MEDICAL SCHOOL
CELL & DEVELOPMENTAL BIOLOGY
UNIVERSITY OF MICHIGAN

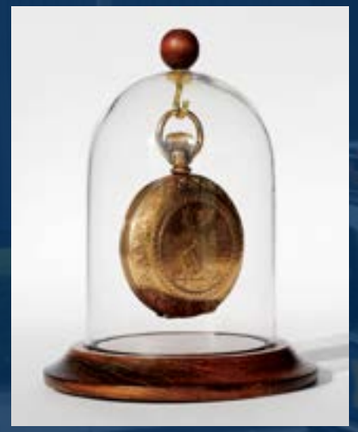
Department Newsletter

Fall 2014

MESSAGE FROM THE CHAIR

Deb Gumucio, Ph.D.

Soon, our department will celebrate 160 years of excellence! When the University of Michigan Medical School was founded in 1850, the Faculty of Medicine consisted of five Professorships. The Professorship of Anatomy was held by Dr. Moses Gunn, who also served as the Chair of Surgery (at a salary of $1,000/year). In 1854, the Department of Anatomy was officially established, with Corydon Ford as its first Chair. By 1870, Dr. Ford's Gross Anatomy teaching duties were expanded to include responsibility for the teaching of Functional Anatomy (Physiology) and Microscopical Anatomy (Histology). Interest in Histology grew rapidly, largely due to the efforts of Charles H. Stowell (whose rise from Lecturer to full Professor took only four years!). In gratitude for his leadership, Dr. Ford presented a gold watch to Dr. Stowell at Christmas in 1885. This beautiful watch was later bequeathed to the University, with the stipulation that it should be placed in the office of the then current Chair of Anatomy (Dr. Bradley Patten) and further passed down to each subsequent departmental Chair. That watch, pictured here, still sits in the Chair's office and is a constant inspirational reminder of the rich history of our department (drop in and see it in person!).



Over the years, our academic missions have evolved greatly. Widely known as the top Anatomy teaching institution in the country in the early years, we soon made our mark on multiple other disciplines, led by such notable figures as G. Carl Huber and Russell Woodburne (Histology) Bradley Patten (Embryology) and Elizabeth Crosby (Neuroanatomy). With the initiation of NIH funding in the late 1960's, research in the department grew exponentially, soon overtaking (but never completely displacing) the teaching component. Cell biology (under Kent Christensen), developmental biology (under Bruce Carlson) and later, molecular biology (under Doug Engel) emerged sequentially as key foci of our faculty. These changing missions demanded several departmental name changes, first to Anatomy and Cell Biology in 1978 and later, in 2000, to the present name, Cell and Developmental Biology.

You can learn much more about our departmental history and the individuals that shaped it by making plans now for the big Anniversary celebration on April 23 and 24, 2105. Half of the present faculty, all of the staff, several students and many Emeritus faculty have been working hard to plan this fun, informative and historically rich event. See the link on our web site cdb.med.umich.edu !

Our past successes are substantial, but our present and future prospects are even more promising. Our faculty are recognized as national and international leaders in their fields. Our departmental NIH ranking continues to climb, from 19th in 2012 to 10th in 2013. How have we done it? Inside this newsletter, you will learn about the exciting research that fascinates and engages current CDB faculty. Collectively, they published >90 manuscripts this year, many in the highest impact journals, including Cell, Nature, Nature Genetics, Nature Cell Biology, Cell Stem Cell, Science Signaling, Nature Neuroscience, Journal of Cell Biology, etc. Newly funded grants include Doug Engel's U01 for Sickle Cell Anemia; Diane Fingar's TWO grants on mTOR signaling; Roman Giger's Neilsen Foundation grant focused on immune repair of the injured spinal cord; a joint R21 for Dawen Cai and Bing Ye to develop innovative tools to depict the complete neuroblast lineage in the Drosophila brain; a multi-PI grant for Ben Allen, Charlotte Mistretta and Anj Dlugosz to study Hedgehog signaling in the olfactory and taste organs; multiple grants to Michael Hortsch to develop new teaching tools for phone and tablet formats; and Shiv Sivaramakrishnan's R01 examining G-protein coupled receptor selectivity, AS WELL AS his NIH Innovator award for spatial and temporal mapping of cell signaling. A new CDB chalk talk program for pre-submission grant planning (faculty helping faculty) has fueled several of these funding successes. Congratulations to all!

This past year also saw many awards bestowed on CDB faculty, staff, students and postdocs. There are too many to mention all here (please, do look inside!), but a few highlights include Doug Engel's Distinguished Faculty Lectureship In Biomedical Research, Brandon Carpenter's Rackham Outstanding Graduate Instructor Teaching Award and Swathi Yadlapalli's Weintraub Graduate Student National Award! Major Kudos!!

As we look to the future, we see huge opportunities for continued growth and success in our department. In this newsletter, you will learn more about CDB's role in Regenerative/Restorative Medicine; this is an area of actively coalescing strength at UM as a whole and CDB faculty are among its leaders and best. Also read about the amazing and innovative new program that is being developed by Dr. Andrea Ramos (a recent graduate from the Barolo lab), along with several graduate students. Not your typical "bring-them-to-us" approach to diversity recruiting, this program will support the travel of our students and faculty to provide week-long workshops in developmental biology to institutions with diverse student populations, allowing our facilitators to transmit their excitement about their work and providing an outstanding opportunity to identify and direct promising students to our CDB graduate program. Way to go, Andrea, it's genius!

.....it's so hard to be humble when your department is so awesome.....

Go Blue!

Deb Gumucio

> **"[A home for] the Department of Medicine and Surgery at this University… represents the fulfillment of a long cherished wish, the final relief of long felt wants, the realization, partly at least, of plans entertained for years, and prospects opening for a bright future."**
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> **-Corydon Ford describing the new Medical Building**, The Michigan Alumnus, Volume 8, October 1902

22
Primary Faculty

18
Joint Faculty

10
National ranking of Cell Biology Departments 2013

5

FIVE RESEARCH AREAS IN CDB

Faculty in the Department of Cell and Molecular Biology are studying a variety of areas of groundbreaking science. In each of these areas, they're seeking to understand the basic biology that leads to abnormalities in the way cells function. By getting a strong grasp on the mechanisms that lead to disease, they're able to find ways to address what's gone wrong. This will lead to treatments for many vexing diseases in the future that today have no effective remedy. Here are just five important areas.

Reversing Neurodegeneration

Some of the most daunting diseases involve a loss of the most crucial bodily functions. Diseases of the brain and nervous system are among the most heart-wrenching. The patient must suffer and loved ones must grapple with the fact that there's no effective treatment. CDB scientists are trying to make inroads, exploring potential cures for ALS, multiple sclerosis and Parkinson's disease. To do this, they're trying to better understand the function of the nervous system in the hopes of unlocking the mysteries of the brain. Faculty are exploring the way that neurons communicate with each other, and how that communication is impacted with disease. They're studying the impacts of specific proteins that contribute to neurodegenerative disease.

Watching Molecules At Work
Building Technologies For The Future

This field focuses on how diseases can be caused by mutations in proteins and chemical imbalances -- changes within cells that lead to human maladies. CDB faculty are employing new technologies that track how molecules and cells work together in the body. They're using microscopy and biosensors to map cell function. Faculty are looking at how changes in the way cells talk to each other can promote the growth of cancer. Mis-wiring of cells can cause epilepsy and schizophrenia. Scientists are using new technologies and sophisticated imaging methods to label individual brain cells and map their connections. Some faculty are using biosensors to monitor brain activity at the cellular level and understand how memories form. Proper wiring is crucial to allowing the brain to function well into a person's old age, so understanding this function is crucial.

Decoding Cellular Conversations
How Miscommunication Leads to Disease

Faculty are examining changes in cell-to-cell communication, found in diseases like Down syndrome, depression, diabetes and Alzheimer's disease. Researchers are studying "cellular crosstalk," where cells talk to each other and respond to incoming signals. Certain signals are used consistently during embryonic development and continue as a person ages. Better understanding of this process, and how it goes awry, could lead to treatment of human development and adult diseases. Faculty are attempting to map connections between hundreds of different nerve cells. If one understands how connections form during development and are modified during learning, this can help to re-establish cell to cell contacts following traumatic brain injury, seizures or strokes.

Cellular GPS
Getting There on Time

In a normally functioning cell, there's a system to help sort proteins, sending them to the proper locations at the proper time. Errors in this cellular GPS system can lead to neurodegenerative diseases like Alzheimer's disease, as well as cancer, diabetes and Parkinson's. Researchers are trying to better understand how this traffic system works and results in the proper movement of intracellular components, in the hopes that keeping traffic moving normally can prevent these types of diseases. In particular, they're looking at abnormalities in transport along the microtubular train tracks, which provide the critical "rails" for transport to different destinations in the cell. They're also looking at the impact of cells deprived of oxygen or essential nutrients. In this situation, cells respond by "cannibalizing" and re-using parts of themselves. CDB research is examining how the cell can switch the cannibalistic mode on and off. This has implications for treating heart attacks or stroke and could lead to more effective organ transplants.

Regenerative Medicine

Advances in stem cell development hold promise for treating diseases ranging from multiple sclerosis to Alzheimer's disease, Parkinson's and spinal cord repair. Following an injury, stem cells are crucial to the healing process, so learning how to activate them could speed up that process. Stem cells also play a role in replacing or restoring damaged cells, as in spinal cord injuries. Stem cells provide an opportunity to easily study the impact of various therapies in a culture dish, since they can be induced to become any type of organ. Researchers are looking at how stem cells replace themselves and how stem cells end up giving rise to organs and tissues during development and maintain these organs in adult life. The hope is that by better understanding how stem cells work, they can be used to improve stem cell transplantation so it's more successful. This field has already honed in on the way that bipolar cells behave differently from normal cells. By taking adult cells from the skin, then turning them into embryonic-like stem cells, researchers were able to see how the bipolar cells behaved differently than normal cells, and the effect that lithium had in making them behave more like a normal cell. Being able to try out different types of therapies on various stem cells is paving the way for individualized medicine.

REGENERATIVE MEDICINE IS THE FEATURE IN THIS ISSUE. READ MORE ON THE NEXT PAGE!

Explore all the questions that drive research and the faculty in CDB starting on page 20.

ONLINE There is so much more information about these exciting areas of research on the CDB website: **cdb.med.umich.edu/research**

A History of Innovation

by Martha Girsch

Inspiration can strike anytime – and a stroke of it that led to the creation of the Sorvall Ultrathin Frozen Sectioning Unit came to A. Kent Christensen after he attended an international scientific congress in 1966. Upon returning to Michigan, Christensen was motivated to examine his own scientific surroundings. His laboratory research involved the preparation of frozen sections for use in electron microscopy; bolstered by the exchanges on scientific research and innovation he'd had with his fellow speakers at the congress, he constructed a rudimentary cryosectioning device from materials in his lab. This prototype was designed to be mounted on an ultramicrotome, provided by Sorvall, Inc., a manufacturer and distributor of scientific instruments. With this prototype, tissue was frozen with nitrogen gas, cut into extremely thin sections, and dried, after which they could be viewed under an electron microscope. Christensen's innovative cryounit and its efficient preparation of ultrathin frozen sections caught the eye of Sorvall, Inc. and commercial production of the device as an accessory to Sorvall ultramicrotome began in 1970. Within a few short years, an innovative idea from one of our own CDB researchers had become a reality – one with the potential, in turn, to provide innovative and forward-thinking inspiration to future generations of scientists.

Above: Photo of three versions of the Ultrathin Frozen Sectioning Unit; original prototype (1966), secondary (1967), and commercial product by Sorvall, Inc (1970)

Regenerative Medicine

The powerful promise in researching cell development

Article by Julie Halpert

When Bruce Carlson began studying regenerative medicine as a graduate student in 1959, every textbook he read stated that skeletal muscles don't regenerate. A prevailing theory 20 years ago was that cells can't divide in the nervous system. "It was difficult to get research funding for regenerative research, since no one believed there was any direct application to humans," said Carlson, who headed the University of Michigan's Cell and Developmental Biology Department for 12 years beginning 1988. Carlson, now 76, demonstrated ways that muscles in rats could regenerate, a significant finding at the time.

Regenerative medicine uses biological mechanisms to heal tissues and organs. This can involve anything from stem cell transplantation to cells that are taught to work their way around an injury or mutation. The field has evolved rapidly from its origins in bone marrow transplantation. Deb Gumucio, interim chair of the Department of Cell and Developmental Biology, says the regenerative medicine field has "thrived in multiple areas," yielding many discoveries at the University of Michigan. Several researchers in the Department of Cell and Developmental Biology are involved in groundbreaking regenerative medicine work, finding ways to treat some of the most daunting diseases for which there is currently no effective cure, such as sickle cell anemia, Down syndrome, autism, spinal cord injuries and Alzheimer's disease.

One of the areas with the most promise is in developing more effective treatments for bipolar disorder. Sue O'Shea, the Crosby-Kahn Collegiate Professor of Cell and Developmental Biology, was in part motivated by witnessing those struggling with the disorder. Her work using stem cells is leading to insights that hold the potential for more easily determining which types of drugs will be most effective for each patient with bipolar disorder. O'Shea said that until recently, there was no truly good model for studying mental illnesses like bipolar disorder. You can't biopsy the brain of a person with bipolar disease or experiment on them to study the function of their brain neurons. Further, studying the brains of cadavers in patients who had bipolar disorder held limitations, since they were exposed to multiple drugs over a lifetime, so it was difficult to decipher how the disease worked and what mechanisms led to it. So O'Shea, along with her collaborator, Psychiatry Professor G. McInnis, created the first stem cell lines specific to bipolar disorder, making what are called induced pluripotent stem cells from the skin of adults with bipolar disorder as well as those without it. Her stem cells came from skin biopsies, but they can be made from just about any organ. She then turned the stem cells into neurons, or brain cells. This allowed her to reverse the clock and create embryonic-like, brand new cells. When she looked at the control and bipolar cells, she found that the bipolar cells behaved differently.

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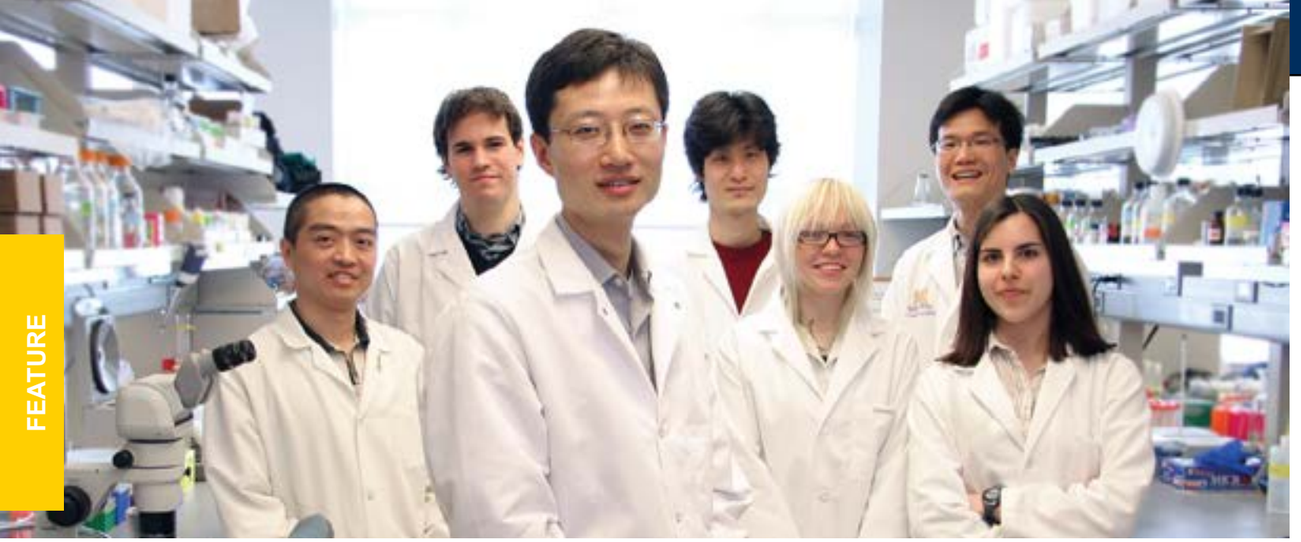
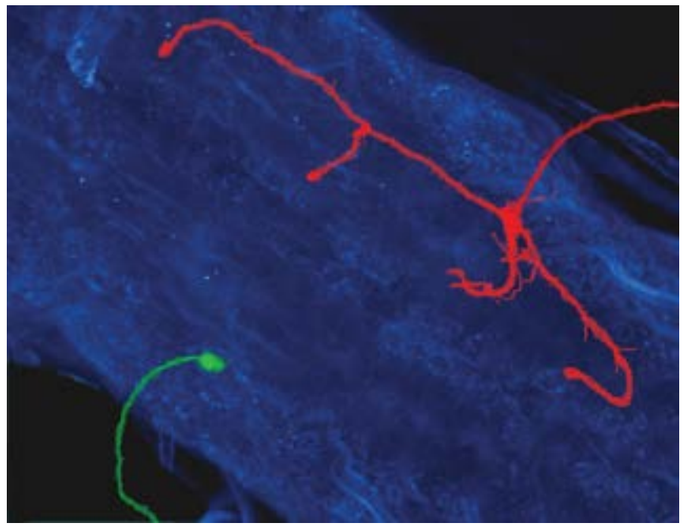
Left: 3D rendition of stem cell cluster



Bing Ye Lab

She discovered that the neurons were different in their firing capacity, reacting more often and strongly to stimuli compared with controls. But when lithium, a common treatment for bipolar disorder, was administered to those cells, their signaling response returned to normal. Though this validated lithium's efficacy, O'Shea said that it's a "non-specific kind of chemical," meaning that it affects signaling throughout the body and has some serious side effects. By identifying when things begin to go wrong from a pluripotent cell to a neuron in a bipolar patient, "we can understand the mechanisms and target that phase." Then, therapies that act on a particular signaling molecule can be developed. She says some drugs on the market offer potential. "There's been no way to do this before, so everything we're finding is basically new and that's what's exciting," she said. Once the area where the signaling is a problem is determined, she can test out a variety of drug therapies more easily on the stem cells. This could lead to more individualized medicine, and put an end to what is often a long trial and error process in determining which medication works best for each patient. O'Shea hopes to expand her research to study how bipolar differs from major depression and how that compares to schizophrenia. She says it could be five to 10 years before targeted therapies could hit the market, but says her discovery holds "huge potential."



This neuron relates the Ye lab's notion of how Dscam might contribute to Down syndrome

Bing Ye, an assistant professor in the Department of Cell and Developmental Molecular Biology, is trying to better understand how flaws in connections in neurological circuits can contribute to conditions like mental retardation and autism. His work could lead to treatments for severe brain disorders like Alzheimer's disease, learning disabilities and psychological problems, which are "at the root of so many diseases and social problems," he says.

Ye studies dendrites and axons and how they grow into proper shapes so they can form correct connections between neurons. Mistakes in the connections between the neurons can lead to autism and mental retardation, where the function of the nervous system is impaired. His goal is to try to regenerate the nervous system so it can return to its normal state.

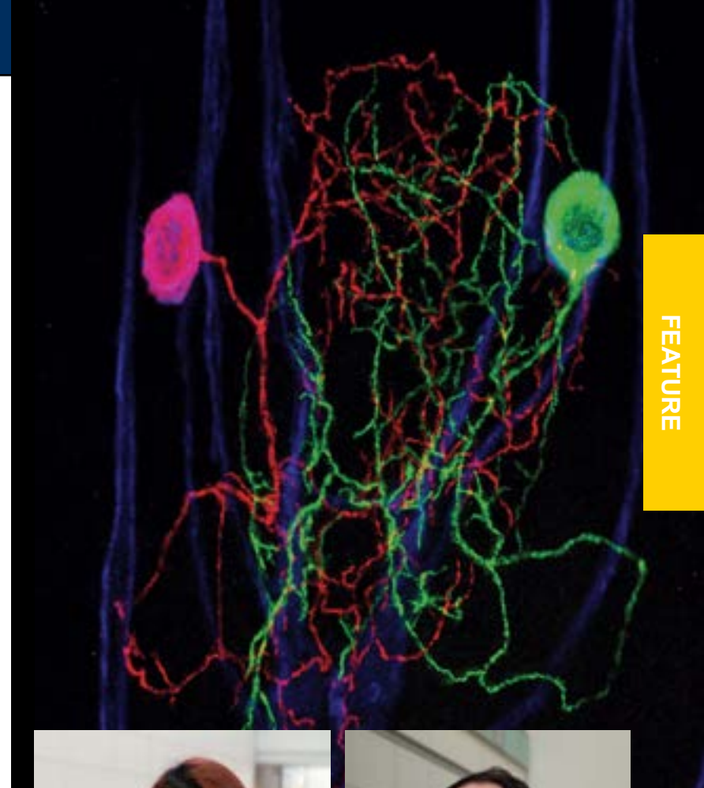
Specifically, he's looking at how one mutated gene in particular, a Down Syndrome Cell Adhesion Molecule, (Dscam), can affect dendrite and axon growth and development.

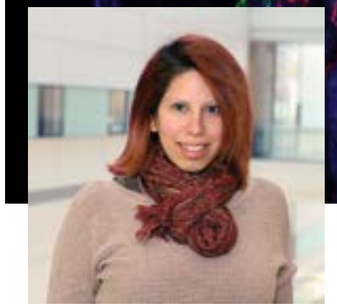
Down Syndrome patients have higher levels of Dscam than those without the disorder. His research, published in June, 2013, shows how these levels affect axon growth. Higher levels of Dscam result in an overgrowth in axons that make incorrect connections with targeted neurons. Using fruit fly models and mouse studies, he is trying to determine how the expression of Dscam contributes to aspects of Down Syndrome. "We know it occurs, but we don't exactly know the link," he says. He hopes to evaluate to what extent Down Syndrome symptoms can be reduced when the level of Dscam is changed to a normal level.

The therapy will be developed through drugs that either target the Dscam protein or the molecules downstream of it that mediate its function. This could someday lead to a drug to treat Down Syndrome or reverse some aspects of it, Ye says. "We're in the process of analyzing this and have made good progress," he added. He's also looking at the role of Dscam levels in Fragile X syndrome, since it seems to be playing a role there as well. Therapies could take several years to hit the market, but "we could find a drug [for this purpose] that's been FDA approved for something else," in which case it would be much faster, he said.

Ye's research is also focused on finding a drug to treat Alzheimer's disease. Masha Savelieff, a postdocural fellow, is working with Ye to test a class of compounds designed to interact with the Amyloid beta peptide, which is believed to cause degeneration in the brain of Alzheimer's patients. Targeting the Amyloid beta peptide could slow the progression of the disease. Savelieff is culturing neurons to see if the compounds can prevent the cells from dying in the presence of the Amyloid beta peptide. She's has always been interested in aging, so focusing on the most prevalent form of dementia in older populations was important to her. "I hope my work will amount to something that will be fruitful for developing a drug to treat Alzheimer's," she said.

Roman Giger's research holds the potential to help those paralyzed with spinal cord injuries (SCI) to someday walk again. Giger, an associate professor in the Department of Cell and Developmental Biology, has met many people with SCI and is optimistic that his research "is going to contribute to a cure." He is looking at ways to help injured neurons repair their cable-like structures, called axons. Currently, axonal growth and neural repair are very limited. Rehabilitation and physical training can help, "but it only goes so far. We have to do better," he said. Following SCI, axonal connections in the spine are severed, interrupting the communication between the brain and spinal cord. He's looking at ways at growing new axons and connecting them properly to restore function. This theory has been successfully tested in animal models, but not humans, Giger says. He's exploring regeneration inhibitors, molecules which tell injured neurons not to extend the axons that form the crucial connections. By genetically removing these inhibitors, you can simulate an injury to see if the system is showing more growth. He's testing this theory in the optic nerve of mice to see how the axons respond in normal mice versus mice that have some of the inhibitors removed. More axons regenerate over a long distance in mice that had three receptor genes that signal inhibition knocked out. "That's something we're very excited about," he said. He says the field has progressed to a very advanced stage and now "we know dozens of molecules that block neural regeneration." Possible





Above: Neurons from Ye lab under flouroscopy
Bottom Left: Masha Savelieff; Bottom Right: Roman Giger

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FEATURE

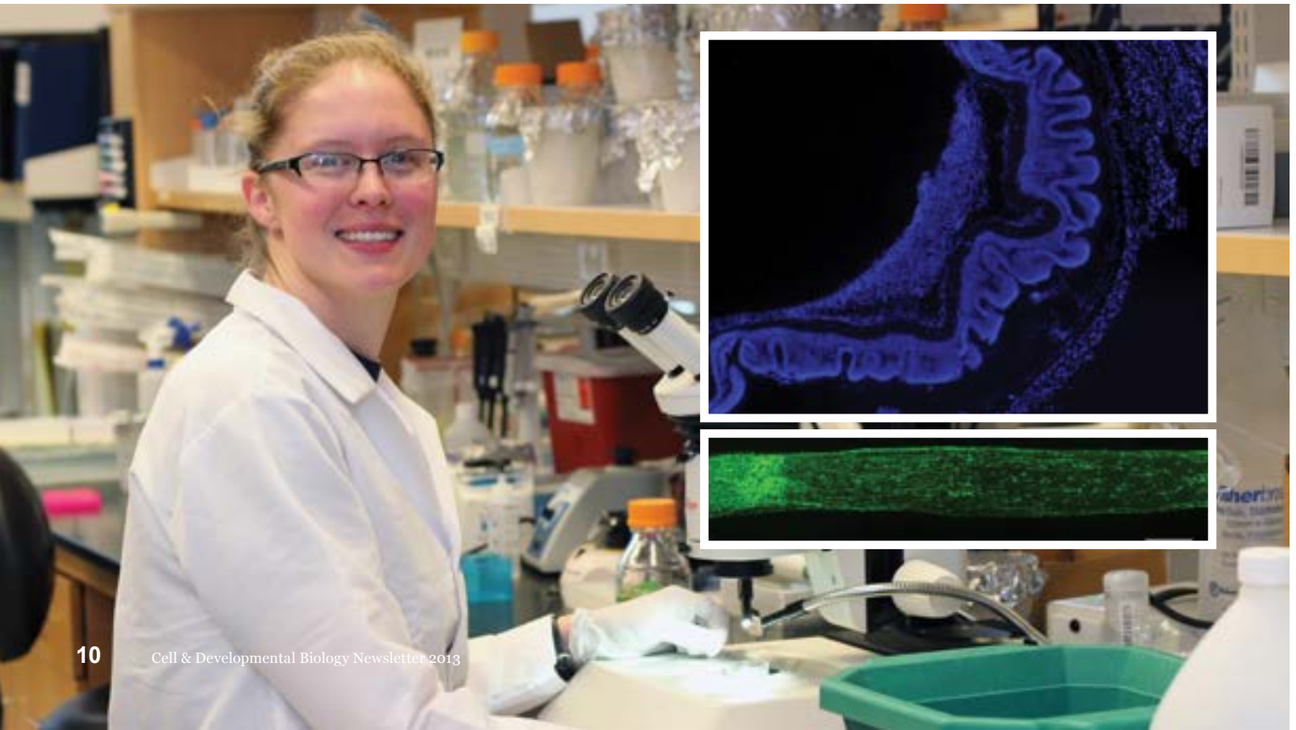
therapy would involve a drug which functions as an antagonist of the regeneration inhibitors. This approach has been successful in stroke models in mice; the next step would be to test the same therapy in spinal cord injured rodents and then in larger animals before proceeding to clinical trials. He says, though, that a drug could be a decade away.

Giger is also exploring the role of inflammation in positively affecting nervous system regeneration. His lab is the first to show which molecules on immune cells are needed to drive axon regeneration. Katie Baldwin is a fifth year PhD student working in Giger's lab, performing surgery on mice to inflict injury. She adds inflammatory compounds which are allowing for regeneration in an area that doesn't usually experience it. Even providing the inflammatory compound 48 hours after the injury resulted in regeneration, a significant finding, since it demonstrated that regeneration doesn't need to happen immediately to be effective.

Baldwin's interest in the research is personal. Her younger sister suffers from a mild form of Spina Bifida and she's always been curious why "we don't regenerate our central nervous system when we can grow back so many other parts of our body," she said. "I feel that's a very important focus."

The jackpot for researchers is finding a drug already on the market for other indications that can also work on their disease. This turned out to be the good fortune for James Douglas Engel, a Professor in the Department of Cellular and Molecular Biology, who discovered that an FDA approved drug for depression, tranylcypromine, or TCP, holds the potential to treat the 110-million people affected by sickle cell anemia. Gumucio recalls that in every grant Engel wrote, he said he wanted to find a cure for sickle cell anemia. Since this is the most prevalent inherited human disease, "I thought if science was going to cure any disease, this would be it," Engel said. But he thought he'd primarily lay the groundwork; he never thought it would be discovered in his lifetime. The disease is caused as a consequence of mutations in the beta-globin gene. Previous studies showed that if a person has an overexpressed gamma globin gene and has the sickle cell mutation, they're not as sick. This led to the theory that the gamma-globin gene, normally silent in adults, can be reactivated to treat sickle cell anemia. Engel found a pharmaceutical compound that inhibited the inhibitor and reactivated the gamma gene. This kept it turned on and prevented the cells from forming the sickled shape that allows them to clog blood vessels, leading to organ failure. Last year, Engel was awarded an $8.2-million multi-institutional National Institutes of Health grant to develop more specific drugs to treat patients with sickle cell anemia and

Below: Katie Baldwin; Inset Top: Injection of beta-glucans into the eye stimulates the innate immune system and significantly enhances regeneration of injured axons in the mouse optic nerve. Regenerating fibers are visualized by anti-GAP43 at two weeks after injury. ; Inset Bottom: A cross section of a mouse eye at two weeks after injection of beta-glucans shows severe detachment and buckling of the retina. Understanding the molecular mechanisms through which innate immunity promotes regeneration will be vital to separate the beneficial aspects of inflammation from the detrimental.



Engel Lab Globin Group (L-R): Shuaiying Cui, PhD, Natee Jearawiriyapaisarn, PhD, Mary Lee, PhD & Doug Engel PhD

FEATURE

beta-thalassemia, the two most commonly inherited disorders in humans. The next step is a clinical trial of adult patients. Engel says most of those suffering from sickle cell anemia can't take advantage of bone marrow transplants, the only genuine cure, since they live in the developing world where access to sophisticated medical care is not generally available, "so there is a huge need for a pill." Gumucio says Engel's track is typical of those who toil in this field: he started over four decades ago working on trying to isolate the first globan genes to get to the point where he knew enough about the basic biology to begin making inroads.

Gumucio's research focuses on understanding how the gut obtains its enormous surface area for absorption. Intestinal failure, a life-threatening condition, can occur when there isn't a large enough surface to absorb nutrients from food. Two main features of the intestine increase its surface area: its enormous length and a surface full of fingerlike projections, called villi. She's trying to understand how the intestine lengthens, working with Santiago Schnell, an associate professor in the Department of Molecular & Integrative Physiology, by developing mathematical models that predict patterns of cell proliferation and tissue expansion during embryonic life. She's also evaluating the cell signaling pathways that are important for the generation of the villi. Another collaborator is Jason Spence, an assistant professor in Internal Medicine, jointly appointed in CDB. The long-term goal is to engineer an artificial absorptive surface in a dish that could be used in a person who has lost a part of their intestine through surgery. "We want to understand how the lengthening and villus growth occur so that we could efficiently replace lost intestinal surface area," she said.

Bruce Carlson

Despite the many advancements, researchers may toil in regenerative medicine for 20 years laying the groundwork for a discovery. Then it's the physician who applies the treatment who gets the praise. But Gumucio says positive reinforcement isn't what drives her, or many of the other researchers in the department. Instead, it's the "tiny new discoveries we make. We get a tremendous thrill out of seeing something in the microscope that nobody ever saw before." She's forever intrigued by the quest to understand a part of a process in a mouse or fruit fly, then thinking about how it could be used to help humans. And she says this basic research is fundamentally important, since "the mass of knowledge we're generating could eventually make a difference in human health."

Carlson is pleased to see regenerative medicine now progressing so rapidly, with many potential applications to cure human disease, especially for the spinal cord and nervous system. "It's a nice feeling of fulfillment that the field is moving so well," he said.

the "Developing Future Biologists" Initiative

Article by Brooke N. Horton

Postdoc, Andrea Ramos, and graduate student, Martha Echevarria Andino, left the warm beaches of Puerto Rico to pursue a graduate education at the University of Michigan. They have since found a growing community and outstanding training opportunities in the department of Cell and Developmental Biology. Although, it's difficult at times to find good plantains and the snow may fall too frequently for their taste, the opportunity to navigate a successful career in the life sciences is something they are bringing back to Puerto Rico with the help of a team of graduate students and supportive faculty through a new initiative, "Developing Future Biologists".

There is currently a great need to connect to Hispanic populations and encourage the exploration of STEM (science, technology, engineering, and mathematics) careers. This population is one of the fastest growing minority groups in the U.S.; however, this growth is not accurately reflected in STEM careers. Currently, Hispanics comprise 15 percent of the total workforce, and only 7 percent of the STEM workforce. These numbers are striking when compared to the more evenly distributed employment numbers for whites, which is 67 percent in the total workforce and 71 percent employed in STEM (2013 Census).

The department of Cell and Developmental Biology at the University of Michigan is in a unique position to improve the accessibility of graduate education in STEM to this underrepresented minority group. In the past four years CDB has greatly improved the diversity in its graduate program. In 2013, 9 percent of CDB graduate students were Hispanic. This is both above the national average and an improvement from the CDB 4 year average of 3 percent Hispanic graduate students. Though these numbers still fall short of an accurate representation of Hispanics in STEM, a more inclusive environment is giving rise to a powerful voice for this community and is bringing to fruition non-contrived graduate recruitment initiatives for underrepresented students as well as opportunities for cross-cultural learning.

The initiative is designed to lower the cultural barriers to graduate education and increase awareness of life science careers for underrepresented minorities.

Andrea and Martha both attended the University at Ponce as undergraduates and knew they wanted to pursue a career in research. However, their passion for the life sciences was met with many challenges in Puerto Rico. Their coursework was limited and there were very few chances to have a hands on experiences with science in a laboratory.

Utilizing their opportunities and success in graduate training, Andrea and Martha conceptualized an outreach initiative to allow others to follow in their footsteps. With the help of graduate colleagues, Brandon Carpenter, David Lorberbaum and Justine Pinskey, the pilot program, "Developing Future Biologists" (DFB), is set to launch in Spring of 2015.

This initiative is designed to lower the cultural barriers to graduate education and increase awareness of life science careers for underrepresented minorities. Through a week-long workshop at the University of Puerto Rico at Ponce, DFB will provide students with personal mentoring, direct exposure to cutting edge research, and inspiration to pursue a career in the life sciences. A set of hands-on experiments accompanying a short lecture series will allow students to experience a topic of biology that is not currently offered at Ponce. Additionally, UM faculty and graduate students will engage professionally and socially with students so that a clear and complete picture of graduate school is provided. As a student lead group, DFB also provides the opportunity for current CDB students to gain teaching experience with non-native english speakers and engage in cross-cultural learning.

This effort promotes the recruitment of qualified underrepresented minorities to pursue advanced degrees in biomedical science research at UM, and will significantly improve the education experience for all graduate students at UM. If you'd like to know more, contact the leadership team at DFB.coordinators@umich.edu.

Get more information about this initiative at: www.cdb.med.umich.edu/dfb

Above L-R: David Lorberbaum, Andrea Ramos, Brandon Carpenter, Justine Pinskey, Martha Echevarria Andino

DFB Faculty Advisors L-R: Scott Barolo, Deneen Wellik & Ben Allen
Not Pictured: Larry Gruppen, Deb Gumucio

Seminars & Conferences

Hedgehog 2014

The 2014 Hedgehog Meeting on Hedgehog Signaling in Development and Disease was held this past August here at the University of Michigan. Ben Allen, along with Scott Barolo, Marina Pasca Di Magliano, Andrzej Dlugosz, Deb Gumucio, Sunny Wong & Charlotte Mistretta organized a very productive meeting with participants traveling from around the world to share ideas that could significantly impact our understanding of embryonic development, stem cell function and adult tissue homeostasis, as well as provide insight into the design of treatments for a growing number of Hedgehog-dependent pathologies.

Sarah Newman Lectureship

The Sarah Winans Newman Lecture held this past April, featured a talk by Peter Walter, Ph.D., HHMI Investigator and Distinguished Professor in the Department of Biochemistry & Biophysics at the University of California San Francisco entitled, "Unfolded Protein Response in Health and Disease"

Burton Baker Lecture

The Burton Baker Lecture held this past September, featured a talk by Geraldine Seydoux, PhD, Professor, Johns Hopkins Medical Institute entitled, "Regulation of RNA granule dynamics by a phosphorylation-sensitive scaffold"

FUN-draising

This year the admin staff has organized a pancake breakfast, sloppy joe lunch & ice cream social. These events are meant to be fun social events but the small donations made by everyone help the student fund. The "Stacks 4 Students" Pancake breakfast fed attendees over 1500 pancakes and raised $550 for the CDB student fund. Want to volunteer at the next FUN-draiser? Let us know cdbinfo@umich.edu.

Below:Hungry participants being served pancakes at "stacks 4 students".

CELEBRATING 160 YEARS OF VICTORS FOR RESEARCH

Join the Department of Cell & Developmental Biology as we celebrate those that have contributed to breakthrough discoveries and excellence in education throughout the history of our department and those whose talent and dedication shows promise to the future.

The plans for this two day event on April 23rd and 24th, 2015 are in progress. We have a great program in the works with a multitude of esteemed speakers both within the department as well as those coming to share in the celebration.

Thursday, April 23rd kicks off with a reception and poster session. Also planned are student talks, a dinner, history of education in the department and Manu Prakash speaking about his foldable microscope project "foldscope". Manu will also deliver a public lecture earlier in the day.

A mix of history and current science is scheduled for Friday, April 24th. The day will feature talks from current students and faculty as well as distinguished invited speakers Drs. Yuh Nung Jan, Dyche Mullins & Shahin Rafii.

In preparation for this event, in addition to the University's bicentennial in 2017, an immense effort has been put into collecting the history of the department. Special thanks go to Emeritus Professor Sarah Newman, Ph.D. and Martha Girsch who along with Deb Gumucio have been hunting down stories, anecdotes and writing a comprehensive document to share with the University's efforts for the bicentennial as well as to serve as a reminder to us all of our departments long and storied past. When complete, this entire text, along with photos, will be available online at cdb160.org as well as printed for attendees of the celebration.

"It is so important to look at what we have done as a department over the last 160 years", said Newman. "It really has been a marvel of accomplishments. I have really enjoyed working on this project to find some of these lost stories."

An enourmous effort by department faculty, staff & volunteers is going into making this a meaningful, memorable & exciting event. RSVP online at cdb160.org or call (734) 615-7509.

We hope you join us!

INVITED SPEAKERS

Yuh Nung Jan, Ph.D.

Dr. Jan is a Jack and DeLoris Lange Professor of Molecular Physiology at the University of California, San Francisco and a Howard Hughes Medical Institute Investigator. Jan's research center on the development and function of the nervous system. Current interests include the mechanisms of dendrite development, the function and regulation of potassium channels, and the contribution of dendritic morphogenesis and channel modulation to the assembly and plasticity of functional neuronal circuits.

Dyche Mullins, Ph.D.

Dr. Mullins is a professor in the Department of Cellular and Molecular Pharmacology at the University of California, San Francisco and a Howard Hughes Medical Institute Investigator. Mullins studies the assembly and regulation of cytoskeletal networks—collections of molecules used by living cells to move molecular cargo, establish polarity, and propel themselves forward. Understanding how cells construct their internal molecular "skeletons" is key to understanding a wide variety of biological processes and human diseases.

Manu Prakash, Ph.D.

Manu Prakash is an Assistant Professor in the department of Bioengineering at Stanford University. Dr. Prakash research brings together experimental and theoretical techniques from soft-condensed matter physics, fluid dynamics, theory of computation and unconventional micro and nano-fabrication to open problems in biology: from organismal to cellular and molecular scale.

Shahin Rafii, M.D.

Dr. Rafii is a professor of Genetic Medicine at Weill Cornell Medical College at Cornell University. Shahin Rafii's laboratory focuses on stem cell biology and angiogenesis uses in vivo mouse model and mouse and human genetics, tissue culture approaches and molecular biology to model angiogenesis, cancer and stem cell metabolic regulation. Genetic, genomic, molecular and cell biological techniques are combined to achieve a systems level understanding of these complex processes.

Be a part of the celebration!

RSVP at cdb160.org or (734) 615-7509

Photos left to right: Interior of Medical School Laboratory, post-1865; Anatomical Laboratory, circa 1890; Surgery and anatomy class, circa 1890-99; Medical School lectures, surgery and anatomy classes, amphitheater views, circa 1893.

Dr. Sun Kee Kim

Defining Excellence in Teaching and Imaging

Dr. Sun-Kee Kim received his B.S. degree from Yon-Sei University, Seoul, Korea, and his Ph.D. in Biology from the University of Rochester. In 1968, he accepted a Research Associate position at the Veterans Affairs Medical Center. By 1974, his research success earned him a promotion to Assistant Professor in the Department of Anatomy at the University of Michigan Medical School. Dr. Kim's research centered on the cell biology of exocrine glands, using the parotid salivary gland as a model system, with emphasis on defining the age-related changes in the structure and function of secretory cells. The research was internationally recognized and continuously funded from 1968 to 1997. At the same time that he was building his research program, Dr. Kim directed significant time and effort to the teaching of Histology, first in the Dental School, and beginning in 1974, in the Medical School as well.

A skilled microscopist and highly valued teacher, Dr. Kim was tapped to direct the Electron Microscopy Program at the VA and to co-direct the Dental Research and Education Trainee Program. Finding himself increasingly drawn to pedagogy, Dr. Kim became involved in teaching gross anatomy and histology. Dr. Kim accepted the call to serve as Histology Course Director in the Department of Anatomy in 1996; a year later, he retired from the VA Hospital to devote his full efforts to Medical School teaching. In 1983, he was promoted to Associate Professor in the department of Anatomy.

11,000+

Over 40 years of service, Sun-Kee has taught approximately 7000 medical students, 4500 dental students, and 300 graduate students.

For over 40 years, Dr. Kim has been the "leader and best" for Medical School Histology. Major changes have characterized the evolution of teaching in this field; Dr. Kim's proactive creativity has been instrumental in helping medical students adapt and succeed during these shifts. In 2003/4, he deftly led them through a major change, from a systems based approach to an integrated curriculum (in which Histology was taught in parallel with gross anatomy, embryology and physiology for each organ system). Since that time, Dr. Kim has been at the forefront of the progressive conversion to digital microscopy as the primary means of teaching in the labs. The online website and virtual microscopy resource for Michigan Histology (http://histology.med.umich.edu/) is now among the most widely used in the world; this resource was selected as one of five inaugural projects to be recognized with the University of Michigan Provost's Teaching Innovation Prize. The digital slide collection at the core of this resource is largely the work of Dr. Kim, who spent countless hours pouring through hundreds of slides to select the roughly 250 representative specimens to go into this collection. Dr. Kim has also developed learning tools that have had an enormous impact on medical student learning, including Anatomy-Histology Correlates (created to help students to easily correlate anatomical structures with histology images, and vice versa) and his famous Review and Look-alike images that help students recognize and understand the differences between similar appearing histological structures.

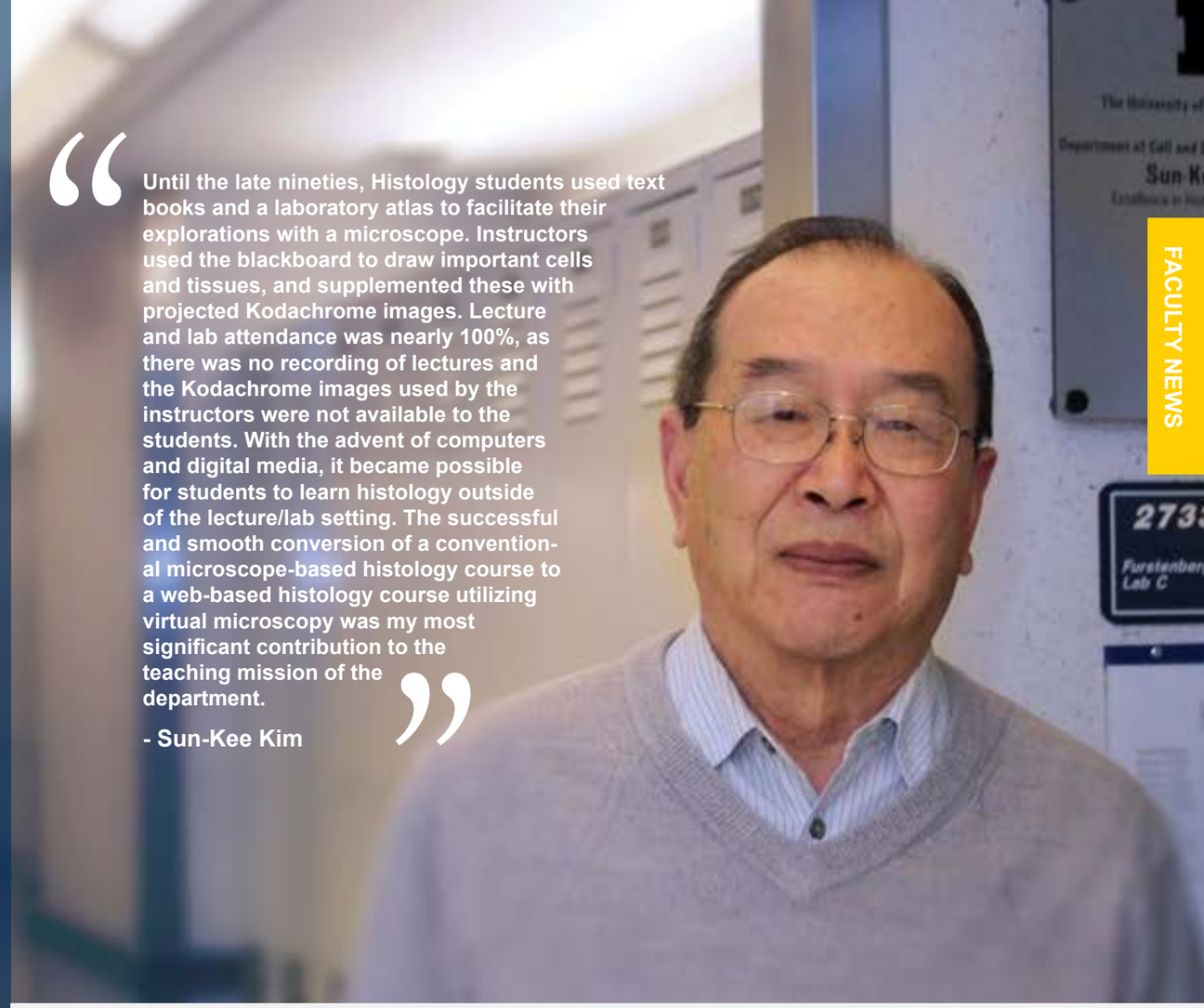
Dr. Kim's excellence in teaching has been recognized repeatedly throughout his long career: he was awarded the Excellent Teacher in Histology Award in 1995; TAMS (Token of Appreciation from Medical Students) Award (2003), the Thomas G. Varbedian Award for Excellence in Service to Medical Students (2006); Elizabeth C. Crosby Award for Excellence in Basic Science Teaching (2007); was named as a Legendary Professor (2010 and 2011); won the Endowment for Basic Science Teaching Award (2011); and has been twice a Finalist for the Kaiser Permanente Award for Excellence in Pre-clinical Teaching (2003, 2004), finally winning this Kaiser award in 2007. Humbly, Dr. Kim is known to respond to such honors by saying that he really doesn't deserve an award for doing what he loves.

Dr. Kim officially 'retired' in 2012 and is now an active Emeritus, but he continues to serve as of the most revered lecturers and laboratory instructors in the Medical histology course and also continues to contribute to the Dental and Undergraduate/Graduate student Histology courses. Without a doubt, Dr. Kim's legacy is a rich one that has impacted Medical School teaching throughout major changes in medical education. Through his quiet, competent and forward-thinking leadership, Dr. Kim has been there at every step along to way to ensure that our educational program is consistently at its best.

"Dr. Kim's teaching skills extend beyond the podium and well into the actual 'classroom of life.' Through his lectures, personal interactions with students, excellent interactive learning materials, and testing style, he has made histology not only enjoyable but also unforgettable. But it is not only in his formal role as a teacher that he deserves recognition --it is also in the small moments on campus, when he is not instructing but still around students, that we can see he truly cares for our education."

- A Former M1 student

FACULTY NEWS



"Until the late nineties, Histology students used text books and a laboratory atlas to facilitate their explorations with a microscope. Instructors used the blackboard to draw important cells and tissues, and supplemented these with projected Kodachrome images. Lecture and lab attendance was nearly 100%, as there was no recording of lectures and the Kodachrome images used by the instructors were not available to the students. With the advent of computers and digital media, it became possible for students to learn histology outside of the lecture/lab setting. The successful and smooth conversion of a conventional microscope-based histology course to a web-based histology course utilizing virtual microscopy was my most significant contribution to the teaching mission of the department.

- Sun-Kee Kim

Honoring Dr. Kim's Legacy

The Sun-Kee Kim Endowed Lectureship in Cell & Developmental Biology

Please consider contributing to the Sun-Kee Kim Endowed Lectureship in Cell & Developmental Biology. The endowed lectureship seeks to do two very important things. The first is to honor Dr. Kim's contributions to scholarship, imaging and teaching in Cell Biology and Histology at the University of Michigan, and to recognize his many students and colleagues. The second is to ensure that excellence in these endeavors, exemplified by Dr. Kim, continues.

Dr. Kim is highly regarded by colleagues, former trainees and students. His passion for imaging and teaching is reflected by the generosity and joy he has demonstrated in mentoring young medical students.

It is this kind of excellence that makes the University of Michigan one of the most esteemed in the nation, able to attract and retain talent of the highest caliber. It is also what the community served by the U-M Health System has come to expect and from which it benefits.

The generosity of alumni, faculty, colleagues, family, friends, and the community in establishing the Sun-Kee Kim Endowed Lectureship in Cell and Developmental Biology helps to ensure that the excellence exemplified by Dr. Kim continues to distinguish the University and the Department of Cell & Developmental Biology. This fund has been made possible by significant contributions from Dr. Kim's fellow faculty colleagues and students. We hope you can join these generous donors in making a gift to honor Dr. Kim's legacy.

To learn how you can contribute, please visit cdb.med.umich.edu or contact Greg Witbeck at germain@umich.edu or 734-232-6017.

Your donation may be used to establish an endowment fund, and distributions from the Fund will be made in accordance with the University's then existing endowment distribution policy. Any surplus distributions during any period may be accumulated for later use for the above purposes or may be added to the principal of the Fund for investment, in the University's discretion.

The Gumucio Lab (L-R) 1st row: Xiaotan Qiao (Traci), Deb Gumucio, Margaux Guysinger, Deepa Chandhrasekhar, Michelle Muza-Moons, Ryan Townshend, Ayana Dambaeva, Jierong Lang, 2nd row: Neil Richards, Andrew Freddo, Shawn Lopez, Kyle Vogt, Ken Taniguchi, Audrey Urquhart, Katherine Walton

NEW ENDOWED PROFESSORSHIP

Gumucio installed as endowed professor

April 17th, 2014 marked inauguration of the J. Douglas Engel Professorship and the installation of Deborah Gumucio, M.P.H., Ph.D., as the first J. Douglas Engel Collegiate Professor. The department and medical school would like to congratulate Deb on her achievement.

Deborah Gumucio, M.P.H., Ph.D.

Deborah Gumucio grew up in Saginaw, Michigan. She is a lifelong Wolverine, having obtained her B.A. in 1971, her M.P.H. in 1975 and her Ph.D. in 1986 all at Michigan. Her Ph.D. thesis on evolution of the mouse amylase gene family, completed in the laboratory of Miriam Meisler, Ph.D., won the University of Michigan's Distinguished Dissertation Award. Dr. Gumucio continued her postdoctoral studies with Francis S. Collins, M.D., Ph.D., studying hemoglobin switching (at Michigan) and joined the faculty of the Department of Anatomy and Cell Biology in 1991. She was promoted to full professor in 2002 and today serves as the Interim Chair of the University of Michigan Department of Cell & Developmental Biology.

Dr. Gumucio credits her students and postdocs for their outstanding accomplishments in research. Working with Morris Goodman, Ph.D., her laboratory was a pioneer in the use of phylogenetic footprinting, identifying blocks of conserved sequence within gamma-globin genes that act as regulators of gamma-globin gene expression. The lab also participated in an international consortium of investigators to identify MEFV, the gene for Familial Mediterranean Fever, the first of the so-called autoinflammatory disease genes to be cloned. Additionally, her laboratory is internationally known for decades of work that has contributed to understanding cell-cell communication during development of the small intestine.

In 1995, Dr. Gumucio founded the Center for Organogenesis and directed this center until 2010. This multi-disciplinary center now serves over 100 members in 27 departments from five schools and colleges of the U-M, bringing together clinical, basic and applied scientists in the study of organogenesis and its relationship to human disease. Dr. Gumucio also directed the NIH-funded Training Program in Organogenesis from 1997-2013; on its third NIH renewal, this Program received a MERIT Award and Dr. Gumucio was named an NIH NICHD Mentor of Excellence.

A skilled and creative administrator, Dr. Gumucio has served on more than 30 Medical School and University committees including nine years on the OVPR Human Pluripotent Stem Cell Oversight Committee. Nationally, she has completed substantial study section service, including Co-Chairing the Developmental Biology Committee at NICHD for two years.

Dr. Gumucio is a stellar and devoted educator, teaching medical histology, medical embryology, dental histology and developmental biology. She has organized six international symposia for the Center for Organogenesis. She also developed and coordinated the graduate course, "Organogenesis of Complex Tissues," for 15 years and is the force behind BioArtography, a program in which beautiful, vividly colored images of organic structures are sold at the Ann Arbor Art Fair. Proceeds benefit graduate student travel. In recognition of Dr. Gumucio's elegant scholarship and her many contributions throughout this institution, it is fitting that she be named the first James Douglas Engel Collegiate Professor. Says Dr. Gumucio, "James Douglas Engel is Developmental Genetics, so the opportunity to hold a collegiate professorship in his name at this great university is exciting and humbling. Doug has been the catalyst for the blossoming of a truly outstanding CDB department and, simultaneously, a scientific role model beyond compare. Plus, he is as fanatical about Michigan basketball as I am."

FACULTY HONORS & AWARDS

Congratulations to **Scott Barolo**, winner of the 2013 Endowment for Basic Sciences Teaching Award for Teaching Excellence in Cell and Developmental Biology. Scott wins this year's award for his outstanding efforts in the classroom (delivery of his excellent and innovative course, CDB580), his extensive work for our graduate program and his consistent efforts to improve education and training in CDB. **(2013 given in 2014)**

Doug Engel was selected by the Biomedical Research Council as this year's recipient of the Distinguished Faculty Lectureship In Biomedical Research (2014). This prestigious accolade, which was first awarded in 1979, continues to be the highest honor bestowed by the Medical School upon a faculty member for research in the biomedical sciences. The recipient of this award is an exceptional leader in research, whose landmark contributions are recognized both nationally and internationally. Their contributions are usually linked to pivotal discoveries that have wide-ranging impact for the advancement of scientific knowledge. The recipient of this award also excels in teaching, mentoring, and service to our institution and to their colleagues in the scientific community at large. Congratulation Doug!

Earlier this year, with little fanfare, plaques were hung outside 2733 Furstenberg, which is one of the histology classrooms. These signs were added in honor of **Sun-Kee Kim**'s contributions to Histology teaching more than 40 years of outstanding service both to our department and to the med school. As one of our most accomplished and appreciated teaching faculty, Sun-Kee richly deserves this honor and our congratulations.

The Biomedical Research Council (BMRC) has named **Yukiko Yamashita** with the 2013 Basic Science Research Award.This award recognizes a scientist or group of scientists identified as having made outstanding contributions to the Medical School in basic biomedical science research.

Scott Barolo

Yukiko Yamashita

RECRUITING RSP CANDIDATE CONTINUES

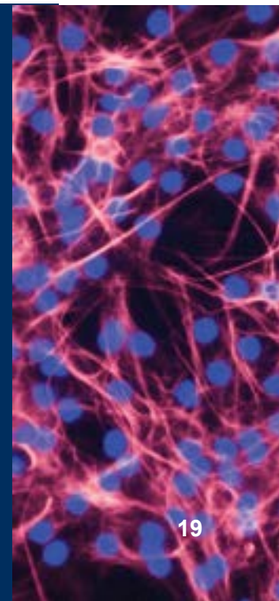
Cell & Developmental Biology is part of the Provost's Reproductive Sciences Program (RSP) cluster hire. This interdisciplinary cluster hire brings together six departments from two schools: The College of Engineering (Department of Biomedical Engineering) and the Medical School (3 clinical and 2 basic science departments). In this context, we are actively recruiting an outstanding scientist with a research program in reproduction and stem cells to enhance understanding of embryonic stem cell growth regulation and directed differentiation with a translatable focus on regenerative medicine.

The RSP at the University of Michigan aims to develop new diagnostic and therapeutic strategies for diseases that result in reproduction failure and disease processes that have their origins in reproductive processes but that are expressed later in life. Processes as varied as gametogenesis, fertilization, embryonic-fetal development, stem cell biology, fetal programming and pregnancy are all part of reproduction and such reproductive processes have long-term effects on health that go beyond fertility. Hence, the Reproductive Sciences Program encourages broad, multidisciplinary involvement in reproductive sciences. Reproductive sciences are central to women's and men's health, fertility, and embryonic stem cell biology.

6 Departments

2 Schools

1 Research Goal



CELL AND DEVELOPMENTAL BIOLOGY PRIMARY FACULTY

Ben Allen
Assistant Professor

How do secreted proteins control the formation of various types of neuronal cells (e.g. motor neurons) in the embryonic brain and spinal cord? Also, how does deregulation of these proteins cause disease, such as pancreatic cancer (a collaboration with Marina Pasca di Magliano)? We are pursuing the activity of a family of secreted proteins (known as Hedgehog) in embryonic development and disease.

Kate Barald
Professor

Birds and fish can regenerate their hearing organs and inner ear neurons, but mammals can't. What crucial molecular and cellular differences in the way the inner ear forms and regenerates are responsible for these differences? What role does the immune system play in inner ear development and its possible repair? Can these findings be used to enhance cochlear implant function?

Scott Barolo
Associate Professor

Cells emit molecular signals to "talk" to their neighbors. Those signals are interpreted by special sequences called enhancers in the genomes of the receiving cells, which regulate the expression of nearby genes. How do enhancers respond to signals during development, stem cell function, and disease, and how are those signals translated into precise changes in gene expression?

Dawen Cai
Assistant Professor

How do our one billion neurons generated from stem cells? How do they physically connect during development? How are these connections modified during learning?

Mara Duncan
Assistant Professor

How do cells respond when they face a situation of low oxygen or low energy (such as in heart attack or stroke)? What cellular machinery gets activated to allow the cell to survive such dangerous situations?

Doug Engel
G. Carl Huber Professor

Our laboratory currently focusses on three different areas of hematopoiesis. We are investigating how transcription factors GATA2 and GATA3 regulate hematopoietic stem cell function and maintenance, how T cells develop in the thymus, and how specific enzymatic inhibitors inactivate epigenetic modifying enzymes in erythroid progenitors leading to induced synthesis of fetal hemoglobin as a treatment for sickle cell disease and beta-thalassemia, the world's most common inherited diseases.

Diane Fingar
Associate Professor

We study an evolutionarily conserved cell signaling pathway centered on the protein kinase mTOR (the mechanistic target of rapamycin), which plays a central role in determining the cellular response to the environment (to grow in mass/size; proliferate; differentiate; or die). mTOR constitutes the catalytic core of functionally distinct signaling complexes and regulates critical cellular process related to metabolism, tumorigenesis, and immune function. Not surprisingly, misregulated mTOR function contributes to diverse diseases including diabetes, cancer, and inflammatory disorders. Despite the clear physiologic importance of mTOR, fundamental gaps exist in our knowledge regarding cellular mTOR regulation and function. Improved understanding of the cellular mTOR signaling network may enable the future development of targeted therapeutic agents to treat human diseases linked to aberrant mTOR function.

Roman Giger
Professor

Neurons have to grow and connect (or synapse) properly during development and they have to establish new connections during learning, and following injury (i.e. spinal cord injury, traumatic brain injury, stroke or multiple sclerosis). How is neuronal growth regulated at the cellular level? How do synapses get established and what regulates the strength of these connections?

Deborah Gumucio
James Douglas Engel Collegiate Professor and Interim Department Chair

How does the intestine develop in the embryo? How does a soluble signaling protein called Hedgehog control both intestinal lengthening and development of the absorptive surface area of the intestine? Additionally, in adults, how does Hedgehog signaling modify the inflammatory response in the intestine, especially in the setting of inflammatory bowel disease?

Michael Hortsch
Associate Professor

Modern technologies play an important role in teaching the biomedical sciences to today's students. Our department is at the forefront of developing novel and exciting teaching resources. However, are these new technologies really effective in educating tomorrow's scientists and health care providers? How can we use these new teaching modalities to help our students both learn better and gain a deeper understanding of the expanding range of scientific knowledge?

Ajit Joglekar
Assistant Professor

Cells build multi-protein "machines" that insure that every time the cell divides, its recently duplicated chromosomal DNA gets properly distributed to each daughter cell; cancer results when this machine doesn't function properly. How does this machine work on a physical/chemical and molecular level? Can we build our own machines to distribute artificial chromosomes to cells for gene therapy?

Jiandie Lin
Associate Professor
Bradley M. Patten Collegiate Professor in the Life Sciences

How does the body's network of nutrient and energy control (the metabolome) go awry in the context of type 2 diabetes, cardiovascular disease and non-alcoholic fatty liver disease? Can we develop therapies that prevent or correct the malfunction of this metabolic network?

Daniel Lucas-Alcaraz
Assistant Professor

The levels of the different cell types in the blood are exquisitely regulated. Blood cells are produced by hematopoietic stem cells in the bone marrow. After hemorrhage, inflammation or injury stem cells proliferate to restore tissue homeostasis. How do stem cells sense the changes in the blood? How does inflammation regulate hematopoiesis? Can we manipulate these signals to increase blood cell production?

Kentaro Nabeshima
Assistant Professor

What controls chromosome dynamics during meiosis (cell divisions for generation of eggs and sperms)? How do chromosomes move around in a nucleus in search for their homologous partner? How do they recognize and pair specifically with their partner? Mistakes in any of these steps can lead to reproductive problems, such as miscarriage and birth defects. We are addressing these fundamental questions by exploiting a simple model organism: the nematode C. elegans and by applying a wide variety of techniques including functional genomics, genetics, molecular biology, cell biology and high-resolution 3-D microscopy.

Sue O'Shea
Crosby-Kahn Collegiate Professor

Human induced pluripotent stem cells (iPSC) and human embryonic stem cells (hESC) can be grown in culture and coaxed to yield a variety of human cell types that are difficult or impossible to study in the human body, including various types of brain cells (neurons). Thus, for the first time, we can ask fundamental questions such as: what genes are involved in neuronal differentiation? In differentiation of glial cells? Which neurons are damaged in the context of bipolar disease or depression? What is the nature of such alterations?

Sivaraj Sivaramakrishnan
Assistant Professor

Cells use molecular motors to move cargo around the cell and to produce force such as contraction in the heart. How does the same motor interact with different subcellular compartments to perform different cellular functions? Using nano-engineering, can we measure contractility in diseased heart cells?

Billy Tsai
Corydon Ford Collegiate Professor

DNA tumor viruses such as polyomavirus (which cause cancer) and bacterial cholera toxin (which causes life-threatening diarrhea) have a feature in common: they both use molecular trickery to hijack the host cell machinery to enable their entry and trafficking to specific sites inside the cell. What features of these proteins allow them to disguise themselves and avoid the quality control mechanisms of the cell? What parts of the cellular machinery participate in this molecular scheme?

Kristen Verhey
A. Kent Christensen Collegiate Professor

Inside of every cell, motor proteins move diverse cargos over a set of highly connected "rail road tracks" composed of microtubules. How do motors choose their cargos? How do chemical modifications of the microtubules act as biochemical road signs to direct motor protein transport to specific cellular destinations?

Michael Welsh
Professor

My team collaborates with the School of Engineering and the U of M Cardiovascular Center to develop medical applications for lasers. Could infrared lasers be used as a therapy for atrial fibrillation, the most common form of heart arrhythmia?

Lois Weisman
Professor
Sarah Winans Newman Collegiate Professor in the Life Sciences

Basic cell biological functions can be readily studied in yeast. Many yeast genes are conserved in humans. For example, Fig4 which is important for lysosomes in yeast, is also critical in humans. Minor mutations in Fig4 can cause neurodegenerative disease! Yeast can be used to decipher the mechanisms underlying Fig4 function. Understanding Fig4 function, may provide insights into how to treat some neurological diseases.

Yukiko Yamashita
Associate Professor
James Playfair McMurrich Collegiate Professor of the Life Sciences

We are all derived from a single fertilized egg, but our bodies contain hundreds of different types of cells, each of which performs a specific function (a skin cell is not the same as a brain cell). What processes control asymmetric cell divisions in which one cell can give rise to two daughters with different identities and functions?

Bing Ye
Assistant Professor, Life Sciences Institute

How do neurons in the brain grow their processes (dendrites and axons) to form functional neural circuits and how do defects in this process lead to human diseases (e.g. Down syndrome and autism)?

Research Faculty

Shuaiying Cui, Ph.D., Research Investigator
Tomonori Hosoya, Ph.D., Research Assistant Professor
Takamasa Inoue, Ph.D., Research Investigator
Yu-Chi Shen, Ph.D., Research Investigator
Kim-Chew Lim, Ph.D., Associate Research Scientist
Katherine Walton, Ph.D., Research Investigator

RESEARCH SUMMARIES

CELL AND DEVELOPMENTAL BIOLOGY JOINT FACULTY

Richard Altschuler
Professor, Otorhinolaryngology Department
Tinnitus (ringing in the ears) and age related hearing loss are important medical problems affecting quality of life. What insults are damaging auditory neurons in the context of these diseases? How can we enhance the survival and growth of the nerves that control hearing?

Maria Castro
Professor, Neurosurgery
The microenvironment of brain tumors affects tumor progression and metastasis. How do tumor cells signal to immune cells and cause them to invade the tumor microenvironment? What signals do immune cells provide that modulate tumor cell behavior? How can these signals be used therapeutically to inhibit tumor growth?

William Dauer
Associate Professor, Neurology
Diseases such as Parkinson's disease and dystonia disrupt motor function, and cause uncontrolled movements. What single gene mutations cause these diseases and how do the mutations affect neuronal circuits? Which particular neuronal circuits are damaged in these diseases and how might we diagnose and treat such damage more readily?

Andrzej Dlugosz
Professor, Dermatology
How do alterations in the Hedgehog signaling pathway contribute to cancer initiation, progression, and maintenance in organs such as skin or stomach? Could targeting the Hedgehog pathway, and/or interacting pathways, provide a useful approach for the treatment of certain types of cancer?

Xing Fan
Associate Professor, Neurosurgery
Malignant brain tumors are thought to be maintained by "cancer stem cells". Can we develop novel therapies for malignant brain tumors based on depletion of these important progenitor cells?

Philip Gage
Associate Professor,
Ophthalmology & Visual Science
What molecular mechanisms and developmental signals control normal mammalian eye development? Which of these is misregulated in the context of eye diseases that result in blindness and how might we design molecular therapies to correct these abnormalities?

Gary Hammer
Millie Schembechler Professor of Adrenal Cancer, Molecular&Integrative Physiology/Internal Medicine(MEND)
Signaling and gene regulatory networks that dictate development and homeostasis of the adrenal gland. Lineage and differentiation of adrenocortical stem cells in health and disease (adrenal aplasia, hypoplasia, hyperplasia and cancer) Basic translational and clinical research (genomic/genetic, molecular, cellular, developmental, cancer, mouse models, human/patient samples & data bases clinical trials)

Peter Hitchcock
Professor, Ophthalmology and Visual Science
Research in my laboratory seeks to identify the cellular and molecular mechanisms that control neurogenesis in the central nervous system. We study neurogenesis in two contexts, during embryonic development and, in adults, during regeneration induced by an injury. We use the retina as the model brain tissue and employ a small fresh water fish, zebrafish, as the animal model. Although the retina is outside the skull, it possesses all the properties of the central nervous system. The retina the zebrafish is unique in that its embryonic growth is amazingly fast. It takes a mere 72hrs for the zebrafish's retina to completely develop and become functional. This rapid growth, plus the array of genetic tools available to us, renders the zebrafish retina an invaluable model for studying how the brain develops. Further, and also unique to fish, the adult retina contains a permanent population of neural stem cells. Due to the presence of these stem cells, injuries to the retina are fully repaired by a process of regenerative neurogenesis. This is in striking contrast to the human brain and retina, where injuries do not stimulate regeneration and the death of neurons results in permanent disabilities. Our broad goal, therefore, is to understand the molecular mechanisms that regulate this regenerative neurogenesis. This work relates directly to understanding injuries to the human central nervous system and gaining insights into therapeutic approaches envisioned for treating these injuries.

Graham Holland
Professor, Dentistry
Research interests for Dr. Holland include the morphological basis of sensory mechanisms in the trigeminal nervous system, particularly pain.

Patrick Hu
Associate Professor,
Internal Medicine/Institute of Gerontology
In the roundworm C. elegans, a conserved insulin-like signaling pathway controls development, metabolism, and life span. How is this pathway regulated, and by what means does it influence longevity? Can insights into the regulation and function of this pathway in C. elegans improve our understanding of the molecular basis for aging and aging-related diseases in humans?

Qing Li
Assistant Professor
Internal Medicine
We work on the signaling of leukemic stem cells (LSC) with the goal of developing novel therapies to target LSCs. We use mouse models and human leukemia samples to identify the intrinsic and extrinsic mechanisms by which oncogenes and tumor suppressor genes transform normal hematopoietic stem cells and progenitors into LSCs. We are developing and testing novel targeted therapies in these models to eliminate LSCs.

Cheng-Yu Lee
Assistant Professor,
Internal Medicine/Life Sciences Institute
Stem cells in the fruit fly brain divide to produce a steady stream of additional stem cells while simultaneously producing hundreds of differentiated daughter neurons. What genes control this balance between stem cells and differentiating cells? Which of these genes have orthologs that function in mammalian brain development? Misregulation of such genes may cause birth defects or brain cancer.

Pedro Lowenstein
Professor, Neurosurgery
What is the molecular and cellular basis of malignant brain tumor invasion and growth? What are the essential mechanisms used by tumor cells to grow and to destroy normal brain tissue, thus killing the host? What are the first steps in the invasive process? Knowing this information, can we inhibit tumor growth?

Ivan Maillard
Associate Professor,
Internal Medicine/Life Sciences Institute
After a stem cell or bone marrow transplant, the implanted cells can attack the host in a reaction called graft vs host disease. How does this reaction initiate? What signaling pathways are involved? Can the underlying mechanisms of this reaction reveal new strategies to prevent graft vs. host disease?

Marina Pasca di Magliano
Assistant Professor, General Surgery
Pancreatic cancer is one of the most lethal human malignancies; we know that pancreatic cancers often show activation of embryonic signaling molecules like Hedgehog. What direct role does Hedgehog signaling play in pancreatic cancer initiation and progression and how can we use this information to design better therapeutic weapons against pancreatic cancer?

Jason Spence
Assistant Professor, Internal Medicine
Human pluripotent stem cells, grown in a culture dish, can allow study of human development and disease. Organoid-like structures grown from such cells recapitulate several tissues, including colon, small intestine, esophagus and lung. Using these, we can ask: How do organs assemble into functional units? What are the genes and signaling programs necessary to form proper organs and which of these are functioning improperly in disease?

Deneen Wellik
Associate Professor, Internal Medicine
Hox genes encode a large family of DNA binding proteins that function in the development of multiple organs. These genes are expressed in mesenchymal stem and precursor cells and instruct the development, maintenance and repair of organs and tissues. The laboratory investigates the mechanisms by which these genes function.

Sunny Wong
Assistant Professor, Dermatology
My lab's general interests involve understanding how hair follicles develop and how basal cell carcinoma arises in the skin. In terms of development, we are specifically focused on the biology of the hair follicle infundibulum, a poorly characterized domain that constitutes the hair follicle opening, or the pores visible on the surface of the skin. We are interested in the cellular events that generate this opening, the genes that maintain its normal function, as well as events associated with hair canal disruption, as occurs in acne patients. In terms of basal cell carcinoma, we are interested in studying the stem cells in the skin which give rise to these tumors, as well as their interactions with neighboring stromal cells. We are also currently investigating how these tumors regress in response to therapy, as well as how they potentially develop drug resistance.

Supplemental Appointments

Osamu Tanabe, M.D., Ph.D., Adjunct Res. Asst. Prof.
John Matthew Velkey, Ph.D., Adjunct Lecturer
Stephen A. Ernst, Ph.D., Professor Emeritus/A
Sun-Kee Kim, Ph.D., Associate Professor Emeritus/A
Margaret Lomax, Ph.D., Professor Emeritus/A
Alphonse R. Burdi, Ph.D., Professor Emeritus
Bruce Carlson, M.D., Ph.D., Professor Emeritus
Walter A. Castelli, DDS, Professor Emeritus
A. Kent Christensen, Ph.D., Professor Emeritus
Sarah Wynans Newman, Ph.D., Professor Emeritus

GRADUATE STUDENT AWARDS

Katie Baldwin **(Giger Lab)**
NIH National Research Service Award (NRSA)

Brandon Carpenter **(Allen Lab)**
2014 Rackham Outstanding Graduate Instructor Teaching Award

Albert Chen **(Hu Lab)**
Patten Award for Excellence in Research for a Graduate Student

Alana Chin **(Spence Lab)**
BTDS Training Grant

Corey Cunningham **(Weisman Lab)**
CMB Training Grant

Colin Delaney **(Hu Lab)**
NSF Graduate Research Fellowship

Andrew Freddo **(Gumucio Lab):**
NIH National Research Service Award (NRSA) for Individual Predoctoral Fellowship in MD-PhD Programs

Alex Holtz **(Allen Lab)**
NIH National Research Service Award (NRSA)

David Lorberbaum **(Barolo Lab)**
Reproductive Sciences Program Training Grant
University of Michigan Center for Organogenesis Training Grant
Sarah Winans Newman CDB Teaching Award

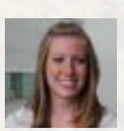
Rabia Malik **(Sivaramakrishnan Lab)**
AHA Fellowship

Yevgeniya Mironova **(GigerLab)**
CMB Training Grant

Kyriel Pineault **(Wellik Lab)**
Tissue Engineering and Regeneration Training Grant

Justine Pinskey **(Allen Lab)**
Sarah Winans Newman CDB Service Award

Andrea Ramos **(Barolo Lab)**
Organogenesis Training grant



Danielle Rux **(Wellik Lab)**
TEAM Training Grant

Gabriella Sterne **(Ye Lab)**
The Innovators Award from the graduate program in Neuroscience
Poster award at the Protein Folding Disease Initiative's Poster session

Sara Wong **(Weisman Lab)**
CMB Training Grant

Qi Xiao **(Lee Lab)**
EDGE (Endowment for the Development of Graduate Education) Award

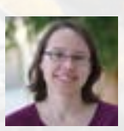
Swathi Yadlapalli **(Yamashita Lab)**
Rackham Conference Travel Grant
Weintraub Graduate Student National Award

POST DOCTORAL AWARDS

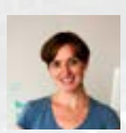
Martin Engelke **(Verhey Lab)**
Swiss National Science Foundation (SNSF) Postdoctoral Fellowship

Sai Srinivas Panapakkam Giridharan **(Weisman Lab)**
American Heart Association Postdoctoral Fellowship

Lihong Shi **(Engel Lab)**
Bradley Merrill Patten Award for Excelence in Postdoctoral Research



Ruth Sommese **(Sivaramakrishnan Lab)**
Post doc fellowship Life Sciences Res. Fdn.



Bethany Strunk **(Weisman Lab)**
The Jane Coffin Childs Memorial Fund for Medical Research Fellow

Daisuke Takao **(Verhey Lab)**
Japanese Society for the Promotion of Science (JSPS) Postdoctoral Fellowship for Research Abroad

STAFF AWARDS

Melissa Karby
Medical School Professional Staff of the Year Honorable Mention

ALUMNI

Cell & Developmental Biology alumni are leading the way as teachers, scientists, doctors and throughout industry. Through formal collaboration or informal knowledge sharing our community continues to help each other innovate. However, the group of alumni is only as vibrant as the people who participate, so regardless of where you live or if you are working in an entirely different field, we encourage you to stay involved! Here are just a few ways to stay connected:

Send us an Alumni Update

Let us know what you are up to now. Fill out our online alumni update form or send us a message to cdb-alumni-update@umich.edu. We would love to hear what you have been up to since your time in CDB.

Online Social Networks

Do you use social media? Find us on Twitter, Facebook, and LinkedIn.

Host a Regional Event

Are you interested in hosting an event for fellow alumni in your area? Contact Greg Witbeck at germain@med.umich.edu or 734-232-6017 to discuss opportunities.

Scholarship Support

You can make a difference in the lives of today's students. Find out how at cdb.med.umich.edu/giving

For those who leave Michigan but for whom Michigan never leaves, this is where you belong.

Kristen Verhey and students in CDB 801

43%
Students Funded through fellowships

23%
Post Docs Funded through fellowships

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Ask us Anything...

Alana: @all: Have you ever felt like you had no idea what you wanted to do with your life? How did you work it out?

Deb: Yes. I had a job after undergrad in microbiology in a local hospital, but was not excited about it, so I decided to go back to school and get a Master's degree. There, I took my first in-depth course in cell biology and was hooked! But I didn't start grad school until 5 years later (I was 30).

Ajit: Not really. There have been a couple of times, however, when I thought I would rather be doing something other than what I was doing at the time. I don't have much to complain about so far about the decisions I made. Things always work out in life; you just have to learn to like it.

Brandon: @Shiv What and who was your inspiration for learning the banjo?

Love the sound of it! A friend of mine John Shutko, an appalachian native, who plays one personally signed by Pete Seeger himself, suggested the open-back claw hammer style for its vibrant tones. Strum one and there is no going back.

Brittney @all: what is your favorite meal to cook?

Deb: Roasted scallops with asparagus

Ajit: Kolhapuri Chicken - an extremely hot and spicy chicken curry from my home state, Maharashtra, India. I think it once made a guest sick :|

Melissa: I like to cook anything that makes people happy. Currently my favorite meal is a full German dinner that includes schnitzel, homemade spaetzle, rotkohl (red cabbage) and some type of dessert.

Justine @Einor: If you wrote a book, what would it be about?

Maybe a cook book with chapters about gardening and building kitchen tools. Or perhaps a history of Isamu Akasaki, Hiroshi Amano and Shuji Nakamura about the invention of efficient blue light-emitting diodes. Talk about a bright idea!

Melissa: @DougEngel & @SueOShea: How many hours have you clocked scuba diving?

Doug: about 300 hours underwater; I'll need to check my log book .

Sue: About 200 hours; but it's the depth you have dived, not the hours!

Jorge Martinez : @all "Right or Left Twix? Why?"

Dawen: Right Twix. I only eat one at one time - the other one must be the "left" one.

Ajit: Twix are for kids.

Justine @CDBstaff: What is the most expensive piece of equipment in the department?

Karen²: The most expensive ever purchased was the 2Photon microscope at $2.4M purchased in 2011, this is part of the Microscopy Imaging Lab and now part of the Biomedical Research Core Facilities.

The most expensive current equipment in the department is $188K for the FSR purchased in 2014. This is a flow cytometer analyzer. It has 3 lasers that can sequentially detect 3-5 fluorescent channels simultaneously. This allows us to detect up to 14 fluorescent parameters simultaneously. In flow cytometry, the instrument is used to interrogate a suspension of cells stained with fluorescent antibodies. It uses hydrodynamic focusing to force the cells into the chamber where the lasers and detectors are. It is an extremely flexible technique; it can be used to analyze cell differentiation and/or the composition of different tissues in vivo. It can also be used to analyze cell viability and proliferation.

MEDICAL SCHOOL
CELL & DEVELOPMENTAL BIOLOGY
UNIVERSITY OF MICHIGAN

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