

Stem Cell & Regenerative Medicine Center
UNIVERSITY OF WISCONSIN–MADISON

2014 UPDATE

From the Directors

These are exciting times at the University of Wisconsin-Madison. We have more faculty than ever before who are experts in stem cells and regenerative medicine coming on board to teach, research and treat patients. Yet there is an ongoing need for resources to support breakthroughs and help move more of our discoveries into the clinic. That's where our center steps in.

The UW-Madison Stem Cell & Regenerative Medicine Center is critical in facilitating scientific collaboration through organizing scientific focus groups, hosting conferences, launching pilot grants for promising new research and hosting visiting professors. We provide shared equipment to researchers. We support training and mentoring programs. Our public outreach programs attract thousands of teachers, students and families from all over the state.

The SCRMC helps support faculty who not only conduct research, but also work together to teach and develop new courses for our incoming students. Our center helps strengthen UW-Madison as the place to receive the best education, training and real world experience in majors such as cell and regenerative biology, biomedical engineering, genetics, molecular biology, biostatistics and chemistry. Our Center's partnership with these departments helps to prepare students for research, medical school, veterinary school, masters programs in pharmacy, business, law and other exciting career paths. In addition to developing courses for credit toward majors, we launched our Stem Cell Certificate program in 2013 to give our students even greater opportunity to augment their education.

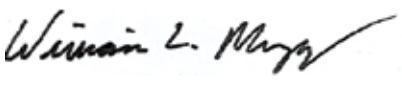
We trust you will enjoy reading about some of our advances and activities from the past year on the following pages, as well as learning about our plans for this year and beyond. You can also learn more about our research by visiting our web page at stemcells.wisc.edu or finding us on Facebook.

We are excited for the year ahead and are grateful for all the support we've received from our campus, our patients and the community.

Sincerely,



Timothy. J. Kamp, M.D., Ph.D.
Professor of Medicine, Cell and Regenerative Biology



William L. Murphy, Ph.D.
Professor of Biomedical Engineering
Orthopedics and Rehabilitation

Co-Directors, UW-Madison
Stem Cell and Regenerative Medicine Center

SCRMC LOOKS TO THE FUTURE

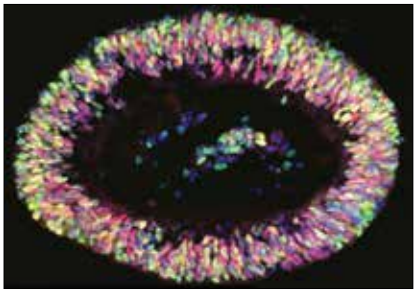
Research to make a difference, programs to engage the community

WORKING TOGETHER on Tough Challenges

There is now unprecedented potential to discover better drugs faster, create smarter medical devices and advance from disease treatments to cures. From basic research through early clinical trials, to emerging treatments involving stem cell transplants, or testing new medications on cells and tissues grown from stem cells, the University of Wisconsin-Madison has been at the heart of it all.

Yet many diseases and disorders still elude a better understanding and effective treatments for the millions of people who suffer from them. So, even as new therapies are helping many of us live happier, more satisfying lives, many others feel helpless when they experience or see the ravages of Alzheimer's, Parkinson's, ALS, MS, cerebral palsy, spinal cord injury, pulmonary fibrosis, hearing loss, blindness and arthritis. In addition, our service members and civilians alike continue to suffer significant traumatic injuries with no ideal treatments.

The SCRMC faculty and the students they train here at UW-Madison are committed to defeating these and other diseases to make sure that in the next twenty years we see progress even more remarkable than in the last 20 years.



Retina cells grown from pluripotent stem cells in the lab of David Gamm, M.D., Ph.D.



Sean Palecek, Ph.D., SCRMC Stem Cell Bioengineering Focus Group chair, talks with Adriana Rodriguez at the SCRMC Fall Conference beside her research poster. Rodriquez was a student from the University of Houston who mentored under Palecek and Amritava Das, Ph.D., in the Department of Chemical and Biological Engineering as part of the Institute for Biology Education's Integrated Biological Science Summer Research Program.



SCRMC member James Thomson, V.M.D., Ph.D., directs Regenerative Biology at the Morgridge Institute for Research on campus. Thomson pioneered embryonic stem cell research, followed by induced pluripotent stem cell research, and continues to work on improving culture techniques for stem cells, as well as learning more about their basic biology. Photo by Michael Kienitz.



Public outreach and education continue to be important with the Stem Cell and Regenerative Medicine Center. We enjoy welcoming groups to our stem cell learning labs on campus, as well as presenting at school family science nights and to community organizations.



Jordana Lenon, B.S., B.A., SCRMC outreach specialist, is happy to work with community groups to arrange a speaker or other outreach opportunities.

RESEARCH LEADS THE WAY TO BETTER HEALTH

Bringing patients, physicians and researchers together

PARKINSON'S DISEASE

Meet **Gene Rood** from Monroe, Wisconsin, pictured below with **Nancy Ninman,** UW Health nurse practitioner. Gene is just one of many people who have benefited from advances in research and clinical care at the University of Wisconsin-Madison. He underwent deep brain stimulation surgery at UW Hospital in 2007 to help control his Parkinson's tremor and he also takes medications.



Gene Rood and Nancy Ninman at the UW Health Neurology Clinic.

Gene participated in a video for an interactive public exhibit on Parkinson's disease research that premiered in Fall 2013 at the Wisconsin Institutes for Discovery. The exhibit, which also featured take-home resources for patients, kicked off with an experts panel that featured **Lily Cappelletti** (Michael J Fox Foundation for Parkinson's Research), **Marina Emborg, M.D., Ph.D**. (School of Medicine and Public Health, Wisconsin National Primate Research Center and SCRMC), and **Michelle Ciucci, Ph.D.** (School of Medicine and Public Health, and President, American Parkinson's Disease Association Wisconsin Chapter).

Dr. Emborg and other key Stem Cell and Regenerative Medicine Center faculty and staff, with partners from across campus, made this exhibit possible. Visitors to the exhibit could learn about advances in stem cell research, regenerative medicine, and basic cellular processes that cause diseases such as Parkinson's. These advances are leading to new drug therapies, cell and tissue transplants, and other novel surgeries to treat this debilitating disease, as well as other degenerative diseases.

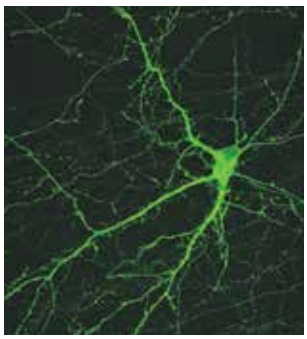


Parkinson's experts Cappelletti, Emborg and Ciucci.

TRANSPLANTED CELLS Produce Dopamine

In an exciting preclinical research advance by SCRMC scientists **Su-Chun Zhang, Ph.D.,** and **Marina Emborg, M.D., Ph.D.** (pictured on previous page at left), achieved what no one else had done before: they transformed skin cells derived from a monkey into induced pluripotent stem cells in a lab dish, morphed those cells into dopaminergic neurons, then transplanted those neurons back into the same monkey.

The resulting, healthy, normal cells integrated into the brain and produced dopamine. The experiment shows that a person's own cells could possibly be made into other cell types that could be used to treat or cure their disease. The work was published in *Cell Reports* in March 2013.

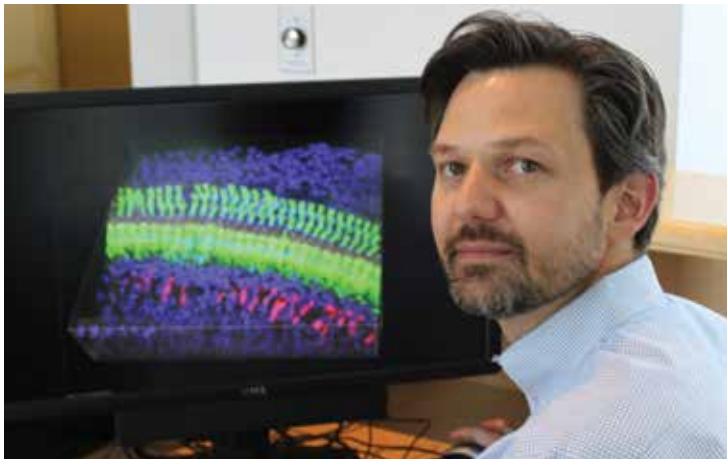


Dopaminergic neuron derived from an induced pluripotent stem cell. Image by Yan Liu.

Zhang and others also succeeded last year in directly reprogramming skin cells into neurons and other mature cells, bypassing the stem cell phase altogether. This work was published in *Cell Reports* in May 2013.

Tackling HEARING LOSS

The ultimate cause of hearing loss is usually found in the tiny hair cells that play the crucial role of converting sound waves into nerve impulses for delivery to the brain. SCRMC member **Samuel Gubbels, M.D.,** is exploring how hair cells can develop from stem cells. Cochlear implants, with which he treats UW health patients, are expensive and lead to a lifetime dependence on technology. Gubbels is studying an approach to treating hearing loss through which inner ear progenitor cells grown from stem cells could be transplanted into patients. But first, he needs to find out what triggers these progenitors to make new hair cells when needed.



Sam Gubbels, M.D., with his colorful ear cells.



Su-Chun Zhang's neural regeneration laboratory at UW. Photo by Jeff Miller.

Down Syndrome DISCOVERY

Even though Down syndrome is common, scientists know little about what goes wrong in the brain. **Anita Bhattacharyya, Ph.D.,** leader of the SCRMC Neural Regeneration Focus Group, has grown brain cells from skin cells of individuals with Down syndrome, providing a way to look at early brain development as it relates to this syndrome. The skin cells were first transformed into induced pluripotent stem cells, then grown into neurons. The research team studied the neurons and reported a reduction in specific neural connections. This synaptic deficit, and its effect on genes on other chromosomes in neurons of people who have Down, also revealed that genes responding to oxidative stress were the most affected. The work appeared in May 2013 in the *Proceedings of the National Academy of Sciences.*



Anita Bhattacharyya, Ph.D.

Bioengineering BETTER CELLS

Meanwhile, SCRMC Executive Committee member **Randolph Ashton, Ph.D.,** and SCRMC member **James Thomson, V.M.D., Ph.D.,** are just a few of our many collaborators who have been hard at work bioengineering better types of human stem cells for research and clinical use. Ashton recently perfected a new and improved "recipe" for growing neural stem cells to study and treat spinal cord injuries, as well as diseases such as Parkinson's, Huntington's and ALS. The journal *Stem Cells* published his team's work in December 2013. This finding was an extension of the Thomson lab's chemically defined hPSC culture system published in 2011 in *Nature Methods.*



Randolph Ashton, Ph.D.

Preserving BREATHING IN ALS

A new study, published online in the *American Journal of Respiratory and Critical Care Medicine* in January 2013 and conducted largely at the University of Wisconsin-Madison, showed the potential for two complimentary treatments—stem cell therapy and intermittent exposure to low oxygen — to preserve and even restore breathing capacity in rats with a condition similar to ALS in humans, according to co-principal investigator **Gordon Mitchell, Ph.D.,** professor of comparative biosciences in the School of Veterinary Medicine.



Gordon Mitchell, Ph.D.

"Prime and boost" stem cell delivery in a preclinical study.



Progress on HEART DISEASE

Amish Raval, M.D., leader of the SCRMC Cardiovascular Regeneration Focus Group, is developing tools to improve treatments for heart and vascular disease. In one novel preclinical therapy, called "prime and boost," his team used mesenchymal stem cells to safely and effectively treat a swine model of acute myocardial infarction. His team first injected stem cells into a vein and these cells circulated up to the heart. This injection primed the heart for a second infusion of stem cells directly into the injury zone, which acted to boost the effectiveness of the first injection.



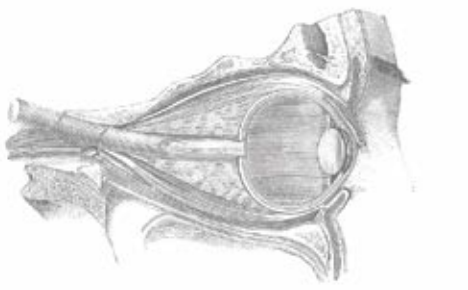
Stem Cell "raft." Image by A. Raval.

In another novel approach, Raval and colleagues published in the *Journal of Cardiovascular Engineering and Technology* on the use of a material acting as a delivery platform, or raft, to carry stem cells to help heal the heart. The raft, pictured at right, is smaller and more pliable than a contact lens. It's made from cardiac fibroblast cells to simulate the heart environment. After it is placed directly on injured tissue, its "passengers" – the stem cells – disembark slowly and migrate to where they are needed in the heart muscle, and eventually the raft dissolves away. Early findings suggest the raft itself may have some treatment benefits also, another exciting discovery.

RETINAL ADVANCES



For children born with Stargardt's disease, Best disease, and other forms of juvenile macular degeneration, their limited vision has been detrimental to normal development, especially in terms of their reading abilities. Now with exciting stem cell discoveries from UW-Madison eye researchers, a new generation has real hope of seeing clearly in their lifetimes.



HUNTINGTON'S DISEASE



Huntington's disease is a debilitating congenital neurological disorder that progressively robs patients of muscle coordination and cognitive ability. It is a condition without effective treatment, a slow death sentence.

UW-Madison neural regeneration researchers have forged a special type of brain cell from stem cells that could someday help restore the muscle coordination deficits that cause the uncontrollable spasms characteristic of the disease.

BLOOD CANCERS and DISORDERS



UW-Madison stem cell scientists and doctors are investigating how stem cells that give rise to all types of blood cells develop and function.

This research is revealing new insights into diseases such as lymphoma, leukemia and other cancers of the blood and bone marrow, as well as myeloid dysplasia, sickle-cell anemia and other blood disorders.

JOINT REPLACEMENT



SCRMC member Wan-Ju Li, PhD, grows cartilage from pluripotent stem cells as part of the SCRMC's Musculoskeletal Regeneration Focus Group

From athletes to the elderly, people of all ages suffer pain and limited motion due to knee and hip injuries, often needing multiple surgeries and finally, artificial joint replacement. UW-Madison scientists are using stem cell technology to bioengineer new cartilage, bone, ligaments and other tissues, with the goal of using them in patients to give them more natural joint replacement options.





Participants in the 2013 Annual SCRMC Fall Conference interact during the poster competition at the Wisconsin Institutes for Discovery (WID).

Educating STUDENTS

UW-Madison undergraduates, graduate students and post-doctoral trainees are the future of stem cell and regenerative medicine research and patient care. They are the backbone of many of our SCRMC activities. Many are active in the Wisconsin Stem Cell Roundtable (WiSCR), an organization of students supported by the SCRMC and dedicated to advancing stem cell research, mentoring, funding opportunities for students and public outreach.



SCRMC Fall Conference organizing committee members were, from left, Weixiang Guo, Ethan Lippmann, WiSCR President Ka Yi Ling, Paul Wrighton and Ronghui Li.



Our MISSION

With close ties to many schools and colleges across campus such as the School of Medicine and Public Health, Graduate School, College of Engineering and School of Veterinary Medicine, the SCRMC advances stem cell biology and fosters breakthroughs in regenerative medicine through faculty interactions, research support and education.

Our GOALS

- Maintain UW-Madison as leader in stem cell and regenerative medicine research and application.
- Foster increased stem cell and regenerative medicine communication within campus and beyond its borders.
- Support stem cell and regenerative medicine research: basic, translational, clinical, bioethics, and public policy.
- Develop educational, training and outreach programs.
- Enhance philanthropic support.

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Support Stem Cell Research

You can play a vital role in the future of stem cell research. Your investment in the Stem Cell and Regenerative Medicine Center will yield rewards that will change the future of medicine and health care.

You can designate your gift to support:

- A specific investigator or research on a specific disease, to help move cutting edge technologies from lab to clinic.
- A training grant or travel award to help a young student or post-doctoral fellow who is devoting his or her career to solving a health problem.
- Our general fund, which allows us to take advantage of both existing and future opportunities in research, education and clinical care.

Make a Gift

Please complete the enclosed gift envelope, or donate online at www.supportuw.org/giveto/stemcell

Contact Barb McCarthy at 608-265-5891 or barb.mccarthy@supportuw.org to learn how you can support stem cell research and regenerative medicine.

UNIVERSITY OF WISCONSIN FOUNDATION

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Plans for 2014 include:

- Teaching the second year of our new course on stem cells and regenerative medicine through the new **Department of Cellular and Regenerative Biology** in the School of Medicine and Public Health.
- Co-organizing the international **2014 Regenerative Medicine Workshop** in March, at Hilton Head with Georgia Tech, Emory University, and the University of Pittsburgh.
- Planning the exciting **Wisconsin Stem Cell Symposium,** "From Stem Cells to Blood," in April.
- Supporting the **Wisconsin Stem Cell Roundtable** (WiSCR), our student stem cell organization, in planning the SCRMC Fall Conference in September. WiSCR also planned its first industry panel in February.
- Expanding our graduate and postdoctoral training award program by doubling the number of awards.
- Continuing to partner with the **UW Institute for Clinical and Translational Research** to support seed grants that support clinical regenerative medicine.
- Setting up our center's new home in the newly built **Wisconsin Institutes for Medical Research Tower II**.



Photo by J. Peterson