of flunixin use and pain mitigation. Michael likes to spend time with his family, and gardens in his spare time. He chose ISU for its focus on food animal production medicine. What he likes about Ames is the size and amenities the city has to offer.

Emma T. Hashman

Emma is the Graduate Program Assistant II in the department of Biomedical Sciences. She earned her B.A. in Political Communication from the University of Northern Iowa followed by her M.A. in International Studies from the University of Iowa. She enjoys spending time with her family and friends. She likes being outdoors exploring and taking trips to new places. Emma's favorite hobby is trying new restaurants and foods each new place she travels to. When asked why she chose ISU, Emma's response was "I chose ISU because I have heard really great things about working here. This position drew me in; because it allows me to work with students, which is what I really love doing". Thus far, she has enjoyed getting to know the staff, students, and faculty in the department. After spending a few years away from the Ames area, Emma likes being back and exploring all the new opportunities the city has to offer.

Emir Malvoic

Emir was accepted to the Neuroscience program in Fall of 2015 and was recently welcomed into Dr. Anumantha Kanthasamy's laboratory. He received his Bachelor of Arts in Biology (Chemistry minor) from Grand View University in 2014. Prior to starting this program, he was employed at Pioneer and Eurofins Scientific in Des Moines. Currently, he does not have a project, but it will probably pertain to molecular mechanisms of neuroprotection and neuroinflammation. He is mostly focusing on familiarizing himself with techniques and current literature. He plays indoor soccer weekly, and sometimes plays basketball, and during the spring and summer he enjoys disc golf. Emir chose ISU because "the neuroscience research is largely molecular, cellular, and developmental." Ames is terrific; awesome people, extremely diverse, and convenient.

Sara El-azab

Sara Taha Mohamed Elazab is an assistant lecturer at faculty of Veterinary Medicine, Mansoura University, Egypt. She is a new visiting scholar. She has her Master's degree in Pharmacology. Currently she is under the supervision of Dr. Walter Hsu. The focus of her thesis will be on pharmacokinetics of Cefquinome in rabbits. Her response to the reason for choosing ISU was "because Iowa State University has a high rank between universities all over the world. I also like the work that scientists and professors conduct at ISU." She is happy in Ames and in Veterinary Medicine College due to its diversity.

AWARDS & **FELLOWSHIPS**

by Dhramin Rokad

DHARMIN ROKAD

AWARD: Best Poster Presentation

TITLE OF PRESENTATION: Molecular mechanisms of manganese-induced exosome release and its relevance to synucleopathies.

NAME OF CONFERENCE: Graduate and Professional Students' Research Conference (GPSRC), April 12th 2016, Iowa State University, Ames, Iowa.

DILSHAN HARISCHANDRA

AWARDS: Inhalation Toxicology Specialty Section Graduate Student Best Abstract Award - First Place
SOT Graduate Student Award
Graduate Student Award for miRNA Biomarkers for Toxicology Meeting

TITLE OF PRESENTATION: Environmental Neurotoxicant Manganese Alters Exosomal miRNAs and Autophagic Regulation in Cell Culture Model of Parkinson's Disease.

NAME OF CONFERENCE: Society of Toxicology Annual meeting, March 13th – 17th 2016, New Orleans, Louisiana.

HIRUNI HARISCHANDRA

AWARD: Best Poster Presentation - First Place

TITLE OF PRESENTATION: Stage Specific Host Manipulation via Exosome-Like Vesicles (ELVs) Released by the Filarial Nematode Parasite, *Brugia malayi.*

NAME OF CONFERENCE: Graduate and Anthelmnintics: From Discovery to Resistance II conference, Feb 9th - 12th 2016, San Diego, California.

MATTHEW NEAL

AWARD: Outstanding Poster Presentation Award – First Place

TITLE OF PRESENTATION: Prokineticin-2 gene therapy strategy shows anti-inflammatory and anti-apoptotic effects in preclinical cell culture and animal models of Parkinson's disease

NAME OF CONFERENCE: Toxicology Graduate Student Organization Research Day, April 29th 2016, Iowa State University, Ames, Iowa.

MONICA LANGLEY

AWARDS: Stem Cells Specialty Section's Graduate Student Award – First Place
Drug Discovery Specialty Section's Graduate Student Poster Award - Third Place

TITLE OF PRESENTATION: Prokineticin 2 Plays a Role in Altered Neurogenesis and Non-Motor Deficits in PD Models.

NAME OF CONFERENCE: Society of Toxicology Annual meeting, March 13th –17th 2016, New Orleans, Louisiana.

QI XU

AWARD: Outstanding Poster Presentation Award - Third Place

TITLE OF PRESENTATION: Neurorescue Effect of EGCG in an Animal Model of Parkinson's Disease

NAME OF CONFERENCE: Toxicology Graduate Student Organization Research Day, April 29th 2016, Iowa State University, Ames, Iowa.

SHIVANI GHAISAS

AWARDS: Metal Specialty Section's Graduate Student Research Award – Third Place
Neurotoxicology Specialty Section's Toshio Narahashi Graduate Student Poster Award – Third Place

TITLE OF PRESENTATION: Chronic Exposure to Manganese Causes Selective Changes in the Enteric Nervous System and Gut Physiology Leading to Altered Nutrient Metabolism and Intestinal Motility.

NAME OF CONFERENCE: Society of Toxicology Annual meeting, March 13th –17th 2016, New Orleans, Louisiana.

AWARD: Outstanding Poster Presentation Award – Second Place

TITLE OF PRESENTATION: Chronic Exposure to Manganese Causes Mitochondrial dysfunction in the Enteric Nervous System Leading to Altered Intestinal Physiology

NAME OF CONFERENCE: Toxicology Graduate Student Organization Research Day, April 29th 2016, Iowa State University, Ames, Iowa

SOUVARISH SARKAR

AWARD: Graduate Student Best Presenter: (Toxicology Division) Award - Second Place

TITLE OF PRESENTATION: Mito-apocynin, a Novel Mitochondria-Targeted Derivative of Apocynin, Inhibits NLRP3 Inflammasome Activation in Primary Murine Microglia in Dopaminergic Neurotoxic Models

NAME OF CONFERENCE: Experimental Biology 2016, April 2nd - 6th 2016, San Diego, California

GPSRC Awards

MELANIE ABONGWA - RESEARCH AWARD

Her research focuses on advancing the knowledge of drugs that are used to control or eliminate nematode parasite infections, which cause severe problems in human and animal health. She has been first author of three publications, she has presented her work at three different conferences in the USA, and has presented seven posters nationally and internationally. She has received recognition for her work including first place winner for Poster and Oral presentations at the American Society of Tropical Medicine and Hygiene (ASTMH), and the Schlumberger Foundation Faculty for the Future PhD Fellowship for the academic year 2015 – 2016.

VIVEK LAWANA - LEADERSHIP AWARD

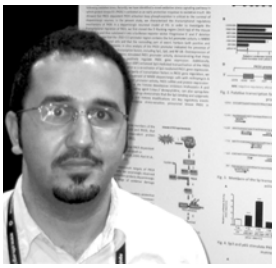
Vivek has received this award for his outstanding commitment and service as leader of more than 14 student clubs in the past four years. He has served as the President of the Toxicology Graduate Student's Organization (2012-13), GPSS Senator for Toxicology (2013-14), New Students' Coordinator and President of the Indian Students' Association (2014-15), International Ambassador (2015), Co-founder of Graduate and Professional Students' Research Conference (GPSRC, 2014) and he is the currently serving as chair of the GPSS Research Conference. He has served in several committees at ISU such as the International Matriculation Fee Committee (2013-2014), and the University Committee on Lecture at Iowa State (2012, 2013). He also has served as a Peer Mentor for undergraduate researchers at Society of Toxicology national meetings since 2013. Vivek was also recently elected as President for GPSS for term 2016-17.

PRESTIGIOUS IOWA STATE RESEARCH AND TEACHING EXCELLENCE AWARDS

Research awards are offered each semester and summer session to recognize students for outstanding research or creativity as seen in their theses and dissertations. These students are also expected to be academically superior and able to not only do research, but develop a well-written product. Teaching awards are offered each semester to recognize and encourage outstanding achievement by graduate students in teaching.

NIKHIL PANICKER

During the course of my PhD in Dr. Anumantha Kanthasamy's lab, I investigated the pro-inflammatory mechanisms that regulate microglial hyperactivation in Parkinson's disease. We demonstrated that Fyn, a non-receptor Src family tyrosine kinase, is preferentially activated in microglial cells following stimulation with various inflammogens. Activated Fyn mediated the tyrosine phosphorylation of the serine threonine kinase PKCδ, and the Fyn-PKCδ signaling pathway subsequently fed into the MAP kinase and NF-κB activation pathways, leading to pro-inflammatory cytokine and mediator production. Fyn and PKCδ knockout mice were resistant against developing both neuroinflammation, as well as neurodegeneration using various mouse models. This study was published in the Journal of Neuroscience. Our subsequent work looked at how sterile inflammation in the form of alpha-synuclein aggregates could prime and activate the NLRP3 inflammasome in microglial cells; the Fyn-PKCδ pathway was again implicated. This work is currently being prepared for publication.



MUHAMMET AY

We have previously shown that activation of protein kinase D1 (PKD1) plays a neuroprotective role against oxidative stress-induced cell death in dopaminergic neurons. During my PhD studies under Dr. Anumantha Kanthasamy, my research focused on understanding the molecular mechanisms of PKD1-mediated neuroprotection using cell culture and animal models of Parkinson's disease (PD). We have found that PKD1 activation positively regulates PGC-1α transcriptional activity and alters mitochondrial biogenesis and bioenergetics capacity to protect dopaminergic neurons. Our results suggest that PKD1 is a promising druggable target and positive modulators of PKD1 signaling may serve as potential neuroprotective agents for the treatment of PD.

DILSHAN HARISCHANDRA

During my graduate studies, I studied the interaction of manganese, an environmental neurotoxicant, with α-synuclein and prion proteins to promote prion-like propagation of protein aggregation, which may contribute to the progression of neurodegenerative processes in Parkinson disease models. Our research demonstrated that Mn exposure promotes αSyn aggregation and secretion via exosomal vesicles, which subsequently evokes pro-inflammatory and neurodegenerative responses in both cell culture and animal models.

COLLEGE OF VETERINARY MEDICINE SEED GRANTS

The overall goal of the CVM Seed Grant program is to provide funds to be used as seed money to generate preliminary or additional data to make proposals more competitive for funding from extramural sources. This is a great opportunity for graduate students in the college because it provides them with the rare opportunity of serving as co-investigators on a grant. Applicants are awarded up to $20,000 for one year with the possibility of renewing for another year.

DR. VELLAREDDY ANANTHARAM, DR. HUAJIN JIN, SHIVANI GHAISAS & DILSHAN HARISCHANDRA

AWARD: $20,000

GRANT: Characterization of the role of microglia-mediated neuroinflammation in exosome-facilitated intercellular transmission of α-synuclein protein aggregates in the brain.

In their lab they investigate different models and mechanisms of Parkinsons disease progression and possible therapeutic targets. With this grant they hope to evaluate the role of microglia in enhancing kinetics of α-synuclein aggregation and exosome-mediated cell-to- cell transmission of aggregated αSyn in preclinical models of PD.

DR. MICHAEL KIMBER, HIRUNI HARISCHANDRA

AWARD: $20,000

GRANT: Exploring the Functional Biology and Control Application of Brugia malayi Exosome-like Vesicles.

Their lab recently identified a novel mechanism by which the filarial parasitic nematode Brugia malayi releases miRNA and protein that have the capacity of manipulating the human host to its benefit. With this grant they hope to explore this further and investigate the protective and therapeutic effects of these vesicles.

FACULTY MEMBER AWARDS AND GRANTS

DR. MICHAEL CHO

Dr. Michael Cho has received a new NIH R21 grant to develop a vaccine using antibody-complexed antigens. The total award is $403,150 for two years. – 2016.

DR. MICHAEL KIMBER

Dr. Michael Kimber has secured a new NIH R21 grant award to investigate the host-parasite interface the host-parasite interface during Brugia malayi infection of the vector mosquito, Aedes aegypti. A total of $421,062 has been awarded for two years.

Dr. Kimber was awarded a second NIH R21 grant to investigate small RNA secretions by the human nematode parasite, Brugia malayi, and their effects on host macrophages. The total awards is $402,659 for two years.

DR. TIM DAY

Dr. Tim Day has received a CVM Seed Grant Award to create an optimized CRISPR/Cas9 protocol for genome editing in Schistosoma mansoni. This award total comes to $20,000.

DR. TIM DAY & DR. STEVE CARLSON

Drs. Day and Carlson were awarded $50,000 by the Regents Innovation Fund (RIF) for a phase II trial of a non-antibiotic drug that prevents bovine respiratory disease at the feedlot. Their award amount will be matched by Aerogenics LLC.

DR. STEVE CARLSON

Dr. Steve Carlson has been awarded a grant from Diamond V Mills to identify the molecular mechanism that is underlying the anti-Salmonella effects of XPC in poultry. A total of $38,332 was awarded by Diamond V Mills and CIRAS matched that funding with $38,331.
Leaving the total at $76,663.

DR. RICHARD MARTIN

Award: Clarence Hartley Covault Distinguished Professor in Veterinary Medicine
Dr. Richard Martin has been a professor of biomedical sciences in the college since 1999. Dr. Martin's research primarily focuses on roundworm parasites. This work has led to many important discoveries in parasitology and was a major factor for being named a Clarence Hartley Covault Distinguished Professor in Veterinary Medicine this year by Iowa State University. Dr. Martin's enthusiasm and genuine interest in his works is eminent in his words; "I found the subject magical," he said. "You can cure a disease by finding a magic bullet. These are modern miracles, these drugs. Pharmacology has an aspect of magic that other disciplines don't."

DR. ARTHI KANTHASAMY

The Office of the Senior Vice President and Provost has promoted Dr. Arthi Kanthasamy to Professor.

STUDENT LEADERS

BMS Students holding leadership positions on campus and in national organizations:

by Shivani Ghaisas

Vivek Lawana

Position: President
Organization: Graduate and Professional Student Senate (GPSS)

Vivek Lawana, a 5th year graduate student of toxicology was elected as the president of the Graduate and Professional Student Senate (GPSS) in April 2016 for the academic year 2016-17. He has been involved in the GPSS since 2013, serving as the student senator of the interdepartmental toxicology program. During this period, along with two other senators, he started ISU's first research conference – the GPSRC - and took lead in planning and executing the conference. Vivek has been the chair of GPSRC from its inception up until 2016. As a result of his enthusiastic involvement in various GPSS associated activities and his vast experience in diverse leadership positions, he was elected as the President of the GPSS by majority vote. As President of the GPSS he chairs the GPSS executive board, and along with this team leads the monthly senate meetings.

Since he assumed this position, he has been actively involved in learning issues pertaining to graduate student campus life and student work. Based on these conversations, he came up with three major goals that he plans to put into motion during his tenure: 1) establish a special interest group of graduate alumni under the Student Alumni Association; 2) encourage graduate students to take up leadership positions and 3) involve the graduate college in assessing the progression of doctoral students annually as a preliminary step to ensure timely graduation.

As president, Vivek meets with the university administration very frequently including the Provost, Senior Vice President of Students Affairs and Dean of Graduate College among other officials, serving as a liaison between graduate/professional students and university administration. He also attends the graduate council, serves on university-wide search committees, the international students' advisory committee, as the vice president of the Memorial Union Board of Directors and on the graduate college professional development special task group.

While being part of such diverse committees makes him an effective liaison between graduate students and the university administration, it does get hectic for a person who is also a graduate student conducting research in the field of neurotoxicology. In order to balance his work as a student leader with the time required for running experiments, he has learnt to effectively compartmentalize his working hours. As Vivek says, "It is impossible to draw a line between these duties but I enjoy my work both as a researcher and leader and I like learning new ways to make my experience more unique and useful as a Cyclone!"

Adhithiya Charli

Position: Graduate Student Officer
Organization: Biotechnology Specialty Section - Society of Toxicology (BTSS-SOT)

Dharmin Rokad

Position: Vice president
Organization: Toxicology graduate student organization (TGSO)

Souvarish Sarkar

Position: Senator for Toxicolgy
Organization: Graduate and Professional Student Senate (GPSS)

GRADUATED **STUDENTS**

by Dharmin Rokad

Joonbae Seo, Ph.D.

Joonbae's thesis was on characterization of splice variants of human Survival Motor Neuron genes in Dr. Singh's Lab (Feb. 2009 - Jan. 2016). During these 7 years, he published 9 papers as first and co-author. He had served on the Biomedical Sciences Herald committee for two years. He accepted a position as a postdoctoral fellow at the Cincinnati Children's Hospital Medical Center in January 2016 and has been studying how Metformin exerts its therapeutic effects by regulating of Ago2's slicer activity since then.

Saikat Banerjee, Ph.D.

As part of his Ph.D under Dr. Michael Cho, he worked on HIV-1 vaccine development. He specifically worked on targeting the membrane proximal external region (MPER) present in the gp41 envelope protein. His efforts in the lab have been directed towards designing and assessing MPER-based vaccine antigens for their ability to induce similar broadly neutralizing antibodies through immunization in rabbits. He was also part of the Molecular Cellular Development Biology's Graduate Student Organization here at ISU. Uponn graduation he accepted a position as a postdoctoral fellow at University of California at San Francisco at Dr. Jeroen Roose's lab, and is currently working on the Ras signaling pathway.

Dilshan Harishandra, Ph.D.

Dilshan's research focus was to study divalent manganese interaction with α-synuclein and prion proteins to promote prion-like propagation of protein aggregation. This was speculated to contribute to the progression of neurodegenerative processes in Parkinson disease models. He served in many positions while at ISU including the graduate student representative on the Graduate council, senator on the Graduate and Professional Student Senate, financial committee member on the Government of Student Body and a columnist in the BMS Herald. He also served as the student representative in national committees such as the Neurotoxicology Specialty Section and the Central State Chapter of Society of Toxicology. He is currently doing his postdoctoral studies at the University of Pennsylvania.

Dongsuk Kim, Ph.D.

Dongsuk's Ph.D. research project dealt with the characterization of p73 and STAT5B genes and their susceptibility to manganese neurotoxicity. He found that Mn 2+ exposure compromises the expression of neuroprotective dNp73 and STAT5B in dopaminergic neurons thereby exacerbating neuronal cell death. He has served a graduate student representative in Computer, Library & Information Management (CLIM) meeting and helped in upgrading the electronics at Vet Med. Presently, he has taken a post doctoral position here at Iowa State University in the laboratory of Dr. Wilson Rumbeiha and is planning to work on elucidating the mechanisms of toxic gas induced neurodegeneration in human and animals.

Nikhil Panicker, Ph.D.

Muhammet Ay, Ph.D.

Lisa Fraser, Ph.D.

Aditi Agrawal, M.S.

1-YEAR MS GRADUATING CLASS OF 2016

Abdullah Al Nouman

Joseph Ambrose

Nathan Asner

Kyle Clay

Timothy DeGroot

Joshua Francois

Eric Hovda

Samantha Hurrle

Jong Jeoung

Michael Jepsen

Melissa Mann

Natalie McAuliff

Christina Mitchell

Christopher Noty

Brandon Plante

Jie Shao

Christian Springer

Colton Tonn

Hong Tran

Christopher VonAhnen

Andie Vsetecka

Katherine Walka

Rebecca Wall

Kaitlin Wright

Zeyuan Zhang

YEARBOOK COMMENTS:

"I have met some of the brightest and most fun poeple ever in this program. I've also found several great mentors who have given me the opportunity to be challenged and grow. The people in this program inspire me to do and be better. It doesn't exactly hurt to have amazing, motivated people around during finals week."

- Samantha Hurrle

"Thank you for giving me the opportunity to be a student in the program. Not only can the knowledge I have gained could greatly enhance my background, but my friends and professors are also amazing. I have learnt a lot from them and feel truly blessed to have met them. I treasure the time spent here. Thank you very much again."

- Hong Tran

"We celebrated our successes after almost every major test. The camaraderie in this program is great!"

- Timothy DeGroot

"The BMS program has been a great experience! I have definitely learned a lot of Biology and have met some amazing people along the way. I have so many fun memories of the BMS group - playing frisbee on the front lawn, ordering pizza and staying up super late in the homeroom to study anatomy diagrams, and let's not forget the message board!"

- Chris VonAhnen

"There were numerous late night study sessions, especially for anatomy where we'd order in pizza. We'd end up spending almost as much time talking life as we did studying."

- Joshua Francois

IN THE LABS

ANTHELMINTIC RESISTANCE: A SERIOUS THREAT

by Shivani Choudhary

Parasitic infections are a major public health concern throughout the world in terms of both prevalence and severity. In general, parasitic organisms take up residence in the host causing both minor ailments as well as serious life-threatening complications. The impact of these debilitating diseases is primarily present in low-income developing countries, which have limited basic health care services and poor sanitation. However the risk of acquiring parasitic infections is on the rise even in developed countries due to increased international travel and migration. Among the various groups of parasites, intestinal nematodes are among the major contributors to the global parasitic disease load. According to the World Health Organization (WHO), more than 1.5 billion people or 24% of the world's population are harboring at least one species of soil-transmitted helminth (STH). Important parasites in this group are roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*) and hookworms (*Ancylostoma duodenale*). Heavy worm burden can cause a range of health problems, including anemia, abdominal pain, diarrhea, blood & protein loss, rectal prolapse and cognitive growth retardation. Children are at particular risk of acquiring STH infections, which have profound effects on school attendance, performance and future productivity. These infections are also believed to increase host susceptibility to other important illnesses such as malaria, tuberculosis, and HIV infection. Lymphatic filariasis, commonly known as elephantiasis, is another severe infection caused by parasitic filarial nematodes, *Wuchereria bancrofti*, *Brugia malayi* or *B. timori*. It has a broad range of clinical manifestations, varying from no visible symptoms to lymphedema and abnormal enlargement of body parts, causing pain, severe disability and social stigma. The disease currently affects more than 120 million people worldwide, with 40 million suffering from serious incapacitation and disfigurement.

The most common strategy used for treatment and prophylaxis of nematode infections is chemotherapy. Anthelmintic vaccines offer a promising avenue for control but so far there are no safe and inexpensive treatments available for clinical use. Other strategies like improved sanitation and pasture control have significant impact on reducing the transmission of STH worms, however they are not sufficient to eradicate the parasites. Helminth control has largely relied on the use of inexpensive and reliable pharmaceutical drugs like benzimidazoles, cholinomimetics and avermectins. But the extensive and unregulated use of chemotherapy including high treatment frequency, single drug regimens, targeting & timing of mass treatment and underdosing along with genetic factors has led to the development of drug resistance to almost all classes of current anthelmintic agents. The presence of resistance has become rampant in many of the veterinary helminths and poses a serious threat. There are reports of high prevalence of multi-drug resistance (MDR) in small ruminants in several regions of the world. Though the current situation of

drug resistance in humans is not yet comparable with that in livestock, the dramatic and rapid spread of resistance in veterinary anthelmintics should be taken as a serious warning. Given the gravity of the situation created by drug resistance, it has become exigent to develop novel anthelmintics or vaccines.

The research in Dr. Richard Martin's and Dr. Alan Robertson's lab focuses on nematode ion channels that can be exploited as antiparasitic drug targets. Our lab employs molecular, cellular, pharmacological and electrophysiological techniques to study the mode of action, effects of drugs and mechanisms of resistance in a range of membrane ion-channels. The range of nematode worms studied includes *Caenorhabditis elegans, Brugia malayi, Ascaris suum, Oesophagostomum dentatum, Dirofilaria immitis* and *Haemonchus contortus*. With the support from NIH, NSF and pharmaceutical company grants, our lab has successfully described the mode of action of novel antiparasitic drugs like paraherquamide, 2-deoxy-paraherquamide, tribendimidine and emodepside. By employing current clamp techniques on somatic muscles, we described the synergistic effect of deraquantel & abamectin and emodepside & diethylcarbamazine as a novel combination therapy to combat evolving parasitic resistance. We have successfully cloned different nicotinic acetylcholine receptor subunits from nematodes and characterized their pharmacology to validate them as novel targets. Presently, I am expressing and characterizing EAT-2, a pharyngeal nicotinic acetylcholine receptor subunit and EAT-18, a small protein. EAT-2 and EAT-18 are involved in the pharyngeal pumping and control the feeding behavior in *C. elegans*. The homologues of this subunit are also present in nematodes of public health importance e.g. *A. suum, Toxocara canis* etc. We are characterizing the pharmacology of the receptor expressed by EAT-2 in combination with EAT-18 to validate it as a novel drug target. Successful targeting of this receptor using new agents, either alone or in combination, will lead to starvation of the parasites and can be used for treatment of parasitic infections.

CAREER PLANNING ADVICE

BY GRADUATE CAREER SERVICES DIRECTOR

by Vivek Lawana

Career development is something that graduate students don't have a great interest in until a few months before graduation. A lot goes to making every individual the best candidate in the job market, and planning ahead is a key to it. A Ph.D. student in the department of Biomedical Sciences spends about 5 to 6 years on average as a graduate student. In this period one accomplishes many achievements and takes an active part in many student activities, but by the time that students reaches the last year, these are the things they quite often undermine the importance of and don't include in their curriculum vitas. This is just one example of many other mistakes graduate students usually make while staying busy with their research. Hence, we decided to interview the graduate career service director, Karin Lawton Dunn, to give some advice to all graduate students in planning their future! Our columnist Vivek Lawana, asked her the following questions which Karin answered to the best of her capacity.

What does the career services office at the graduate college offer for graduate students?

Our office offers career planning related help for masters and Ph.D. students as well as post-doctoral fellows. Masters and Ph.D. students can also go through their academic college; however, the college of Veterinary Medicine does not have that great career counseling for graduate students, as it its focused on professional students. In such cases, my office helps the graduate students. It is also the only place that works for Post-docs' career services.

What are the resources that the graduate college and Iowa State University have that a grad student can take advantage of?

Besides the career services office, the graduate college has a center for communication excellence, which works majorly for oral communication issues for TAs and faculty aspirants. They also provide extensive help with writing a better resume or CV, drafting grants proposals, etc. The graduate college also has a McNair program for first generation minority and underrepresented college students to felicitate attainment for them at ISU. They essentially work with undergraduate students whose family has never gone to college before and work with them to help complete their degree and make sure they also get a graduate degree. Another resource is student counseling services; they have programs like crisis assistance, career exploration, personal career development and career coaching. It is open to all students and research staff in the university. They offer many strength tests to assess your strengths and weaknesses that are very important in finding the best matching job. It is again, free of charge!

The next questions is how soon is too soon for a student to start utilizing these services and start career planning?

It's never too soon to start working on your career planning. The most crucial thing in shaping your career is networking. So, essentially every individual working with you, above you or under you is your basic network. You must reach out and make your network bigger and more diverse. It is always too late if you do that few months before you graduate and you might not get the best suiting job! So, you really can't start soon enough.

You just mentioned networking. Can you please elaborate on the importance of networking and how a graduate student can learn and improve that?

The power of networking is beyond one can explain. It is certainly the most crucial thing as far as your career planning is concerned. For example, my 17-year-old son, who is very interested in sports broadcasting, found a connection through his high school guidance counselor. It so turns out that my son's guidance counselor's brother is a sports-caster for Cyclone fanatic radio and blogs. So, basically you never know which connection is just a person away from your next employer and it is important to maintain healthy relationships with everyone around you. Always make acquaintances when you go to a new place and find commonalities, such as favorite food, undergrad institution, relatives living in same town, etc. These small things will make that person remember you for a long time. LinkedIn helps those people who are little introvert. Graduate students must download the LinkedIn mobile app and when they meet someone at a conference and if they have a LinkedIn profile, add them right away. Following up on these connections is also important.

What is MyIDP and how useful it is?

MyIDP is extremely important and many universities are now making it compulsory for all graduate students and post-docs to maintain their IDP. IDP stands for individual development plan, which takes your skills, interests and values and puts them together to give an idea about what careers would best fit you and what careers you should avoid pursuing with the present skill set. A graduate student in the Toxicology program at ISU figured that one of his top areas is public policy which as a toxicology graduate research student, he had never thought about before. In short, it will help you best in understanding what fits best for you and where you will fit best.

The last question is, what is the departments' and facultys' responsibility in making sure that their students are the best candidates?

Well, one thing that the graduate college is currently working very hard to make all the DOGEs and faculty understand that it is very important to help their students become employable. They must allow their students to explore professional development workshops on campus, regularly check for career counseling and encourage them to get involved with student organizations to gain some leadership experience. We are trying to explain to faculty that they are not just mentors for students' lab work but that they essentially need to create an overall product. A student with excellent experimental skills who has not acquired proper interpersonal or team player skills is a failed product. Faculty and departments need to understand this important issue and plan professional career development workshops for their students and post-docs. We know there is still a lot of work to be done, but we are very optimistic in educating our faculties with this issue. I also work with students, helping them go up the ladder and explain to faculty why LinkedIn or ResearchGate is crucial in today's age.

We would like to thank Karin for her time and answering these questions as well as giving a seminar to BMS students on the 23rd of March. If you want to learn more about Karin's office or have any specific questions, you may reach out to her. Her contact information can be found below.

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FACULTY SPOTLIGHT
DR. MICHAEL KIMBER

by Shivani Ghaisas

Could you please give a brief overview of your education and what made you decide to join the field of biological research?

My undergraduate degree is in Biology from Queen's University Belfast, which is my hometown. I then went on to earn my Ph.D in Molecular Parasitology again from Queen's University before moving to Iowa State University to pursue my post doctorate and finally got hired right after my post doc as a faculty member.

So that means you have always been interested in molecular parasitology?

Well, biology was a subject in which I excelled since school and if you are interested in biology in school most people assume that you want to go ahead and become a medical doctor. For a while I too believed that a degree in medicine is what I wanted, however the closer I got to applying for college, the less interested I became in pursuing a medical degree. Consequently I ended up pursuing an undergraduate degree in biology without any real focus initially. So I can't really say that I was interested in parasitology from the start, at that time I did not know much about parasites and did not contemplate pursuing research in that field. However I was definitely interested in the area of physiology rather than microbiology, virology or ecology.

People get into a certain field for various reasons. Some have a personal connection, for example someone growing up had a relative who had Alzheimer's and hence is later interested in studying Alzheimer's disease. I got interested in parasitology because the professor who taught this subject during my undergraduate years was a fantastic teacher, very charismatic and someone who was able to present the material in a compelling way that made it easy and interesting to learn about. If I had such a professor teaching, say behavioral ecology, I might have been interested in that field instead! Moreover, I felt that research in parasitic diseases was more applicable, it wasn't an esoteric discipline that is hard to get your head around and hard to see the applicability of it. Millions of people around the world suffer from various types of parasitic worm infections so it was easy to see how research involved in understanding the mode of infection, host immune evasion and drug resistance can lead to the development of better treatments that

would reduce the morbidity and mortality of the infected population. In short, it was a combination of the way the study material was presented, the applicability of doing such research and my budding interest in this field that helped make my decision to pursue research in the field of parasitology.

Presently your research is in the area of filariasis. Could you tell us more about this disease and your contributions to understanding the biology of filariasis and schistosomiasis.

Mostly in the lab we work on filariasis. Filariasis is a disease of humans caused by thread-like worms called filarial nematodes that are transmitted through the bite of an infected mosquito. The mosquito houses the larval stage, when it bites a human, the larvae are transferred to the skin of this individual, they find the puncture wound caused by the mosquito and migrate into the lymphatic vasculature where they grow and develop into adulthood. About 120 million people suffer from filariasis and it is endemic in about 60 countries around the world. It is most recognized for an extreme manifestation of the disease called "elephantiasis" that affects 40 million people worldwide. Elephantiasis exhibits as gross swelling of limbs that look like elephant feet, hence its name. The parasite mainly grows in and obstructs the lymphatic vasculature to extremities such as limbs. The blockage in conjunction with inflammation causes chronic edema, secondary bacterial infections and skin malformations and hence the legs take on an elephantine appearance. While this condition may not lead to mortality, it does lead to disability. Lymphatic filariasis is the second leading cause of permanent disability in the world behind leprosy. It's an incredibly cruel disease and socially stigmatizing - people afflicted with this condition struggle to work and it also affects their personal life in many different ways. Unfortunately we don't have many effective drugs against this parasite. While there are some drugs available, these kill the larval stage parasites but not the adult.

Why is it difficult to kill the adult filarial nematodes?

(Smiles) That is a really good question and a lot of people are trying to figure that out! There are some drugs that have been used such as Benzamidazole, Ivermectin and most commonly Diethylcarbamazine. Diethylcarbamazine has been shown to kill 50% of the adult worms in-vitro however, at the tolerable therapeutic dose it is not very effective. That has been one of the biggest challenges in combating filariasis - finding drugs that kill all the important life stages of the parasite. There are definitely some mechanisms and processes that these parasites employ to evade immune activation and death.

This brings me to a recent paper from your lab that was the featured article in in the journal PLOS Neglected Tropical Diseases and also led to a podcast presented by BBC. Could you tell us a bit more about the results and conclusions presented in that paper?

One of the unusual things about lymphatic filariasis is that the worms can live in the human body for as long as 10-12 years, much longer than most parasitic helminths. So the question is how do they live so long and evade the host's immune response during this time? Another interesting aspect is their ability to rearrange the host vasculature locally thus creating conditions where they can live favorably. Presently the mechanisms behind host manipulation are not fully understood however if we can interfere with the mechanism by which the parasite manipulates the host, we can perhaps prevent the parasite from establishing itself in the host body and help the immune system in clearing the infection.

We now know that the parasite can secrete proteins - people have profiled the secretome and have found hundreds of proteins that are secreted by the parasite. While we can see a correlation between some secreted proteins and the parasite's ability to manipulate the host environment, the mechanism via which these proteins affect the host environment has not been teased out. A few years ago we read a manuscript on how a single celled parasite called Trichomonas can manipulate the cells in which it parasitizes by releasing extracellular vesicles called exosomes, which contain a mix of small RNAs and proteins that can affect the host cells. Now exosomes have been a hot topic for the past 3-4 years. They are the focus of a renewed investigation because it is now believed that they might be mediators of cell-to-cell communication and contain a lot of bioactive effector molecules such as miRNA's, lipids, protein, carbohydrates etc. With such a cargo, they can produce effects in distant cells. So we harnessed these ideas and developed a hypothesis that the filarial nematodes are able to secrete exosomes and these exosomes contain effector molecules that have the potential to manipulate the host and consequently allow the parasite to live for a long time undetected by the host immune surveillance system. In that manuscript, we provided some evidence in support of this hypothesis. Mainly 1) these parasites do secrete exosomes, and 2) these exosomes contain both proteins and small RNA's that can influence the host's immune system. Interestingly some of the small RNAs that form a part of the parasites exosome cargo are similar to host derived small RNA's that are involved in immune function.

Also, these exosomes invoked classical activation of host macrophages suggesting a novel method by which the parasite may actively direct the host responses to infection. Currently we are conducting studies to validate the manipulation of host immune system by exosomes.

Switching gears, we heard that you have been nominated for both the Margaret Ellen White Graduate Faculty award as well as for the ISU Award for Mid-Career Achievement in Research. What are your thoughts on this subject?

It's fantastic just to be nominated along with other superior nominees. Last year I won the CVM mid-career faculty research award and subsequently the BMS department nominated me for the ISU research excellence award. It's amazing to be shortlisted because it highlights the work put together by the lab as a whole. The Margaret Ellen White nomination came from students, which makes me feel terrific! There are a lot of great advisors and mentors in the BMS department and

I can think of several worthy nominees; so it is an honor to be nominated from such a pool of laudable candidates by the students. Winning this award would definitely make our department proud and bring recognition to it.

Lastly, any advice to graduate students aiming to be future faculty as well as those who will pursue research further?

Students preparing to teach courses in future should have empathy towards those whom they will be teaching. Having an "us and them" mentality will not create a positive learning environment. As for pursuing the field of scientific research, all I would say is be dedicated and be determined! Science technologically is easier to do today than twenty years ago yet it has never been harder in terms of getting funding and finding a lab to do your research. So my advice is be determined, be persistent and good things will eventually come your way.

LYMPHATIC FILARIASIS AND NEW INSIGHTS INTO THE HOST-PARASITE INTERFACE

Kimber Lab Update

by Dr. Michael Kimber

In our lab we study Neglected Tropical Diseases of the developing world that are caused by parasitic helminths (worms). One of these diseases, Lymphatic Filariasis (LF), is caused by thread-like filarial nematodes, including *Brugia malayi*, that are transmitted through the bite of infected mosquitoes. LF is endemic in over 60 countries throughout South and Central America, Africa and South and South-East Asia, with at least 120 million people are afflicted with the disease. It is the adult worms that cause the pathology associated with LF. Blocking of lymph flow can lead to dermatitis and secondary bacterial infection. Severe obstructions can lead to gross swelling of the extremities, with appendages taking on an elephantine appearance, leading to this chronic disease being known as elephantiasis. Over 40 million people suffer from elephantiasis, making it the second leading cause of long-term disability behind leprosy.

Controlling LF is incredibly challenging and involves multiple strategies including education, improved sanitation and mosquito control but the most important approach is mass drug administration. In the last 15 years, over 5 billion drug treatments have been administered to over 1 billion people but despite this huge effort, LF is still a significant global health concern. Why has LF proved so difficult to eliminate? The primary reason is a sub-optimal portfolio of drugs; only three drugs are available to treat the disease (diethylcarbamazine, ivermectin and albendazole) and although they are effective at killing circulating larval stages, none of these drugs can kill adult worms meaning there is no 'cure' for LF. The biology of the parasites also presents some major challenges. Adult filarial nematodes are extremely long lived in the host. These worms are known to live for up to 15 years and can release microfilariae for up to 8-10 years, necessitating continual drug therapy to infected individuals for up to a decade in order to break disease transmission. Such a long life span suggests that these parasites have developed strategies to ensure sustained viability.

Successful parasitism depends on intricate and specific interactions between the parasite and host. The host mounts a robust immune response that the parasite must evade or manipulate in order to persist. Filarial nematodes, like other nematodes that infect humans and animals, can clearly manipulate the host immune response. This manipulation may be direct or indirect but it is logical to assume that parasite derived factors play a major role at the host-parasite interface. Our understanding of the parasite factors influencing the host-parasite interface is poor and recent research in our laboratory is aimed at providing new insights on this interface that may have some important applications in LF control.

It has long been known that filarial nematodes like *B. malayi* secrete proteins but the functional significance of these proteins as effectors of host change and their mechanisms of action have not been clear, leaving many questions unanswered. How are these proteins secreted, and how

are they trafficked to target host cells or tissues, for example? Work performed in our lab by Mostafa Zamanian, Hiruni Harischandra, Lisa Fraser and others have identified parasite-derived exosomes as important new players at the host-parasite interface and, specifically, as a mechanism for the release of parasite effector molecules capable of host immunomodulation. Exosomes are a specific subtype of extracellular vesicle formed during the late endosomal pathway. For many years it was thought that exosomes represented a form of cellular waste disposal but recently the identification that exosomes carry potently bioactive proteins, lipids, mRNA and small RNA has changed our perception on these structures. Exosomes are now considered highly active mediators of cell-to- cell communication and functional in a wide variety of disease states, from cancer to neurodegeneration. We proposed that exosomes might be released by parasitic nematodes into the host milieu to serve as a mechanism for effector molecule release and trafficking to target host tissues.

A combination of electron microscopy, and a nanoparticle tracking system in the lab of our colleague Prof. Michael Cho, allowed us to show that all life stages of the filarial nematode, *B. malayi*, release prodigious quantities of extracellular vesicles. These vesicles have a size and shape consistent with the exosome literature so we termed them exosome-like vesicles (ELVs). Pursuing our hypothesis that these ELVs were a mechanism for effector molecule release, we characterized the protein content of the ELVs. A global proteomic profile of L3 stage ELVs revealed classic exosome markers and proteins with known effector function, describing for the first time a mechanism by which filarial nematodes can release proteins that manipulate the host. Finally, the ELVs also contained proteins with RNA binding characteristics.

Given that exosomes in other biological systems are known to contain bioactive RNA, we also profiled the RNA cargo of the vesicles using RNA-seq. This approached revealed a complex microRNA (miRNA) complement. Although many miRNA were present in both worm tissue and ELVs at comparable levels, a cohort of miRNA were enriched in ELV preps, indicating they are specifically loaded into ELVs for release. Further, many of the miRNA showed identity with host miRNA. This was significant as they represent parasite-derived miRNA that are potentially capable of manipulating host gene expression. This is an exciting and powerful idea, that parasitic worms may be able to directly alter host gene expression to facilitate or maintain parasitism. One particular parasite-derived miRNA was notable. L3 ELVs are enriched in let-7, a *Brugia* miRNA that shows 100% identity to host let-7. This is significant because host let-7 is an important regulator of macrophage responses to invading pathogens, such as nematodes. Here we have shown a potential specific mechanism by which parasites may manipulate the host immune response via miRNA delivered to cells of the immune system. Indeed, when we incubated parasite ELVs with host macrophages, not only did we see internalization of the macrophages via phagocytosis but the ELVs elicited specific macrophage activation phenotypes in a life-stage specific manner – L3 stage ELVs classically activated the macrophages whereas adult ELVs did not. In summary, this recent work describes a mechanism by which parasitic nematodes can release effector proteins and miRNAs capable of host manipulation. These effectors are packaged in exosome-like vesicles which serve to traffick the effector molecules to host tissues, including cellular mediators of the immune response, where they elicit specific modulatory phenotypes.

Others report similar findings; the Maizels lab at The University of Edinburgh has described exosome release by the murine gastrointestinal parasite, Heligomsomoides polygyrus. These exosomes are also immunomodulatory and contain miRNAs that alter gene expression in mouse cells. These studies are important as they point to modulatory exosome release as a conserved strategy used across parasitic nematodes, from blood-borne to gastrointestinal parasites. The critical next steps will be addressing the outstanding questions that emerge from this work. In general terms, we must resolve the roles ELVs play in establishing and maintaining infection – are they vital structures or is their activity more peripheral? Our studies have revealed differences in ELV cargo between parasite life stages and even between male and female worms. How are these ELVs selectively loaded and what is the relevance of these differences? What determines the ELV-target cell interaction and how specific is this interaction? These questions have great basic science interest in that they illuminate new players at the host-parasite interface but parasite-derived ELVs may also have more applied value that could be leveraged to combat LF and other parasitic worm diseases. If these ELVs are critical to parasitism, it may be possible to block or disrupt important structural or cargo proteins. Similarly, it may be possible to prevent individual miRNA executing their task using inhibitors or mimics. It may even be viable to disturb ELV release from the parasite as a broad intervention strategy. All these paradigms require more thorough validation of parasite ELVs and this work is ongoing in our laboratory.

Allied to these therapeutic avenues, parasite ELVs have great potential as novel biomarkers of infection. One of the challenges with filarial nematode infection is the lack of drug efficacy against adult worms. A more sensitive diagnostic test than is currently available could identify pre-patent infection with larval stages that are more responsive to drug treatment. ELVs are excellent candidate biomarkers of parasite infection because they freely circulate in the bloodstream, can be purified from host biofluids and they contain proteins and nucleotides that allow discrimination between different parasite life stages. Leveraging a LF diagnostic assay that can rapidly and reliably identify larval infection could be of great value in preventing established disease and interrupting the parasite life cycle. We are presently trying to develop a qPCR-based assay that can be used for LF diagnosis.

This recent work represents an exciting new direction for investigating the host-parasite interface. The mechanisms we are studying may apply to other parasitic nematodes as they manipulate their hosts, be they humans, livestock or indeed plants. Defining this “Parasite Effector Toolkit” may reveal conserved mechanisms employed by animal, human and plant pathogens that could be utilized for broad-spectrum control applications.

FACULTY **MENTORS**

by Hiruni Harischandra & Diou Luo

Dr. Anumantha Kanthasamy

What are the points you look for in prospective graduate students?

I look for three things: passion – they need to be passionate about what they want to do; dedication – they need to be dedicated to their work because that is what will drive them throughout their course of study; integrity – they need to have good ethical standards and lastly resilience.

What expectations do you have of your students?

It's a gradual process. They need to have a good skill set, so they spend the first year in my lab learning techniques. They are usually assigned to a senior graduate student for this training and I expect them to listen to their graduate mentor. I also expect them to read literature. At the start, they will spend about 70% of their time doing bench-work, about 20% reading literature and about 10% writing. Their writing skills will improve overtime and by about their fourth year they will spend about 50-60% of their time writing, be it papers or recording their experiments or notes on literature.

How independent do you want your students to be? At what point do you want them to come to you for advice/ guidance?

I go to the lab every evening and this gives the students a chance to talk to me if they have any concerns. During the first year, they will be highly dependent on the post-doc or graduate student mentors they are assigned to. By the 2nd and 3rd year, I expect them to be able to design experiments with proper positive and negative controls. By the time they graduate, they need to be able to challenge themselves and come up with their own ideas; they need to be independent thinkers and be confident in what they do. That's when I decide they are ready to graduate.

When planning projects, do you want your students to plan their own or do you plan the experiments for them?

I give them fixed projects because I know what is workable and fundable. Having said that though, I am also open to ideas students bring. Each student is assigned one steady project which has a high probability of succeeding. They are also given a more challenging high-risk project. This way, even if the high-risk project does not work as planned, the student will not have wasted his or her time and will still be able to graduate in a timely manner.

How do you help your students achieve their end goals and grow professionally?

I encourage each student to attend at least one conference a year. This is the best way for them to know where they stand, what's growing in the field and get to know other scientists. Also, when they win awards, it reassures them that their work is worthy of recognition and gives them confidence to strive even harder.

Would you encourage your students to go into academia or industry?

Both have their pros and cons and it all comes down to passion. I encourage students to go into academia because it is very satisfying. The satisfaction and happiness I feel when I see students who have passed out from my lab succeed out there is indescribable. However, it isn't an easy path; it's hard to get tenure and is a very stressful process; the job market is limited and you are constantly writing. When you go into industry you have to work only 8am-5pm and it pays in the long run to be a vice president or CEO in a big name company. It can be interesting especially if you are in the drug discovery or biomedical sciences field, but you have bosses to report to where as in academia, you are your own boss. A big issue in being in industry is that companies are always restructuring and no matter how hard you've worked or how good you are, if your company is bought out by a bigger company, you might end up having to switch to a different section where you have to do work that is not related to your interest or might lose your job entirely. It's very insecure.

If you had to go back and advice your former graduate-self, what would it be?

I earned my PhD in Biochemistry. If I could go back, I would probably couple that with a professional degree like an MD or DVM so that human and animal samples would be more readily accessible to us. This would help our research efforts very much.

In the years you taught and guided graduate students, was there any incident (good or bad) that made you rethink your present career?

I think this is a good profession and I can't recall any such events that made me reconsider my choice in coming into academia.

If you could make changes to the current graduate student scenario in biological sciences, what would they be?

I would like to see the funding situation for students change in a way so that graduate student training is coupled with funding. I would like there to be more fellowships, teaching assistantships and endowment funds to support graduate students so that they do not have to worry about their finances but can rather focus on their education and so that faculty can recruit students to their labs without having to worry about having to support them in the face of financial downfall.

Dr. Alan Robertson

What are the qualities you look for in prospective graduate students?

Enthusiasm! Some demonstrate their interest in what we study in the lab, with Dr. Richard Martin and myself. I prefer students who are particularly interested in our research. I do like to talk to prospective students, perhaps by Skype or similar modes of communication, rather than just by documents. As long as they show interest, the student's educational background is not important. Currently there is one student from the BMS graduate program, one from Genetics, one from Toxicology and one from Chemistry in our lab. Again, enthusiasm and some experience in either the field of research or techniques employed are preferred. It doesn't have to be a perfect match as long as some aspects overlap between what we do and what the students are interested in.

What expectations do you have of your students?

Given the nature of the research, I don't expect them to start with a great deal of knowledge, but I do expect them to work towards gaining it. Basically, if they work hard and think independently, those are the only expectations I have.

How independent do you want your students to be? At what point do you want them to come to you for advice/ guidance?

That varies very much from student to student. From a supervisor's point of view, a completely independent and successful student is perfect! The less work I have to do the happier I am, up to a point at least. Generally, I'd like to see independence develop. I don't expect the students to start with thinking of a project or an approach, but with time if they can develop independent thinking then that's great. We usually prepare our PhD students in at least two projects. The first project that a student gets is mainly thought out by the supervisor. By doing so, the students develop a better understanding of the field and obtain necessary training of techniques.

After that, depending on the student, I really encourage them to come up with new ideas and see what they would like to investigate and talk about how they want to investigate. The best example is Melanie (Abongwa). Her first project was investigating various nicotinic receptors. She also expressed an interest in testing herbal medicines. So we worked together and came up with a project where we combined the two. We looked at traditional herb plants used in Cameroon, and then we screened it to see if we could find active drugs. Having ideas of work is not easy. As the thoughts mature and knowledge increases, their preferences establish. I will accommodate them as much as possible.

How do you help your students achieve their end goals and grow professionally?

Again, it depends on the individual student and the goals. The bottom line is to give them a training in research and make sure they have the knowledge and expertise to earn a PhD. That's the same for all the students. Aside from that, it really depends on where they want to go after graduation and what they want to do as their career. With regards to my field of research I can give them some advice but outside of that, I guess it becomes more difficult. I do not have a great deal of experience with say the pharmaceutical industry, where some students want to work. What I can do to help them is contact some people whom I know work for a pharmaceutical company. That usually works well. Again, it very much depends on the student and how ambitious they are and what they want to do. I prefer the student tell me what they want to do rather than asking, "what should I do?"

There are always stressful points. I make it a point to tell them that working towards a PhD is a long-term commitment. It's not a sprint, it's a marathon; there will be ups and downs and it won't always be easy. Things will go wrong and mistakes will be made by both the students and the supervisor alike. One has to learn and cope with these mistakes, things do not work as we expect sometimes but that's the nature of research. Preparing students by telling them this, not telling them that they're going to fail and preparing them for the fact that it is not going to be smooth is important. Sometimes, the students just have to do more work, sometimes the student may be too ambitious and you have to say, "Slow down and finish this completely and get it published." Often students have the idea that research is about getting results. However it is not just about getting results; it's about writing up the results for publication that contributes significantly to the thesis.

It's about understanding this research and fitting it into the bigger picture. For example, if you want to go into academia, a huge percent of your time is spent obtaining grant funding. To successfully get grants, it is important to know how to

explain your research. Results matter and publications are vital. You must learn how to write properly and clearly. That's underrated since several students don't appreciate how important that is. The other thing is you must be able to present your result well. That can either be in writing or at conferences as posters or presentations. I do try to train them to do all these. In our lab as a general rule of thumb, the students are generally advised to do a poster presentation at first scientific meeting they go to. After that, they have to give an oral presentation. It is very important to have the student present their work. It is also good because my research is a relatively small field and this is a good way to network. Your job opportunities and academic opportunities are all based on your publication record and the experience that other people in this field have heard of you presenting. That's how you get known.

You don't get known from simply producing results. You have to write up well, advertise, go to conferences and present it well and that's the way you get reputation. Try to develop your reputation, since that is what will help you get a job more than anything else.

If you had to go back and advice your former graduate-self, what would it be?

Do an easier job. This is difficult. I would say you have to like your research to make a career of it. If you find that you don't enjoy your experiments, you should be very careful of what you're doing. It's a big commitment. You have to get some enjoyment from your job. It's demanding, it's not overpaid, a lot of benefits but not that many. Would I do it differently? I don't know. I've no idea.

In the years you taught and guided graduate students, was there any incident (good or bad) that made you rethink your present career?

Not my career. It's really pleasing to see graduate students come up with ideas for research. It takes some guidance, but basically it's really pleasing for a supervisor to see them succeed. That shouldn't be underrated; it's really a nice thing when somebody comes up a good idea that I haven't thought about. We can work together to investigate it and that is very satisfying. I like seeing students graduate and I like seeing them get jobs elsewhere. When you care about the field you are in, it is always a bonus to see that the more students you have the more students you graduate. I'm trying, at least, to stay in this field and expand it. To me, that's very important.

The other thing I like is the diversity. There are not that many jobs that I know that have quite as much diversity; We've got one Chinese student, three Indian people among whom one is student and two are staff, a student from Jamaica, another from Cameroon, two professors one from England and one from Scotland, and also an American student. This diversity is a benefit of the job; I enjoy it and it broadens the horizons and experience of not just me but everybody else in the lab. It is not always easy.

Having said that though, it can be challenging. You've got language difficulties, as well as culture difficulties. But as far as we can work through them, I think it is still successful overall. We didn't look for this situation. It was a happy accident. The field, specifically the one I am in is dealing with multiple diseases. I try to explain to a lot of people that they would not find another job in the Midwest that is as diverse as this one and these people from different cultures and backgrounds do help us solve problems about these diseases.

If you could make changes to the current graduate student scenario in biological sciences, what would they be?

Pay graduate students more money. I know that's not popular, but I actually think that would help. Some of our students are veterinarians, meaning they've already studied for four or five years. Everybody is a graduate of some sort and you are asking these people to commit four to five otherwise very well-paid years, which is not good. I think a pay increase would help. From a personal point of view, I am unsure about the balance between course work and research work. I came from a system which has no course requirement at all.

The benefit of taking courses is that it provides a better education; the down side is that it takes longer, and some courses are of arguable use to individual students. I think USA graduates have a broad knowledge, while European graduates have more focused knowledge within their field. The truth is, there is not a huge difference between the students who come from these two systems other than the fact that the graduates from the UK system turn out to be younger due to a speedy program.

ZIKA

by Souvarish Sarkar

Since April 2015, more than 1.5 million people have been infected with the Zika virus in South America, mainly in Brazil and more than 190 cases have been reported in United States of America. On March 6th, 2016, the Centers for Disease Control and Prevention (CDC) issued an alert relating to travel to Zika infected areas.

Zika virus was first isolated from monkeys in Uganda back in 1947. The first evidence of Zika virus infecting human was back in 1952 and there have been reports of infection in various countries including Polynesia since then but never an outbreak before 2015. There were only 14 reported cases of Zika virus since its discovery until 2007. Zika virus is transmitted mainly by female Aedes aegypti mosquitoes but also through other species of mosquitoes. There have been no reports to date that this virus has been transferred through blood transfusion. Recently there have been 3 reports of Zika virus being transmitted sexually but these reports have not yet been confirmed. The symptoms of Zika virus infection include headache, rash, fever and joint pains.

Though other viruses from the same family are found mainly in the cytoplasm, the Zika virus has also been found in the nucleus. Moreover, this virual infection in pregnant women has been associated with defects in their babies. Among many other developmental defects microcephaly has been attributed to the effects of the Zika virus. Since the outbreak in 2015 in Brazil, more than 3500 cases of microcephaly have been reported. Reverse transcriptase analysis of brain samples from two newborns that died within twenty hours of birth showed the presence of Zika virus.

The latest updates can be located at http://www.cdc.gov/zika/.

PUBLICATIONS
FROM THE LABORATORIES OF:

Dr. Michael Cho

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BACK FROM **CONFERENCES**

by Souvarish Sarkar

ANTHELMINTICS: FROM DISCOVERY TO RESISTANCE II CONFERENCE

Mark Mc Hugh

February 9th - 12th, 2016 in San Diego, California

I am truly grateful and honored that I was offered the opportunity to present results from an ongoing project that had its genesis during my third rotation in Dr. Richard Martin and Dr. Alan Robertson's Lab. Anthelmintics: From Discovery to Resistance II Conference is an event that will live in my heart and mind forever. Prior to attending Iowa State University I have attended a few scientific conferences. However, this experience was somewhat different in the sense that I had the opportunity to meet, interact and glean knowledge that was disseminated by numerous renowned and novel scientists in the field of parasitology. Furthermore, I was amazed and enthused at the various experimental approaches that are currently undertaken to find an effective and sustainable solution to control and eradicate drug resistance in parasitic nematodes. I also had a good time eating at various restaurants and enjoying the view of the harbor. My trip climaxed with a visit to Balboa Park which was close by, and it was just awesome and spectacular. I would encourage all graduate students who have not yet attended a conference to take advantage of that opportunity, because it is a great place to gain knowledge from and meet influential people who can assist in propelling you to the next level in your career.

Other attendees from BMS: Melanie Abongwa, Nicholas Wheeler, Hiruni Harischandra

SOCIETY OF TOXICOLOGY 55th ANNUAL MEETING

Adhithiya Charli

March 13-17, 2016 in New Orleans, Louisiana

This is my third year of attendance at the Society Of Toxicology (SOT) annual meeting and every time I attend, I get the opportunity to meet new people from the toxicological scientific community and industries. There are about 6000 attendees each year from various fields of toxicology who participate and share their research at this meeting. Being a graduate student, learning to know about networking and soft skill enhancement are very crucial with regard to career path planning and development and I personally feel the SOT provides a great platform for such types of a professional growth, apart from discussion of research and scientific topics. This year at the meeting I served as a graduate student officer for the Biotechnology specialty section (BTSS), which has been actively involved in organizing a number of webinars, graduate student career development and mentoring sessions at the SOT annual meeting. This opportunity to be a part of such a dynamic group enabled me to network with scientists from industries, government organizations, academia and also contract research organizations. Also it augmented my skills in organizing and hosting events. The overall experience attending the SOT is truly very beneficial from a graduate student's perspective and I really enjoy the annual meeting.

Other attendees from BMS: Dilshan Harischandra, Dongsuk Kim, Dharmin Rokad, Monica Langley, Vivek Lawana and Shivani Ghaisas

EXPERIMENTAL BIOLOGY 2016

Souvarish Sarkar

April 2nd-6th, 2016 in San Diego, California

This is the second time I attended the Experimental Biology meeting as an American Society of Pharmacology and Experimental Therapeutics (ASPET) member. Unlike most other annual meetings, this conference is a conglomeration of 6 different societies. There were about 18,000 attendees from various fields of science including nutritionists, biochemists and pharmacologists. Being a graduate student it gives us lots of exposure not only to the field that we are working in but also other fields. Also there were a lot of vendors and it was useful to get information about new techniques. It was also a great platform for networking with the scientists from all over the world.

Other attendees from BMS: Qi Xu, Dongsuk Kim

DEALING WITH **STRESS**

by Vivek Lawana

The Oxford dictionary defines stress as "Pressure or tension exerted on a material object", whereas the National Institute of Medical Health (NIMH) describes stress as "the brain's response to any demand". Everyone feels stressed from time to time! Many things can change the level of stress; over working, trying to meet deadlines, loosing track of work-life balance and not taking enough vacations are few contributors to stress as per NIMH. Graduate students typically go through more than one of the above mentioned stressful situations. Hence, I decided to ask some graduate students in the department of Biomedical Sciences to open up and talk about stress. We asked six graduate students individually, how do they define stress? What are the days or months they feel more stressed then others? How do they manage work-life-balance? And what is their best strategy to deal with stress? Here are their answers.

Hiruni Harischandra

Hiruni Harischandra, a fifth year graduate student in Dr. Michael Kimber's lab, current president of BMS graduate organization, student editor of the BMS Herald and a teaching assistant (TA), defines stress as a deadline pressure. Hiruni also mentions that "stress is being constantly productive, especially when things are working". Strange? Yes, I felt so too. Her explanation is that when things are working you want to get the most out of it and want to work extra hours to get everything done. However when things do not seem to work, you still have to put in those extra hours to figure out why! In her

theory, you are always under stress, it can be a happy-stress or angry-stress. To help deal with this stress; Hiruni does not like to take work home. "I would rather stay late and finish (work) in the lab and then go home to relax. I also try to plan things in a way such that I don't have to come to the lab on Sundays, unless absolutely required". One important aspect she points out is making a timetable for the day and for the week to come. This helps minimize procrastination and also helps her know which days she might be staying late. The week before a particular deadline is when she feels really stressful. Hiruni also found her initial days as a TA to be challenging. She mentions that daily meetings with other TAs and faculty kept her extremely busy, which compromised her attention to research. Eventually, when I asked her about her best tactic to deal with such stress, she immediately responded, "COOKING!" Hiruni explained that cooking has been her best stress-buster since undergrad days! Hiruni explains "It might be my way of procrastinating, but when there is an exam or something, I cook a lot the day before". Initially she liked to indulge in some of her hobbies such as crafting and reading but has recently figured that these activities keep her over occupied whereas after cooking, she could still go back and work on her deadlines.

Another stress reliever for Hiruni is her husband. "He knows when I am stressed, so he tries no to disturb me, pampers me well and avoids doing anything that may add to my stress" Hiruni said laughingly.

Garrett McCormack

Garrett McCormack is a fourth year graduate student from Dr. Nick Jeffrey's lab. According to Garrett, "Stress is something like a mental discomfort that gets in the way of work and life. For me particularly, not having as much work done as other people is the biggest contributor for stress". Garrett mentions that he makes sure to set aside evening times for personal things including having family-time. "Since my wife lives in different city, decreased gas prices have certainly helped me balance the work-life equilibrium", joked Garrett. Mondays are bit tough for Garrett as he usually tries to avoid working weekends, so getting back to work is always challenging. He points out that a lot of his stress comes from being somewhat isolated in an office away from other people. Hence, he started playing podcasts in the background while doing his day-to-day work. Garret explained "Watching YouTube videos and other channels are really distracting. I realized they actually add stress by forcing me to stare at the bright screen. I felt that listening to some podcast in background could totally avoid that issue and still help me manage my isolation".

Adhithiya Charli

Adhithiya Charli, currently pursuing a Ph.D. in toxicology, works in the laboratory of Dr. Anumantha Kanthasamy and for him stress is a mental obstacle disrupting your routine or not allowing you to function in a normal way. "When working on an animal study, we are required to work round the clock. So it is important to take a few hours off during such weeks and do what makes you feel happy" replied Adhithiya. He agreed that the first couple of years of a PhD program are more stressful as you are learning new techniques and taking classes, but then we slowly mold into the routine. During this early period, Adhithiya tried things like watching TV, going out for dinners and having game nights, but these were not that helpful and kept him indoors. Photographing animals and birds in nature turned out to be the stress-buster for Adhithiya. He describes it as an art. "Every Saturday morning I take my camera and roam around in Iowa to get some clicks worth sharing". This new hobby-turned-passion has made him travel over 5000 miles in the past three months. He also spends another 3 to 4 hours on the same day processing his pictures and posting them on his photography page on Facebook. He is proud that a few of his pictures have led him to be friends with professionals from National Geographic.

Shaunik Sharma

Shaunik Sharma, a graduate student from Dr. Thimmasettapp Thippeswamy's lab, said, "Stress is when I have so much workload that I cannot meet the deadline". He answered that it is very difficult to manage the 'work-life balance', especially during the time when he has deadlines and there are multiple projects going on. Shaunik's best tactic to deal with stress is to stay calm and not to rush! After trying several other strategies, he perceived that meditation is the best way to stay calm. Practicing several basic yoga exercises for a few months, Shaunik has now adapted this as part of his daily routine. He added that watching inspirational videos also helped him calm down on stressful days. "You may not see an immediate effect, but after performing this for few months the results are evident" promised Shaunik.

Luna KC

Luna KC is a third year PhD student working in the Animal welfare laboratory with Dr. Suzanne Millman. She describes stress as a state of mind that brings out anxiety and pressure of some sort in an individual. As a graduate student Luna thinks it's quite common to get stressed when you want to do many things and they might not go as planned. Luna does not see herself as the most well organized person, but she still tries to make a weekly schedule for herself so that it's easier to prioritize her tasks. She feels most stressed out on Wednesdays when she has an 8 am class on main campus and weekly meetings with her mentor in Vet Med back to back. Since Luna is working towards completing her required courses, December and May are usually busy months. During these strenuous times, talking to her younger sister who is in Canada and who works as a student counselor, keeps her relaxed. Luna said "My sister is my best friend, my guide and my stress- buster. Talking to her never fails in combating my worst stressful days".

Luna considers herself as an introvert, so her sister who is an extrovert helps her see a different perspective to a difficult situation and life becomes a joyride. "Just a phone call is what I need to get over with my stress," says Luna.

Monica Langley

Lastly, I interviewed a fifth year graduate student and president of the toxicology graduate student organization, Monica Langley. Monica is working with Dr. Anumantha Kanthsamy in the Parkinson's Disease Research laboratory. She defines stress as a combination of being overworked, anxiety and physical hard work. Monica manages her work and life by keeping them separate from each other. She added, "When I am home or away, I do not think about work. But, when I am in lab, I pay full attention to my responsibilities". Having a proper dinner and breakfast is essential for her normal daily life. However, the days before a conference or lab meeting turn her routine upside down. Doing outdoor activities is Monica's strategy to deal with stress. She lists hiking, walking her dog, fishing and sometimes hunting in the woods with friends as some of the things she enjoys. "Even if I am in my house I force myself do something, but keeping myself outdoor takes my mind off everything" said Monica.

We also asked all the participants to give advice to fellow graduate students on avoiding stress. Everyone agreed that it really depended on an individual. "Making a proper timetable and following it" is the advice from Hiruni and Adhithiya. Shaunik says that work is never ending because accomplishing a deadline only leads to the goals of the next deadline so he suggested remaining calm and taking timely breaks. Shaunik also suggested the importance of staying healthy and regular workouts, which can be a good way to release any pent-up stress. "Have a backup plan" is Garrett's suggestion. He said that as a graduate student one must not hinge on one technique or experiment. Garrett commented, "Experiments are bound to fail sometimes, so get something else to do while you figure why they are failing". Luna also echoed the strategy of sticking to a plan. She thinks it's easier said than done, but it's the only way you can try avoiding work getting piled up on your desk. Luna thinks that taking a proper lunch and dinner is very important. As graduate students, we often undermine our eating habits and thats dangerous. Talking about breaks, Luna thinks that taking a week or two vacation works for her, whereas Shaunik said taking an hour break every four hours is something he likes to do. Monica thinks it has to be a mix of both, "you must take at least an hour daily doing something away from work and home, but also taking a week break every semester will rejuvenate you for the next phase".

To end this article, I would like to draw my own conclusions along with these six very different graduate students in our department. Stress is part of graduate student life, so deal with it! Take a few minutes away from what you are doing. Listen to music, watch random videos, paint like you are Picasso, drive down to Ada Hayden park or North Grand mall, talk to friends and if nothing else works, eat chocolate! Stress is part of life whether you are a graduate student or a wealthy business person. These six individuals have learned their way to deal with it and I suggest we all decide what works best for us and do that whenever we feel stressed.

Lastly, a great philosopher, psychologist and trained physicist, William James, once said,

"The greatest weapon against stress is our ability to choose one thought over another".

UPCOMING **CONFERENCES**

by Souvarish Sarkar

NEUROSCIENCE 2016 - SOCIETY FOR NEUROSCIENCE

https://www.sfn.org/annual-meeting/neuroscience-2016

November 2nd - 6th, 2016, San Diego, CA, USA

CENTRAL STATES SOCIETY FOR TOXICOLOGY

http://www.toxicology.org/groups/rc/centralstates/index.asp

November 17-18, 2016, University of Iowa, IA, USA

AMERICAN COLLEGE OF TOXICOLOGY - 37th ANNUAL MEETING

http://www.actox.org/am/am2016/index.asp

November 2nd - 6th, 2016, San Diego, CA, USA

IMMUNOLOGY 2017

http://www.immunology2017.org/

May 12th - 16th, 2016, Washington DC, USA

PRION 2017

http://prion2017.org/

May 23rd - 26th, 2017, Edinburgh, UK

RNA 2017

http://www2.convention.co.jp/rna2017/

May 30th - July 2nd, 2017, Prague, Czech Republic

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