

BIOMEDICAL SCIENCES

BVMS

HERALD



SPRING - SUMMER 2015

VOLUME 2

IOWA STATE UNIVERSITY
Department of Biomedical Sciences

A MESSAGE FROM THE CHAIR

The growth of the College of Veterinary Medicine and the Biomedical Sciences Department (BMS) during the past decade has been remarkable. Our leadership continues under the campus-wide “One Health” initiative, which promotes the optimal health of animals, humans, and plants through key local, national and international collaborations.

The department has a combined mission that encompasses three distinct areas:

- » Teaching of the basic science curriculum to the veterinary medical students,
- » Conducting state-of-the-art research that is relevant to the health of animals as well as humans, and
- » Educating graduate students. Graduate education programs include the BMS graduate program, as well as a number of multidisciplinary interdepartmental programs within the University, including toxicology, neuroscience, molecular biology, genetics, and immunobiology. BMS department has the most number of graduate students in the college.

The research programs being conducted in the department cover a wide range of topics including fundamental neuroscience, neurotoxicology, immunology, vaccine development, infectious diseases of several types, RNA biology, nutrition, development, mechanisms of learning and memory, auditory processing, and aquatic biology. More information on specific research can be found on the BMS faculty websites. Regardless of research areas, our faculty are committed to the University’s priority of service to the people of our great state of Iowa, and the global responsibilities associated with the “One Health” initiative.

If you are a prospective professional student in Veterinary Medicine, you will initiate your training in the BMS Department. Here you will learn the structure and physiology of domestic food and companion animals. Later you will receive instruction on the properties of drugs and how they can be used in the treatment of clinical conditions. There also are opportunities to work with BMS faculty as you pursue a concurrent DVM-MS or DVM-PhD degree. If you are a prospective graduate student, the department offers thesis and non-thesis MS and PhD programs with areas of emphasis in anatomy, physiology, and pharmacology, as well as the other interdepartmental majors previously mentioned.

Whatever your interests or educational goals, the Department of Biomedical Sciences is available as an active resource to you. Please feel free to contact our central department office or any of our faculty and staff if you have questions with which we can help.



Anumantha G. Kanthasamy, Chair

akanthas@iastate.edu
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2062 Vet Med

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NEW FACES

By: JAYNE DURNIN

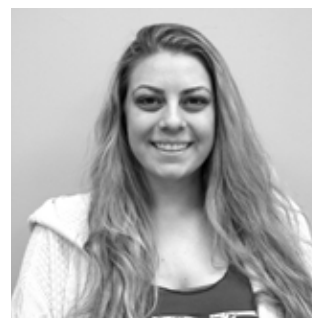
Cindy Robertson

is the new Program Coordinator for the Center for Advanced Host Defense, Immunobiotics and Translational Comparative Medicine (CAHDIT), directed by Dr. Michael Cho. Since she began working for CAHDIT, Cindy's main project has been creating marketing materials and designing the website for the Vaccines Against Antigenically Variable Viruses Symposium (VAAVV2015.org). Before taking this position, Cindy worked as a biomedical illustrator for Dr. Diana Peterson where she created 3D anatomical images for teaching and publication. In her free time, Cindy enjoys biking, illustrating, and is currently working on her Master's degree.



Jayne Durnin

is the new Communications and Office Assistant Student for the Biomedical Sciences Department. She is a junior studying Political Science and Communications at Iowa State. She is working with Amy on several projects, including; shooting promotional videos for the department, helping to organize next fall's new student orientation, and, most recently, contributing to the BMS Herald. In her free time, Jayne is teaching herself how to play guitar.



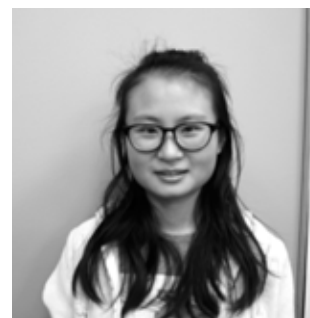
Sudhanva Kashyap

is a post-doctoral student in Dr. Richard Martin's lab, with additional PIs including Dr. Alan Robertson and Dr. Saurabh Verma. He graduated from University of Liverpool in the United Kingdom in 2014 and holds a PhD in neurophysiology. In the lab, Sudhanva works to target cholinergic receptors in parasitic nematodes, which can cause disease in humans and cattle. In his spare time, Sudhanva enjoys playing and watching football.



Fudan Zheng

is a graduate student studying analytical chemistry. She earned her undergraduate degree in pharmaceutical science from Fudan University in Shanghai, China. Fudan is currently working in Dr. Richard Martin's lab, with additional PIs including Dr. Alan Robertson and Dr. Saurabh Verma, and her most recent work has been in finding a new hit compound as a selective agonist or antagonist for *Ascaris suum* Acetylcholine Receptor subtype 16. Her favorite part about Iowa State is the beautiful scenery and the nice people, and her hobbies including traveling and learning Chinese cooking from her parents.



GPSS TRAVEL AWARDS

Iowa State University Graduate and Professional Student Senate
Professional Development Grants

<https://www-gpss.sws.iastate.edu/students/pag/>

GENETIC TRAVEL AWARDS

Iowa State University Interdepartmental Genetics and Genomics
Graduate Programs, Travel to Professional Conferences and Symposia

<http://www.genetics.iastate.edu/travel.html>

TOXICOLOGY TRAVEL AWARDS

Iowa State University Interdepartmental Toxicology Graduate Programs,
Travel to Professional Conferences and Symposia

<http://www.toxicology.iastate.edu/travelTOX.html>

SOT TRAVEL AWARDS

Society of Toxicology Awards and Fellowships For Graduate Students

https://www.toxicology.org/ai/af/awards_details.aspx?criteria=14

SFN TRAVEL AWARDS

Society for Neuroscience Travel Awards

<http://www.sfn.org/awards-and-funding/individual-prizes-and-fellowships/travel-awards>

RNA TRAVEL AWARDS

RNA Society Travel Awards

<http://www.rnasociety.org/conferences/rna-2015/travel-fellowships/>

SACNAS TRAVEL AWARDS

Society for Advancement of Hispanics/Chicanos and Native Americans in
Science

<http://sacnas.org/events/national-conf/travel-scholarships>

FASEB TRAVEL AWARDS

Federation of American Societies for Experimental Biology

<http://www.faseb.org/MARC-and-Professional-Development/Travel-Awards.aspx>

UPCOMING CONFERENCES...

RNA 2015

<http://www.rnasociety.org/conferences/rna-2015/>

May 26-31, 2015

University of Wisconsin, Madison, WI, USA

CURE SMA 2015

<http://www.curesma.org/news/2015-conference-registration-open.html>

June 18-21, 2015

Westin Crown Center, Kansas City, MO, USA

FELLOWSHIPS & AWARDS

By: DILSHAN HARISCHANDRA & HIRUNI HARISCHANDRA

GRADUATE STUDENTS



Melanie Abongwa

Melanie Abongwa, a third year graduate student in Dr. Richard Martin and Dr. Alan Robertson's lab, successfully renewed her fellowship from the Schlumberger Foundation Faculty for the Future for the academic year 2015-2016. Her research focus is in anthelmintic potential and metabolomic profiling of extracts and chromatographic fractions of plants commonly used in rural villages in northwest Cameroon for the traditional treatment of nematode parasite infections, including: onchocerciasis (river blindness), lymphatic filariasis, and ascariasis. Abongwa also received the third place "Emil A. Pfizer Drug Discovery Student Award" in the student poster contest for her poster, titled: "In Vitro Filaricidal Activity, Cytotoxicity, and Phytochemical Analysis of Crude Extracts of *Daniellia oliveri* and *Psorospermum febrifugum*" at the 54th Annual Meeting of the Society of Toxicology (SOT), held in San Diego, California March 22-26, 2015.



Sreemoyee Acharya

Sreemoyee Acharya, a fourth year student in Dr. Timothy Day's lab, was awarded the Biology Teaching Assistant Learning Community (BTALC) Fellowship in January 2015. The BTALC, started by the ISU-HHMI Biology Teaching Fellowship Program, is funded by the Howard Hughes Medical Institute (HHMI), and it provides a venue for graduate students interested in pedagogical practices along with the concept of "teaching as research" to gain and share experiences. The goals of this learning community are to improve undergraduate biology education at Iowa State University, and to provide opportunities for professional development of teaching assistants interested in pedagogy, best practices, curriculum development, and/or future academic careers. Acharya will be attending a series of five interactive lectures meant for professional development and improved pedagogical sophistication as part of her fellowship training.



Cole Converse

Cole Converse has been awarded a \$10,000 merit scholarship for each year of dental school at the University of Iowa College of Dentistry, where he will start dental school in the fall. He was one of only four applicants to receive this scholarship. Converse graduated this May with his master's degree in biomedical sciences.



Nicolas Wheeler

Nicolas Wheeler, a second year student in Dr. Timothy Day's lab, received the Brown Graduate Fellowship from the Office of the Vice President for Research at Iowa State University. The award offers \$10,000 to outstanding graduate students with the purpose of strategically advancing scientific research at Iowa State. Nic plans to use the funds to further the optimization of genome editing in parasitic blood flukes of the genus *Schistosoma*.



Muhammet Ay

Award: Genetic Travel Award, Iowa State University Interdepartmental Genetics and Genomics Graduate Program

Conference: Society of Toxicology, 54th Annual Meeting, 22–26 March 2015, San Diego, CA



Dilshan Harischandra

Poster title: "Lysosomal Dysfunction Caused by the Environmental Neurotoxicant Manganese Increases Exosome-Mediated Intracellular Transfer of α -Synuclein"

Award: Toshio Narahashi Graduate Student Poster Award, First place, Neurotoxicology Specialty Section. Molecular and Systems Biology Specialty Section graduate student research award, second place

Conference: Society of Toxicology, 54th Annual Meeting, 22–26 March 2015, San Diego, CA

Presentation title: "Environmental Neurotoxin Manganese Promotes Cell-to-Cell Transmission of α -Synuclein via Exosomes in Cell Culture and Animal Models of Parkinson's Disease."

Award: Best Oral Presentation Award, Graduate student platform presentation,

Conference: Central States Society of Toxicology Meeting, 16-17 Oct 2014, Kansas City, MO

Award: GPSS Research Award for best overall research impact presented by the Graduate and Profession Student Senate (GPSS), Iowa State University, 2 April 2015, Ames, IA



Monica Langley

Poster title: "Preclinical Efficacy Testing of the Mitochondria Targeted Antioxidant Mito-apocynin in the Transgenic MitoPark Mouse Model of Chronic Dopaminergic Neurodegeneration"

Award: Toxicologic and Exploratory Pathology Specialty Section (TEPSS) Society of Toxicology Pathology (STP) Award, Emil Pfitzer Drug Discovery Endowment Award, Second place graduate student poster award.

Conference: Society of Toxicology Annual Meeting, March 2015, San Diego, CA

Poster title: Non-motor Symptoms in the MitoPark Model of Parkinson's Disease, Central States Society of Toxicology

Award: Outstanding Poster Presentation Travel Award

Conference: Central States SOT, October 2014, Kansas City, MO



Vivek Lawana

Poster title: "c-Abl tyrosine Kinase is a Critical Mediator of Dichlorvos (DCV)-induced Cell Death in Dopaminergic Neuronal cells"

Award: Graduate Student Travel Support Award. Finalist Award for best poster presentation from Association of Scientists; Indian Origin Specialty Interest Group. Honorable mention for best abstract from Molecular and Systemic Biology Specialty Section.

Conference: 54th Society of Toxicology, San Diego, CA. March 22nd - 26th, 2015



Matthew Neal

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

Award: Third place for outstanding poster presentation

Conference: Molecular, Cell, and Developmental Biology Graduate Student Organization poster competition, 31 March 2015, Iowa State University



Souvarish Sarkar

Award: Toxicology Travel Award, Iowa State University Interdepartmental Toxicology Graduate Program.

Conference: Experimental Biology meeting, March 28 – April 1 2015, Boston, MA



Qi Xu

Award: Toxicology Travel Award, Iowa State University Interdepartmental Toxicology Graduate Program.

Conference: Experimental Biology meeting, March 28 – April 1 2015, Boston, MA
\$300, Experimental biology 2015

FACULTY & STAFF



Dr. Arthi Kanthasamy, Ph.D.

Dr. Arthi Kanthasamy received a RO1 grant from the National Institutes of Health. Kanthasamy will use the grant to study the role of neuroinflammation in Parkinson's disease.



Dr. Steve Carlson, D.V.M., Ph.D.

Dr. Steve Carlson has secured a contract from Diamond Mills Industry to develop plant derived additives to eliminate salmonella from poultry. The total amount of the contract is \$50,000 for nine months.



Dr. Eric Rowe, D.V.M., Ph.D.

Dr. Eric Rowe has received the SAVMA Teaching Award for Basic Sciences. This award and two others were presented by SAVMA President Adlai Schuler at the final spring semester meeting of the student chapter of the AVMA to recognize excellence in teaching and service.



Wolfgang Weber

Wolfgang Weber received the SAVMA Service Award. This award and two others were presented by SAVMA President Adlai Schuler at the final spring semester meeting of the student chapter of the AVMA to recognize excellence in teaching and service.

A NEVER-ENDING BATTLE WITH INFLUENZA VIRUSES?

Someday the hostilities will be suspended by universal vaccines.

By: HOJIN MOON

The World Health Organization, or WHO, estimates that more than three to five million people are severely ill with the flu infection worldwide, and 250,000 to 500,000 flu-infected people die annually. The immune compromised generations - those younger than two or three years, and those over age 65 - show higher mortality. When scientists guess a mismatched flu strain to target for the annual seasonal vaccine, like they did for the 2014-2015 season, risk of the disease may be increased. In the context of economic loss, over \$37 billion is spent annually due to influenza and pneumonia in the United States. In addition, an even more devastating situation in both economic and public health terms could come from a flu pandemic. At this very moment, you may want to know what methods we currently have to deal with this viral infection, and what means we have to vanquish the threat of the flu virus infection in the near future. This article will briefly address those questions.

The main threat of the influenza virus is its frequent and rapid genetic mutation. This rapid genetic reassortment of the flu virus causes severe health issues, such as the mismatching seasonal vaccine issue and pandemic outbreaks. Even though we are able to get seasonal flu vaccines annually, meaning it is not a mismatched vaccine, the mutated flu virus easily evades our immune defense system, which is previously built by the vaccination before the flu season. The efforts of scientists to eliminate the flu virus infection are classified into two categories: the pursuance of antiviral drugs, or the pursuance of vaccines.

Currently, three anti-influenza medications are approved by the United States Food and Drug Administration: Oseltamivir (Tamiflu), Zanamivir (Relenza), and Peramivir (Rapivab). These drugs are neuraminidase inhibitors, which are useful for both influenza A and B viruses, and offer much broader protection compared to flu vaccines. These antiviral drugs offered tremendous help to infected people during the 2009 pandemic. However, the side effects of these antiviral drugs still ignite significant controversy among scientists. Although

antiviral resistance of current flu viruses to these drugs has not yet been reported as “alarming”; no one knows when these virus will acquire highly resistant genes against the drugs.

The other current means to control the flu virus infection is vaccination. Despite its challenges (long-term manufacturing, risk of mismatching strains, and allergic response to the egg) vaccination against the flu virus is still considered the most cost effective measure to prevent and control influenza infections. Vaccines that are currently licensed and used worldwide (e.g. seasonal flu vaccines) are either inactivated virus vaccines or live attenuated virus vaccines. Both vaccines induce immune responses toward hemagglutinin (HA) protein and neuraminidase (NA) protein of flu viruses. Those proteins are well exposed on the surface of the virus, and in turn our immune systems can easily recognize the protein and induce preventive immune response effectively. However, the elicited neutralizing antibodies by the vaccines are mostly strain-specific. Thus, the seasonal flu vaccine must be updated annually to match antigenicity with the currently or newly circulating flu viruses. In addition to this inconvenient circumstance, seasonal flu vaccines are usually not effective vaccines for pandemics. Because of this, pandemic and zoonotic flu outbreaks have motivated development of universal flu vaccines inducing broader and longer lasting protection against various flu strains.

Because of the inherent property of the virus (frequent and rapid genetic mutation), scientists have focused on genetically conserved regions, such as extracellular matrix protein 2 (M2e) and HA stalk domain to develop an effective universal flu vaccine. Among the universal vaccine antigen candidates, M2e is the most studied one, and it showed good protection in mouse models. However, immunogenicity and potency of M2e in other experimental animal models and its potency are less convincing compared to the results from mice evaluations. Recently, scientists have isolated broadly neutralizing antibodies

from humans and characterized the interaction between the antibodies and influenza HA protein in binding. As a result of these studies, researchers returned to focusing on HA stalk region for vaccine candidates, and developing a HA stalk region-based universal flu vaccine to protect from all subtypes of influenza. Although these efforts shed light on the feasibility of universal flu vaccines, they were not able to overcome important hurdles: the low immunogenicity of the antigen, incomplete protection against heterosubtypic flu viruses, and difficulty in presenting proper epitopes to elicit broadly neutralizing antibodies.

Nonetheless, many researchers continuously try to develop universal flu vaccines, and some of the developed vaccines are now in the clinical stage (see table 1). Although there are still many issues to resolve in those attempts using M2e and HA stalk, such as the necessity to increase immunogenicity, to increase breadth of protection for most flu strains, and to generate intact structure of vaccine antigen as its native form to elicit proper immune response, answers are on the way. The huge and continuous effort of scientists provides hope that the never-ending battle with influenza viruses could come to an end in the near future.

See table on next page.

Table 1. Development status of current vaccine candidates

Organization Identifier	Approach, Target, Adjuvant	Pre-Clinical	Phase 1	Phase 2	Phase 3
Novartis (USA)	Use of MF-59 adjuvant to achieve broadly cross-reactive antibody response.				✗ & Phase 4
VaxInnate (USA)	Fusion protein between influenza M2e and bacterial flagellin (TLR5 ligand). Self adjuvanted. Proposed to be used with conventional TIV.			✗	
Dynavax (USA)	Fusion protein comprised of two highly conserved influenza antigens, NP, and M2e, covalently linked to proprietary immunostimulatory sequence. Envisioned to be used with conventional TIV.		✗		
Wistar Institute (USA)	Fusion protein between M2e and NP, expressed in chimpanzee adenovirus vector.	✗			
Florida Vaccine and Gene Therapy Institute (USA)	Computer optimized consensus HA sequence. Elicits broad antibody response. Alum adjuvanted.	✗			
Icahn School of Medicine at Mount Sinai (USA)	Various approaches to target conserved broadly reactive epitopes on HA stalk, such as “headless” HA or functional chimeric HA (comprised of non-matched “head” and “stalk”) expressed either in the context of whole virus or as a rHA. Use of recombinant cHA protein requires adjuvant.	✗			
University of Pennsylvania (USA)	Adenovirus expressing broadly-neutralizing monoclonal antibody against HA delivered by intranasal administration.	✗			
Sanofi Pasteur (USA)	Multiple, including support for Flanders Institute and the Vaccine and Gene Therapy Institute. Internal work attempts to develop sequence-optimized HA.	✗			
Georgia State University (USA)	M2e expressed in a virus-like particle (VLP).	✗			
Merck (USA)	M2e-based vaccine comprised of peptide fusion to KLH carrier protein.	✗			
University of Wisconsin (USA)	“Headless” HA expressed together with NA and M1 in Drosophila S2 cell line for induction of anti-stalk antibodies	✗			

Extracted from background document (Status of vaccine research and development of vaccines for universal influenza vaccine) of WHO Product development for vaccines advisory committee meeting, 2014. http://www.who.int/immunization/research/meetings_workshops/pdvac/en/

THE GRADUATE GUIDE

By: SHIVANI GHASIS, LUNA KC, HIRUNI HARISCHANDRA, SREEMOYEE ACHARYA,
DILSHAN HARISCHANDRA, JONEBAE SEO, PRINCE AGBEDANU

This edition of the herald presents the 11 elements of the ideal graduate student. Here, the ideal graduate student refers to one that excels as a young scientist aspiring to go through graduate school successfully by being able to find a balance in all things; he succeeds by having the following attitudes, drawn from the viewpoints of dedicated graduate students and postdocs of the department of biomedical sciences.

1. Dedication is important

Dedication means having passion for something you've always wanted to do in your life. A dedicated graduate student works diligently towards his/her project and sees every challenge as an opportunity. So it goes: "When you love your work, you will be dedicated to it." Be sure you love it first, and the rest will follow.

2. Promptness

A graduate student should be prompt; not only in taking actions, but also in taking responsibilities of those actions. It requires an active and decisive mindset to be prompt, and this is a quality which helps you be an independent thinker in the long run. Again, lack of dedication will negatively impact promptness.

3. Avoid the blame game and give no excuses

As a graduate student you work as part of a team in a research lab. While working in a group, you may fail to do your job correctly, which affects not only you, but others around you. In such situations, it is easy to make excuses and blame others for your problems. However, this disrupts normal functioning of your lab, and might create conflict among the lab members. The most important thing for you, as a graduate student, is to accept the reality, take responsibilities of your actions, and try to fix the damage.

4. Have a mindset willing to tolerate an array of human folly and injustice

Graduate school brochures and websites can be misleading, often showing happy students in happy places, doing happy things at all times. But life as a graduate student isn't always rainbows and unicorns. This phase as a graduate student exposes you to certain unanticipated challenges and struggles. A student might come across difficult courses, lack of funding, unfriendly lab mates, incompatible principle investigators (PIs), or if you are lucky enough, the best of all worlds. In the end, it is important to work in a

peaceful and (somewhat) stress-free environment. Be aware of your surroundings and maintain a good relationship with everyone. Often, many students switch labs due to a dislike for the project or problems beyond your control, and the sooner it's done, the better. If you feel uncomfortable in any situation, first and foremost, talk it out with the people concerned. This is where you need to be brave enough to take the first step. Many problems can be averted, provided an open discussion ensues. If you are still unsure, then discuss your options with the heads of the department they are always aware of everything and they can provide the best support possible. As Baz Luhrmann mentioned in his sunscreen song; "Be careful whose advice you buy but be patient with those who supply it." Every person is different. If you still feel that you are not happy with the outcome, then try switching labs and research. The goal of coming to graduate school is to complete it successfully and it is imperative that one leaves essentially with somewhat good memories. But never ever give up—the joy of securing your degree after years of hard work, toil, frustration, and exhaustion is totally inexplicable.

5. **Be motivated at all times even when there is little hope for immediate gratification**

Rome was not built in a day. All great achievers throughout the course of history have attained success through years of hard work, toil, sweat, rejection, and failure. Obtaining a doctorate degree is no easy task, nor an easy achievement. Very few get admitted to their university of choice, nor to their desired field of research. The very fact that you got selected, however, sets you apart from many prospective students. It means there is something special about you. The first experiment you perform may fail, but that should not stop you (neither should the one hundredth time you fail the same experiment). If you hear of any person who has completed an advanced degree with absolutely no hurdles whatsoever, then understand that either that person had extraordinary fortune, or he may have painted a false picture. Always remember, you are never alone—there's always help and support if you seek it actively. When J.K. Rowling gave a speech to Harvard graduates in 2008, she said the following: "You might never fail on the scale I did, but it is impossible to live without failing at something, unless you live so cautiously that you might as well not have lived at all—in which case, you fail by default."

For most of us, the journey through graduate school is a bumpy ride. If one's experiments work perfectly and they graduate within three years without facing any problem, it is because of that person's luck, rather than their ability because this is almost never the case. Once we graduate and go out into the real world, we need to be able to solve our own problems, and graduate school is the place that prepares us, and gives us the training for that. Therefore, the more problems you face during your training, the better you become at analyzing and solving these problems. If your experiments fail, read current literature and see whether there are alternatives or try different methods to see whether you can get it to work. Learn from your mistakes—go back, read the instructions, note the smallest details, consult and seek advice from other lab members, and give a go at it again. Believe me, these provide the most gratifying results! However, do not get demotivated if things don't work out; it is not your fault. A good PhD program is one where you get the training to critically think and solve problems in such a way that enables you to stand on your own once you graduate and go into the real world.

6. Be sure to give credit where it is due

The purpose of a graduate program is not solely focused on just academics. It helps to develop an all-round personality and to prepare a person for a future career. Just as you are working tirelessly to achieve your goal, similarly, there are people around you, your lab members or other colleagues, who burn the midnight oil for that same purpose. Being a good, honest person is way more important than being a successful person. Taking material from another person to get your work done, and not offering due credit, is equivalent to stealing. It might bring you fame and fortune for a fleeting second, but in the long run your career, your life, and your reputation will be destroyed forever. In a lab, you do not work on your own, you work with many people—it's a team effort. So, in the process, you will be jeopardizing others' careers too. Think well before you take any drastic measure—and concentrate on the long run. There's always a way out to solve a problem, no matter how impossible and unreasonable it may seem at the moment.

7. Do not lie

This is probably the most important lesson that our parents have tried relentlessly to incorporate within us, ever since we were born. Mark Twain once said, "If you tell the truth, you don't have to remember anything." As mentioned in the previous point, the momentary lapse in judgment may initially provide fame, but this is short lived. You have been accepted to an excellent program based on merit, and there is no point destroying your hard earned glory for a couple of lies. If your experiment is not working, mention this truthfully to your lab members and your PI without fabricating the data. Remember, all experiments are expected to be reproducible, meaning others attempting the work must yield similar results. In case that fails to happen, papers are retracted, fines are imposed, grants are refused, and careers are damaged beyond repair. These lessons are what we should deeply impress upon our minds.

8. Work with a good mentor and advisor

Now this is a tricky point. Mentors and advisors are human beings too, and they may be flawed. However, it is difficult to comprehend a personality at first glance. The key element of a good mentor is comfort—you need to be comfortable around your PI. He/she is perhaps the most important person in your graduate school training, and it is imperative that you choose him/her wisely. He/she is someone who does not only guide you to the completion of your degree, but he is also one that plays a role in preparing you for your future life. A good advisor to one student, however, may not be a good one for another. For example, one student may prefer to work mainly on his or her own and not like it when the PI checks with them regularly, whereas another student might prefer more guidance with regular meetings. It is important that you have the same principles as your advisor or your journey will be even more difficult.

To be sure you find a match, it is advisable to conduct some background research on your potential PI by consulting present lab members, or better yet, the students who have graduated before. Try rotating in labs before choosing the one best for you—you can thus get a taste of the environment for your own benefit. Often students choose labs which do not match their initial field of interest simply because they preferred the PI in charge, so

it's also very important to be flexible. Another form of mentoring comes in the form of senior graduate students in your lab or program. Most programs assign you a graduate student mentor and my advice is to make the most of this opportunity. Senior graduate students are a great asset because they went through what you are going through not so long ago, and can provide you with insights that can be life-savers. Find someone who pushes you, encourages you to reach your maximum potential, and never gives up on you.

9. Read, read, read

New discoveries are made every day. It is important to be up-to-date with the important findings and current techniques applied, especially in the field of your research. You don't want to spend your time, energy, and resources proving a hypothesis that has already been published! You increase your knowledge by reading journal articles and reviews pertaining to your field, you broaden your perspective by reading about the latest inventions and discoveries in other areas of research, and lastly, it helps you to think outside the box.

10. A sense of humor about things is always good

"It is not getting any brighter out there. You have to come to terms with stupidity and make it work for you" —Frank Zappa. Let's face it, 99% of tests conducted end in failure. Rather than getting dejected, it is necessary to maintain a positive and bright attitude through the ups and downs of graduate student life. After all, laughter is the best medicine after a failed experiment!

11. Look at the bright side of things

The path of a graduate student isn't all dark and dreary. You get to work on topics that excite you, travel to various places (via conferences) and meet different people, share your experience, and even collaborate with scientists from other universities. At the end of your graduate studies, your dissertation is a not only proof of the research you have carried out, it is proof of the research that, in a small way, moves a field forward.

This article has been adapted from: laea, David B., and Natalia Gertsik. "So You Want to Be a Graduate Student?" ASBMB Today, Vol 14, No. 4 (Apr. 2015): 29-31. Print.

THE SPREAD OF SCHISTOSOMIASIS

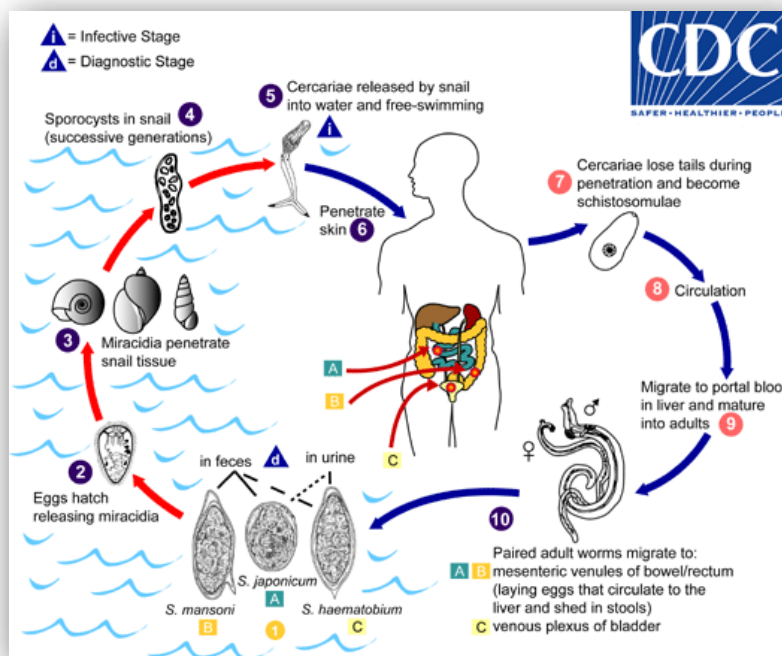
By: SREEMOYEE ACHARYA

Schistosomiasis, also known as snail fever, bilharzia, and Katayama fever, is a neglected tropical disease, prevalent mostly in tropical and sub tropical locations of the world, namely Africa, the Middle East, the Caribbean, Brazil, Venezuela and Suriname. This disease dates back to 1200 B.C., when calcified eggs were discovered in Egyptian mummies. Presently it is mostly found in areas which don't have access to safe drinking water and proper sanitation. According to the World Health Organization (WHO), more than 200,000 deaths per year occur in the sub Saharan African continent as a

result of Schistosomiasis. This disease is a major source of global morbidity and mortality, affecting more than 200 million people worldwide, with more than 700 million people living in the endemic areas.

The causative agents behind the spread of the disease are parasitic worms, which may infect the urinary tract (urinary schistosomiasis) or the intestines (intestinal schistosomiasis). People are exposed to this disease when they come in contact with contaminated water previously infected with the larval forms of the parasitic worms, known as cercariae.

Prior to human penetration, these cercariae undergo cycles of growth and multiplication within attractive red snails, after which they are released into the water and they make their way into humans. Once inside the human hosts, the worms reside within the veins, and ultimately move from the lungs into the liver, where the worms undergo maturation. As a part of the life cycle, the adult worms deposit eggs within the liver or the blood vessels surrounding the urinary bladder and the intestines. One of the earliest symptoms of schistosomiasis is hematuria, which



IN THE LABS



PHOTOGRAPHED BY AMY BRUCKER

is blood present in the urine. Often in women the disease is identified by lesions, bleeding, and pain in the vagina and the cervix, whereas in men, the infection is characterized by pathology in the seminal vesicles and prostate. Bladder cancer is often a possibility in the long run. Based on the guidelines issued by the World Health Organization (WHO), when a village reports more than 50% of children with hematuria, mass treatment is initiated by the administration of the oral anthelmintic drug praziquantel. Praziquantel has been administered successfully over the past 30 years to control schistosomiasis in many countries. Unfortunately, some factors, like the restricted availability of safe water, sanitary facilities, mobilization, and education of affected communities, plus the limited distribution of the drugs have prevented the complete eradication of the disease. All these factors, in addition, to an increased possibility of praziquantel resistance, has reopened and encouraged the search for new drugs and alternative control strategies. In 2013, a review published by C.T. Fonseca et al.

provides a valuable insight into the world of parasitic genomes and bioinformatics, which in turn can be used in drug and vaccine development.

Various prominent research institutes have been established all over the globe to fight and attempt to cure Neglected Tropical Diseases (NTD), one of which is the Schistosomiasis Control Initiative (SCI), located within the Imperial College of London. Under this initiative, a number of successful organizations have cropped up all over the world (e.g. the Yemen Schistosomiasis Project, supported by the World Bank (2014-2016)). In December 2014 and January 2015, health workers distributed praziquantel to children and adults, thus bringing down the proportion of heavy Schistosoma infections to below 1%. In January 2015, the Ethiopian Federal Ministry of Health introduced a ground breaking deworming program for school age Ethiopian children, aiming to create a disease free environment as soon as possible. As per the report published by WHO in February

2015, praziquantel still remains the primary drug of choice, followed by oxamniquine, which is specific for *Schistosoma mansoni*.

To disrupt the *Schistosoma* life cycle, Dr. Tim Day's lab embarks on pursuing select receptors that could be valuable drug targets in this parasite. In the lab, RNA interference is used to suppress the expression of these receptors and thus observing the consequences on the development stages. In addition to the suppression, the lab is also in the process of developing unique microfluidic phenotype screening platforms in order to assess the effect of the suppression systems. This ongoing project promises to identify more appropriate compound screening methods for *Schistosoma* drug discovery.

The hopeful consensus is that in the future, schistosomiasis can be effectively controlled in a coordinated approach with treatment on a large scale with safe and effective drugs, and at regular intervals.



PHOTOGRAPHED BY AMY BRUCKER

FACULTY SPOTLIGHT

Dr. Ravindra Singh

By: PRINCE AGBEDANU & HIRUNI HARISCHANDRA

We realize you have had a lot of success in research. What drives you? What's your motivation?

When you are in science you have to fix your goal, what you want to do. An important thing to consider is to do something that people will remember; a discovery that can be translated, something that others can use. So my goal changed from simply publishing papers to making discoveries that the public will appreciate. I also believe that this has to happen during one's lifetime. There are a lot of great discoveries being made but people don't realize their importance until ten years later and the inventor is no longer alive to see his or

her work being appreciated. Therefore, it's important to start thinking in those directions very early on. It's easy to get distracted. There are many times where people have come up with money for me to do science (that they would like) and I have said "no" to them because once you take money, you have a commitment; you have to write reports and that takes away time. Not that it's bad, it simply means you have only that much time and you have to focus on certain goals that have high impact.

So your main focus is not publication driven? You want your discoveries to go to the general public?

I am not against publishing, but publishing too soon with too little data. Everytime you write a grant it takes your time; everytime you write a paper it takes your time. Why not use your time wisely? You make a highly reproducible discovery first and then you can publish. My saying is that "a good finding is fundable, publishable and patentable" and we have been successful in this. All our work has been fundable, patentable, and publishable and we generally have good stories to tell. Publications are important because you need to tell what your findings are so that people know you are moving forward.

In the process of doing

this, what are some personal challenges you have faced?

Anytime you have a finding that does not conform to existing literature or hypothesis, people tend to ignore it. You build a hypothesis based on published literature and when you find something which is not supported by the literature, the task of publishing it is an uphill battle. You also have to find ways to demonstrate that it's a real finding. For example, if you are doing a western blot, your proposed mechanism will be based on the expected up-regulation or down-regulation of the protein. On the other hand, if you find something that is completely unexpected, such as an entirely new isoform of the protein, that will be an exciting novel discovery. However, such novel findings require validation by additional techniques. In other words, one technique is not enough to make bold claims.

Going back to your way of doing research, I have a question regarding graduate students. Your main focus is not to publish, but to do something that has a high impact to society instead. How does that affect graduate students who need to publish in a timely manner to graduate? What are your

expectations from your students?

I'm not against publishing. We publish things which have a certain appeal. I, myself, am a managing editor of a journal with an impact factor of four. I can publish more frequently in this journal or any other journal with similar impact if I wanted to. However, if you rush to publish, people will read that story and judge you by that standard. We are interested in making very in-depth reports. Generally, our publications have about 20 pages. It is very difficult to refute the claims that we make. Everyone is slowly coming to realize that there is nothing in the numbers game. It is actually the claim that matters. Claims in paper should be solid. If you make a weak claim, someone can make the counter claim with a lot of supporting experiments. Such mistakes could be avoided simply by doing more experiments in the first place. While this approach would extend the publishing time from six months to one year, you will have a complete and better story at the end. Both my graduate students have publications where the work started quite early. Now they are writing up their own work and understand that this is the story that they want to have. They are very happy

because the papers they are writing now have solid stories. There is a value to it when it comes to applying for jobs. People look at where you have published, who is citing your work, and it all turns out to be good.

I run the lab a little differently. I want to create scientists with responsibilities. Each person in my laboratory makes his or her own solutions, even the most commonly used ones. If two people are using the same primer for PCRs they will synthesize these primers separately. That way, the person is solely responsible for the results he or she produces.

Do you view research in academia as a form of competition where you want to hurry up and publish your materials with the fear that if you don't, someone else will, or are you comfortable with your work and move at your own pace?

If you are at the top, people are competing with you. At conferences, we present unpublished work or only preliminary data for others to see or even publish in that area. In a way, we prime other people such that they think it is an interesting area of research. Once they publish in that area that is evidence

that the idea works and now we can proceed. It's the validation that is important, not the basic finding. There could be both advantages and disadvantages but in short, presenting preliminary data at conferences is aimed at inviting more people to work in this area. On the other hand, if you have done a substantial amount of work, you can show it and try to immediately publish it. Faking laborious steps, making animal models, are not things that people can quickly reproduce, so you are safe for some time with the presentation of these kinds of data. In short, do not show your result until you are ready to publish. In my field, we file for patents even before presenting at a conference. In addition, the fact that it is published in a conference proceeding gives you a lot of security because even if someone takes the idea, you will get the credit because you were the first to publish the abstract. Sometimes, if the discovery is of much significance, you don't even write it in a grant until you file for the patent first because that's your bread and butter.

Can you use this platform to tell us a little about what your current research is about?

My lab works on Spinal

Muscular Atrophy. Our goal is to know the mechanism of severity of the disease; what are the disease modifiers; what is the pathology of the disease? We know that these diseases can be regulated by splicing factors, thus we are trying to elucidate the splicing mechanism of selected genes. We also look at RNA protein interactions and gene therapy targets and splicing correction.

What advice do you have for graduate students in general?

Challenge your boss. Read high impact literature; that is very important. Try to do hypothesis-driven research. Understand your hypothesis correctly and write down your findings. Use the right controls; you need both a positive control and negative control. As a graduate student, you can say you have done everything correctly, but you have to think which possible question reviewers might raise. Most graduate students do fantastic experiments but they miss one or two controls. The problem is reproducibility. Your work will not be judged by volume of data alone, but also by quality of data. If you saw about a 20% increase in the level of a factor in your first experiment, but saw about a 50% increase in a repeat experiment, you need to state this. In this case, it is

important to give a range. If the data is not reproducible, you have to state that as well. You don't have to worry about sticking to your hypothesis. Feel free to say, "by the way, we could not reproduce this." Honesty is very important (rather essential) for being a scientist. The same drug when given to multiple animals might give you different results, because each animal is different. Animals are not cell cultures; they are expected to behave differently. Unfortunately, people try to remove outliers to make their data consistent. I would caution against that.

Finally, how do you want your students to represent you once they are out of Iowa State University?

After finishing work in the lab and moving forward, I would like my graduate students to take a challenge and not do the same research. "You are trained enough to go and lead in a field of your choice." Science is a field that changes constantly. What I did ten years ago, it's not the same now. Science is technology-driven. My goal is to pursue those areas that are challenging. Those days are gone where one person in the field does the same thing as their successors, who do the same thing as

their successors. That is not a good approach. There has to be changes and challenges. I don't think my graduate students represent me; they represent themselves. I have given them a good training and freedom. I tell them "if you do something and write it, even if I don't agree with you, and you submit it to my

journal, I will try to publish this but I won't be a co-author in that paper." I have no agenda here that they should represent me. If my student is successful, it's purely his or her credit, but if he or she is not successful, he probably won't be in my lab. We make a lot of investments in our graduate students. When

stakes are so high, you don't want students who are not committed. I always tell my students "the stipend is the least expensive part of your training. The most expensive part is the resources (chemicals, reagents, and facilities) and my time."



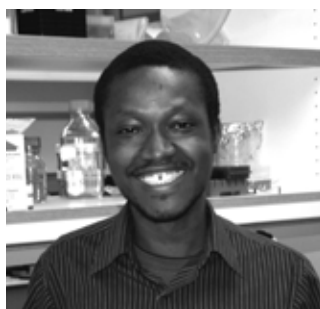
PHOTOGRAPHED BY AMY BRUCKER

MOSTAFA ZAMANIAN

Dr. Mostafa Zamanian joined the Neuroscience Graduate Program in 2005, and completed his PhD in the laboratory of Dr. Tim Day in 2011. His doctoral work was concerned with neglected disease genomics and drug target discovery. Upon graduation, he migrated to McGill University in Montreal as part of a joint appointment between the laboratories of Dr. Michael Kimber and Dr. Paula Ribeiro. Most recently, he took on a Research Fellow position at Northwestern University in Chicago, as a member of the laboratory of Dr. Erik Andersen, while maintaining an appointment at Iowa State through the Kimber laboratory. Dr. Zamanian states that these experiences have helped him approach the neglected disease field with a variety of scientific perspectives, working on projects that blend both computational and 'wet lab' approaches. He currently works at the intersection of quantitative genetics and drug resistance. With funding from the Gates Foundation, Dr. Zamanian collaborates closely with the Day lab on projects related to genome editing. According to him, both Dr. Kimber and Dr. Day provided him a great deal of scientific space to freely roam, and presented him with early opportunities to aid in the creative formulation of projects and grants.



SAMUEL BUXTON



Dr. Samuel Buxton pursued a B.Sc. (Honors) in Biochemistry at the University of Ghana before moving to Iowa State University in 2007 to pursue a PhD in Toxicology. After finishing co-Tuttle PhDs at ISU and François Rabelais University of Tours, France in 2012, he completed a post doc in Dr. Alan Robertson's lab. Dr Buxton is presently working in the lab of Dr. Xander Wehrens, who is well known for his research in cardiovascular disease at the Baylor College of Medicine, in Texas. Baylor College of Medicine has a vibrant, competitive community for human medicine research with a strong emphasis on postdoctoral training. At Baylor, his research involves the study of the role of protein phosphatases in the pathophysiology of Atrial Fibrillation, a common arrhythmia affecting millions of people worldwide.

Dr. Buxton's advice for current graduate students is to understand the big picture, i.e. success transcends bench work. Developing people skills, presenting one's research to those outside your field, attending conferences, establishing strong connections and networks, and eventually following up on job applications with emails or calls whenever appropriate, are all very important for one to succeed. He also places a great deal of importance on learning something outside one's comfort zone, for example, a new technique in other labs, or under the guidance of other researchers. This will boost one's resume and open new avenues of scientific exploration post graduation.

Mentor Advice from Faculty in Biomedical Sciences

INTERVIEWED BY: SHIVANI GHASIAS

What are the qualities you look for in a prospective graduate student? (To help prospective students prepare themselves for grad school)

I ask what their expectations are in order to figure out what their perception is of graduate school. I find that the biggest determinant of how successful a student will be is their attitude and approach to research. As a PI, I appreciate those students who are independent and try to work out any kinks they might encounter while working in the lab.

What expectations do you have of your students?

Students should be self-motivated and drive their research independently. To have a student unable to design and run experiments on their own is bad for both the PI as well as the student concerned. If the students go through their graduate life just doing what their PI tells them to do, then they do not grow as a scientist. Since science does not usually work the way we think it should, students should not be discouraged by failed experiments but instead trouble-shoot and adapt to get the results.

How independent do you want your students to be? At what point do you want your students to come to you to seek your help or opinion?

As researchers, they should be able to independently develop and run their experiments. It's bad to have someone knock on my office door every hour of every day because it shows that he/she is not thinking critically.

Do you want your students to plan their own projects? Or since you have more experience and expertise in the field, do you think it will be more beneficial for you to plan their experiments?

While projects depend on the funding, planning the study and coming up with a hypothesis should come from the student. A healthy discussion between a student and his/her PI can help the grad student plan their projects.

What do you do or how do you help your students to achieve their end goal and grow professionally?

Professional development means many things to me.

Proficiency in bench work and later writing grants are important to developing a well rounded individual. Getting a PhD more than anything, means having the license to do research. There are other ancillary aspects like giving presentations, discussing and defending your study, collaborating with people in your field of study since they help you get new ideas, as well as networking with people from different fields to help you understand how to further your career.

How would you mentor a student who doesn't want to stay in academia?

With the current NIH funding situation, it is easy to see why it might be more tempting to join industry. There are pros and cons to being in both academia and industry. In industry, you have a defined project and good pay. However, your project is at the mercy of whatever is the trend in production among the science companies. In academia, you may be paid less but you have the freedom to take the project in any direction you wish for. My advice to students who want to go to either of these paths is that once you have made your decision, it is not set in stone. There are people who have joined academia after working for many years in the industry and vice versa. But you need to talk to relevant people when making any decision.

What is your opinion about activities that encourage interaction between students in the lab and even with you, for example, lab potlucks or outings?

We used to celebrate every lab members birthday. Back home during the holiday season, we would go to a restaurant and have a Christmas dinner. That never took off here! But it is understandable since everyone has family and would like to spend time with their loved ones. But it is nice to have a lab potluck and if any student takes the initiative then I am all for it!



**DR. MICHAEL
KIMBER**

What are the qualities you look for in a prospective graduate student?

I start by looking at test scores, including: GRE, the GPA, and TOEFL if it is an international student. After that, the main thing I look for is their area of interest. It is nice to have a student who is accommodative, friendly, and agreeable with other labmates and the major professor. Of course, rotations are the best way to recruit because then they get to know the lab and we get to know them. Having said all that, it is never one or two criteria, but an overall package that we look for while taking a new student.

What expectations do you have of your students? How independent do you want your students to be? At what point do you want your students to come to you to seek your help or opinion?

Initially, my colleague and I, train them closely. Every case is different than other. Some international students lack in English but they are very hardworking. On the other hand, some local students may speak English well but greatly lack the knowledge of scientific terminology. In short, the initial period is a training where we make sure that they are not just learning techniques, but are learning to be independent in planning experiments and coming up with newer ideas. Lab meetings are a good place where they learn the business of public speaking, and then go to some international meetings. We typically expect them to write them about two papers as first authors and two as collaborator to first author. This is, in short, a perfect formula for training a graduate student.

Do you want your students to plan their own projects? Or since you have more experience and expertise in the field, do you think it will be more beneficial for you to plan their experiments?

Our funding has been through NIH, so the work is decided. NIH grants us money to achieve some specific goals that we have been working on in our lab and therefore, the frame is fixed and students are required to work towards achieving these goals. However, there is always scope to go in a slightly different direction, or to explore the related area of research.

What do you do or how do you help your students achieve their end goal and grow professionally?

I always ask my graduate students what their ambition is. Based on what they want to do, we put forth effort in guiding them to build their future. Most of my students want to go into academia. Since our research is pharmacology related, we occasionally

get students who want to join the drug industry. In this case, we arrange a short industrial training while they are in my lab so they get exposure to the industrial culture. For individuals looking for academic positions, we ask them to take training classes offered by the university. Writing research papers is different than writing grants, and we make sure that the students planning to go into academia are trained in this aspect too.

What is your opinion about activities that encourage interaction between students in the lab and even with you, for example, lab potlucks or outings?

There are regular lab meetings, which are reasonably formal but have a lighter atmosphere. Besides that, we often have lab outings. I am fortunate that I get to work with students from different countries and this helps me learn about their culture and etiquettes. I also believe that this helps to create greater respect and admiration for each other. Apart from this, going to departmental programs and specialty section meetings helps them keep in touch with their colleagues in the department and helps them to share and learn information they need for their professional advancement. I am pleasantly surprised to see how well these graduate students get along.

Do you have any last words to our graduate students?

I genuinely feel jealous of these young scientists because they are starting their career now, and they have freedom, that I don't have, in a sense. I truly think they are the key to the future of research, and how our society will advance. The simplest example of this would be how nicely people get along at scientific meetings, which we do not see at political meetings. I think science can break boundaries and provides a platform to researchers from various countries and ethnic background without any discrimination. I am privileged that I got opportunity to train such wonderful individuals from various backgrounds. In the end, I wish all graduate students the best, and I will consider myself useful if I get a chance to help them in building their career.



**DR. RICHARD
MARTIN**

"[GRADUATE STUDENTS] ARE THE KEY TO FUTURE RESEARCH, AND HOW OUR SOCIETY WILL ADVANCE."

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One-Year MS Program through the eyes of a student

BY: REID BROWN

Spring is blooming as the students in the One-Year Masters program prepare to blossom forth, back into the wide world. But where are these students going, and who were they in the first place?

The MS program attracts a wide range of science-minded candidates looking mostly to prove themselves academically, and develop a stronger knowledge base for professional school or industry. Many of the students are recent graduates, while others have come back to school after taking years off and a few have traveled from abroad for various reasons.

The science curriculum is very good and will definitely prepare those who put the effort in for whatever they would like to pursue in the future. Students take a wide range of graduate level courses mounting to around 15 credit hours per semester. For the most part, the program is designed such that the classes complement each other. For example, in first semester we took both anatomy and physiology at the same time and the professors made an effort to sync their lectures to the same topics from different perspectives.

Other classes feel more eclectic because they are made to cater to an extremely wide range of topics. No class is this more true than for Methods of Biomedical Science, a lab course that tries to find labs for every possible technique and process relevant to biomedical science. To give you a sense of the class: in the first week we are injecting mice with sedatives, the second we are plating bacteria and growing phages, the third week we are doing pain sensitivity on horses, and the fifth we are learning about biosafety and good laboratory practice.

While the program does not have a required outside research component, it is certainly possible to join a lab should one want to. The wide variety of BMS faculty with interesting and diverse research areas has presented us with the prospect of getting hands-on experience, and many students in the program have taken advantage of this wonderful opportunity by being actively involved in research being conducted in the department.

In polling the students before writing this I found that quite a few got accepted this year into the programs they are interested including: veterinary school, medical school, podiatry school, optometry school, and private industry. However, the majority still do not know exactly where they will find themselves in the future. Many plan to apply again to medical school, physician assistant school, dentistry school, and other medically related programs. Others seek to enter PhD graduate programs in areas like genetics and biochemistry.

Overall, I think the One-Year Masters program at Iowa State does a very fine, if not perfect job, of preparing students with the knowledge of health related biological science. The program is aided greatly by quality professors and superb support staff who make the program run smoothly behind the scenes. I think this program is worth strongly considering for those that think an extra year of challenging classes will enable them to fulfill whatever future they have in mind.



PHOTOGRAPHED BY KELSI THRASHER

2015!

ONE-YEAR MS GRADUATES

Baber, Katherine
Berge, Kristine
Bonham, Julie
Brown, Reid
Cataldo, Rachel
Converse, Cole
Eastman, David

Gosa, Shelby
Guo, Mingxi
Hao, Shuang
Hays, Sally
Hu, Yawen
Johnson, Jessica
Johnson, Samantha

Li, Ruoran
Ligon, Cheryl
Lovaj, Taying
Luo, Diou
McNitt, Sean
Nelson, Laura
Phan, Phong

Randell, Holly
Robertson, Jessica
Singleton, Kirby
Thompson, William
Woody, Jeffery

TWO-YEAR MS GRADUATE

Lind, Melissa



Melissa Lind

Melissa Lind graduated from Iowa State this spring as a doctor of veterinary medicine with a master's degree in biomedical sciences. The title of her thesis was, "Time-course study of retinal pathology in mice infected with scrapie." After earning her undergraduate degree in biology from Iowa State, she worked for the United States Department of Agriculture National Animal Disease Center. Melissa then went on to work in Dr. Heather Greenlee's lab while pursuing her graduate degree. She has accepted a small animal rotating internship at a veterinary specialty practice in Buffalo Grove, Illinois, to start next year.



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