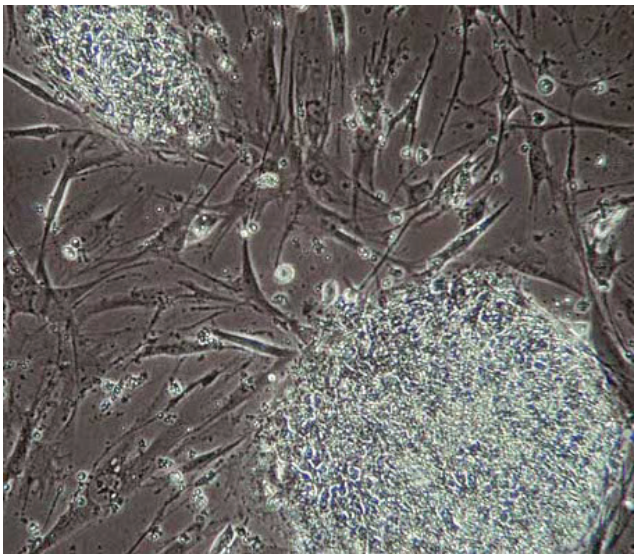
Stem Cell & Regenerative Medicine Center
UNIVERSITY OF WISCONSIN–MADISON

2018 Update



Nov. 6, 2018, marks the 20th anniversary of the seminal paper “Embryonic stem cell lines derived from human blastocysts”, published in the journal *Science*. The paper documented a breakthrough that occurred when UW–Madison scientist James Thomson, V.M.D., Ph.D., developed a technique to successfully isolate and culture human embryonic stem cells from lab-fertilized embryos.

In the abstract, the authors predicted that “these cell lines could be useful in human developmental biology, drug discovery and transplantation medicine.”

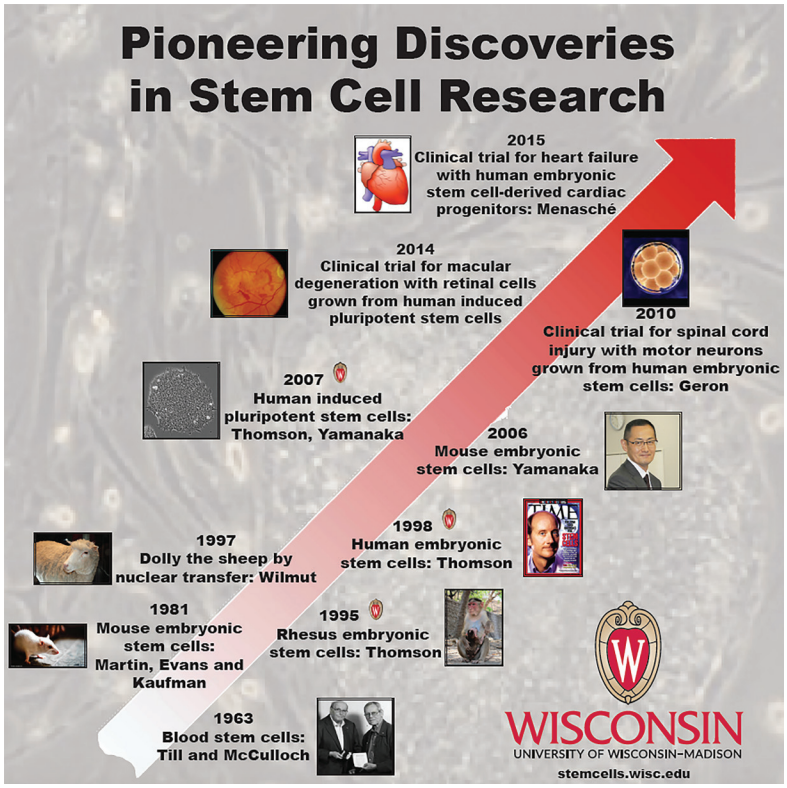
Today, that prediction is coming true.

The discovery underscores the importance of basic science and is an excellent example of how it can lead to applied science, clinical trials, entrepreneurship and expanding business and industry.

This fall, UW–Madison and its partners will celebrate this milestone with lectures, multimedia productions and other events and stories. It’s a great opportunity to honor the pioneers and to support and celebrate the work of those who are building on that discovery.

Please join us and share in the discoveries that led to a new era of science and medicine. See page 11 for information on upcoming stem cell anniversary events.

Thank you for supporting us on this incredible scientific journey!



About the SCRMC

Welcome to our annual update sharing cutting-edge discoveries by our SCRMC scientists and physicians, student highlights and impacts of stem cell research in Wisconsin and beyond.

SCRMC faculty members collaborate across several UW–Madison schools, colleges, departments and centers, including the School of Medicine and Public Health, UW Health, College of Engineering, Wisconsin Institute for Discovery, Morgridge Institute for Research, Waisman Center, Wisconsin National Primate Research Center, School of Veterinary Medicine and many others.

To help the best minds solve the most difficult problems and move our field ahead, the SCRMC:

- Facilitates campus collaboration through scientific focus groups that meet frequently to share research progress and next steps.
- Co-funds pilot research project grants with the UW-Madison Institute for Clinical and Translational Research.
- Hosts scientific conferences and visiting professors to spur shared knowledge and collaboration.
- Provides core services and shared equipment to researchers.
- Supports undergraduate, graduate and post-doctoral education, training and mentoring programs.
- Supports public outreach programs that inform thousands of teachers, students, families and civic groups.

Contact us

Tim Kamp, M.D., Ph.D.
SCRMC Director
Professor of Medicine, Cell and Regenerative Biology, School of Medicine and Public Health
tjk@medicine.wisc.edu

Sue Gilbert, B.A.
Program Administrator
sggilber@wisc.edu

Jordana Lenon, B.S., B.A.
Communications and Outreach
jlenon@primate.wisc.edu

Phone: 608-263-2982
www.stemcells.wisc.edu
Facebook: uwmadisonstemcell
Twitter: UWSCRMC

The SCRMC helps strengthen UW–Madison as the place to receive the best education, training and real world experience. We make discoveries, build partnerships, and support the next generation of scientists, clinicians and business leaders – all working together to improve our health and quality of life.

James Thomson at the Morgridge Institute for Research (Photo by Michael I. Kienitz)

Twenty years of stem cell discovery

In this 20th anniversary edition of the SCRMC Update, we're sharing some key discoveries by SCRMC faculty members. Pages 4-8 represent discoveries related to our center's five scientific focus groups, with many research highlights involving other groups as well.

These groups help advance scientific and medical progress by getting researchers together to share ideas and methods, seek research funding, assist researchers new to campus and more.

Research highlights are searchable by title online and lead to their UW–Madison news releases.

To learn more about the exciting stem cell and regenerative medicine science happening at UW–Madison, enjoy our new scientific focus group videos!

2018 Regenerative Medicine Award

Su-Chun Zhang, M.D., Ph.D., accepted the SCRMC and WiCell award for Regenerative Medicine Innovator of the Year on May 7 at the Discovery Building.

Zhang is a professor of neuroscience in the School of Medicine and Public Health, a Waisman Center investigator and co-founder of BrainXell, a Madison company that produces and sells specialized neurons to pharmaceutical researchers.

Over his 20-year career at UW–Madison, Zhang has transformed the field of stem cell research. He was the first in the world to isolate neural stem cells from embryonic stem cells (ESCs) and induced pluripotent stem cells (iPSCs), a landmark discovery he patented with the help of the Wisconsin Alumni Research Foundation (WARF) in 2001.

From left are SCRMC faculty member Krishanu Saha, Su-Chun Zhang, WiCell Director Robert Drape and SCRMC faculty member Bill Murphy. (Photo by Jordana Lenon)

Stem Cell Bioengineering Focus Group:
Directed by Sean Palecek, Ph.D.

Advances in Stem Cell Bioengineering

2005
Engineered stem cells may help sneak drugs into the brain

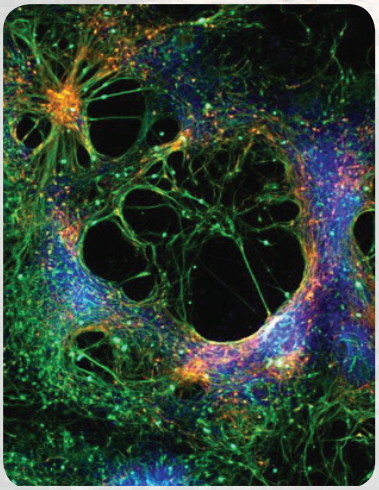
2012
Blood-brain barrier building blocks forged from human stem cells

2013
Material screening method allows more precise control over stem cells

2014
UW-Madison team developing 'tissue chip' to screen neurological toxins

2015
Researchers aim to broaden understanding of how toxins affect the body

2015
UW engineers use 'CRISPR' technology to locate crucial protein in stem cell survival



2015
Stratatech receives $247 million contract to develop skin product

2016
Engineers reveal fabrication process for revolutionary transparent sensors

2016
Smart cancer therapies: Teaching the body's own T-cells to attack tumors

2017
New culture substrate furthers stem cells for use in drug discovery, cell therapy

2017
UW–Madison to partner in $20 million cell-based therapy center

2017
All-in-one repair kit makes CRISPR gene editing more precise

"The stem cell bioengineering focus group brings to bear technology on a wide variety of diseases. We're focused on how you can use technology and quantitative science to understand questions in basic stem cell biology and in clinical translation." – Sean Palecek

UW-Madison Blood Research Program:
Directed by Emery Bresnick, Ph.D.

Development and Regeneration of Blood Cells

2001
Stem cells guided down blood's developmental pathway

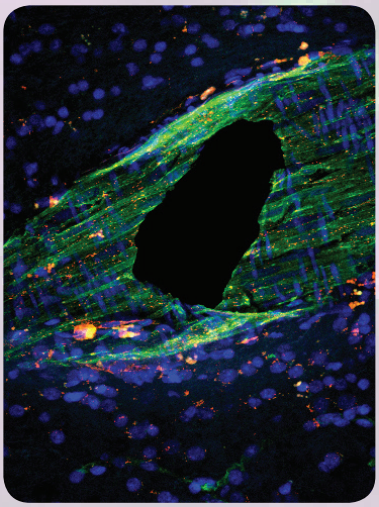
2006
Stem cells used to create critical brain barrier in lab

2009
Scientists make multiple types of white blood cells directly from stem cells

2012
New genetic mechanism for controlling blood cell development and blood vessel integrity found

2014
Wisconsin scientists find genetic recipe to turn stem cells to blood

2015
Research finds 'encyclopedia' of genes that regulate blood cell development



2015
Researchers forge leukemia cells in lab

2016
Researchers identify mechanism controlling red blood cell development

2017
Cell therapy could reduce bone-marrow transplant and radiation injury complications

2017
Stem cells yield nature's blueprint for body's vasculature

2017
UW scientists create a recipe to make human blood-brain barrier

"We have tremendous expertise, innovative systems and unique multidisciplinary teams... we have everything here that we need to essentially address any complex problem." – Emery Bresnick

Cardiovascular Regeneration Focus Group:
Directed by Amish Raval, M.D.

Progress in Cardiovascular Regeneration

2003
Stem cells grown into three major heart muscle cell types

2005
Transplanted stem cells show promise for mending broken hearts

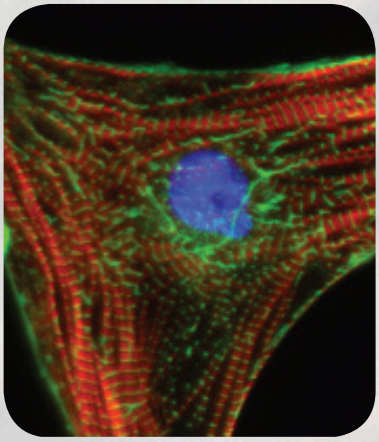
2007
UW launches study testing adult stem cells for heart damage repair

2007
UW launches human trials testing adult stem cells for advanced heart peripheral artery disease

2009
Researchers grow iPS cells into heart cells

2010
UW-Madison heart stem cell study among top research advances

2012
New stem cell technique promises abundance of key heart cells



2016
Researchers transform common cell to master heart cell

2016
Morgridge–UW project investigates tissue-engineered arteries for transplant

2017
UW-Madison scientists grow fuctional artery cells from stem cells

2017
Stem cells yield nature's blueprint for body's vasculature

2017
UW treats first participant in trial of stem-cell therapy for heart failure

2017
UW treats no-option heart failure patients with adult stem cells in two major trials

"Major discoveries cannot come from a single lab. Our work has to involve many collaborating researchers, their students, and clinicians in different areas of expertise from across campus." – Amish Raval

Musculoskeletal Regeneration Focus Group:
Directed by Wan-Ju Li, Ph.D.

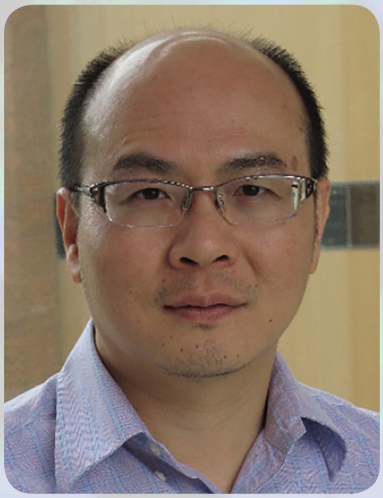
Forging Musculoskeletal Regeneration

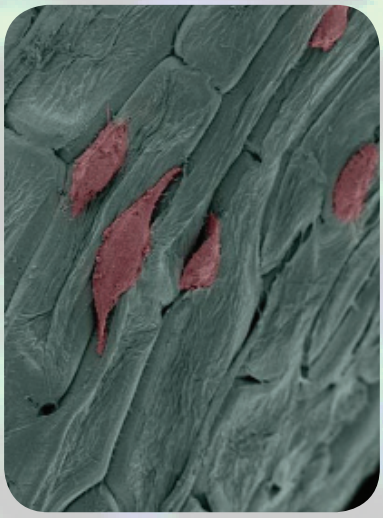
2014
Researchers unveil a non-viral transfection approach to improve stem cell properties

2014
Researchers discover new way to make muscle cells from human stem cells

2015
NIH awards UW-Madison research team grant to investigate blood-derived stem cells for cartilage repair

2017
Research team discovers a novel macrophage cell therapy for tendon repair





2017
Researchers identify an etiological mechanism of type 1 diabetes-associated bone loss

2017
Parsley and other plants lend form to human stem cell scaffolds

2017
UW scientists find key cues to regulate bone-building cells

2017
UW-Madison scientists, inspired by old bones, find new strategy for drug delivery

2018
Scientists establish stem cell-based model of osteoarthritis

"We hope that musculoskeletal researchers use our group as a platform to share innovative ideas, to develop projects together, and ultimately, with collaborative efforts, to advance the science of musculoskeletal regeneration." – Wan-Ju Li

Neural Regeneration Focus Group:
Directed by Anita Bhattacharyya, Ph.D.

Understanding Neural Regeneration

2001
Neural cells from human embryonic stem cells

2005
Scientists grow spinal motor neurons

2008
Engineered stem cells for studying ALS

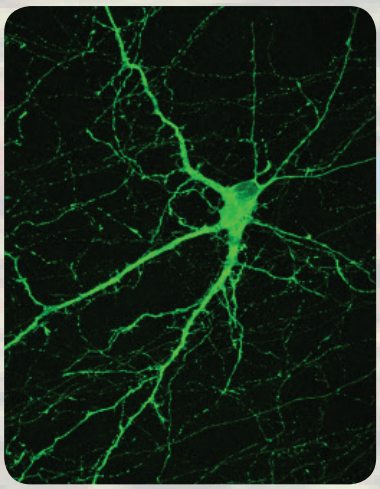
2009
Retina cells grown from skin-derived stem cells

2010
Gene regulating human brain development identified

2011
Patient stem cells yield early 'retina in a dish'

2012
Stem cells hint at potential treatment for Huntington's disease

2013
Transplanted brain cells in monkeys light up personalized therapy



2013 – Down Syndrome neurons from stem cells show signature problems

2014
Study helps unravel the tangled origin of ALS

2014
iPSC-derived neurons from Fragile X patients show growth defects

2015
New company gives hope to patients with neurological disorders

2016
Cell transplant treats Parkinson's in mice under control of designer drug

2017
Designer molecule may help tackle diseases caused by DNA repeats

2018
Fueling hope for Rett Syndrome

"Having a focus group that only discusses neural regeneration and disorders and development of the nervous system really enables researchers to find who on this large campus they can collaborate with and where the expertise is around campus." – Anita Bhattacharyya

Stem Cell Fast Facts

- More than 100 scientists conduct stem cell and regenerative medicine research at UW–Madison. A total of 700 faculty, staff and students are working, teaching and studying in the field.
- SCRMC faculty members work across six UW–Madison schools and colleges, 40 departments, and 10 centers and institutes.
- UW–Madison stem cell research drew more than $42 million in NIH grants in 2017-2018. Additional funding comes from other federal government agencies, industry, and philanthrophic sources.
- UW–Madison School of Medicine and Public Health funding and philanthropic gifts support the SCRMC's activities, such as funding pilot research grants, education and training for students, events facilitating scientific collaboration, and public outreach.
- There are 27 clinical trials around the world involving embryonic stem cells and their derivatives. Another 42 trials involve the use of induced pluripotent stem cells.
- More than 60 companies in Wisconsin engage in stem cell and regenerative medicine-related research and development or lab support activities and employ approximately 3,500 people.
- Globally, the market for products from companies founded, license agreements and patents related to stem cell discoveries is projected to reach more than $270.5 billion by 2025.
- Since 2004, SCRMC members are inventors on more than 120 issued patents and have executed more than 70 commercial license agreements to 47 entities through the Wisconsin Alumni Research Foundation.

1998
"In the long run, the greatest legacy for human embryonic cells may be not as a source of tissue for transplantation medicine, but as a basic research tool to understand the human body." – James Thomson, V.M.D., Ph.D., Director, Regenerative Biology, Morgridge Institute for Research, SCRMC faculty member.

2008
"The research we undertake holds great promise for biomedical science and our ability to treat debilitating disease, discover new medicines and uncover the fundamental processes that lead to disease." – Timothy Kamp, M.D., Ph.D., SCRMC Director, Professor of Cardiovascular Medicine, Cell and Regenerative Biology, School of Medicine and Public Health.

2018
"I think, as human beings, we have a natural tendency to want to help people, and when you actually interact with people in need, it reminds you that what you are doing in the lab is not just to satisfy intellectual curiosity, it's not only the pursuit of knowledge, it's also trying to help people as much as you can." – Qiang Chang, Ph.D., Waisman Center Director, SMPH medical genetics and neurology, and SCRMC faculty member.

10 years of SCRMC research training awards

The SCRMC Education Committee, chaired by Krishanu Saha, Ph.D., assistant professor of biomedical engineering, established the Research Training Awards Program in 2008 to recognize and provide support for promising graduate students and postdoctoral fellows conducting stem cell and regenerative medicine research.

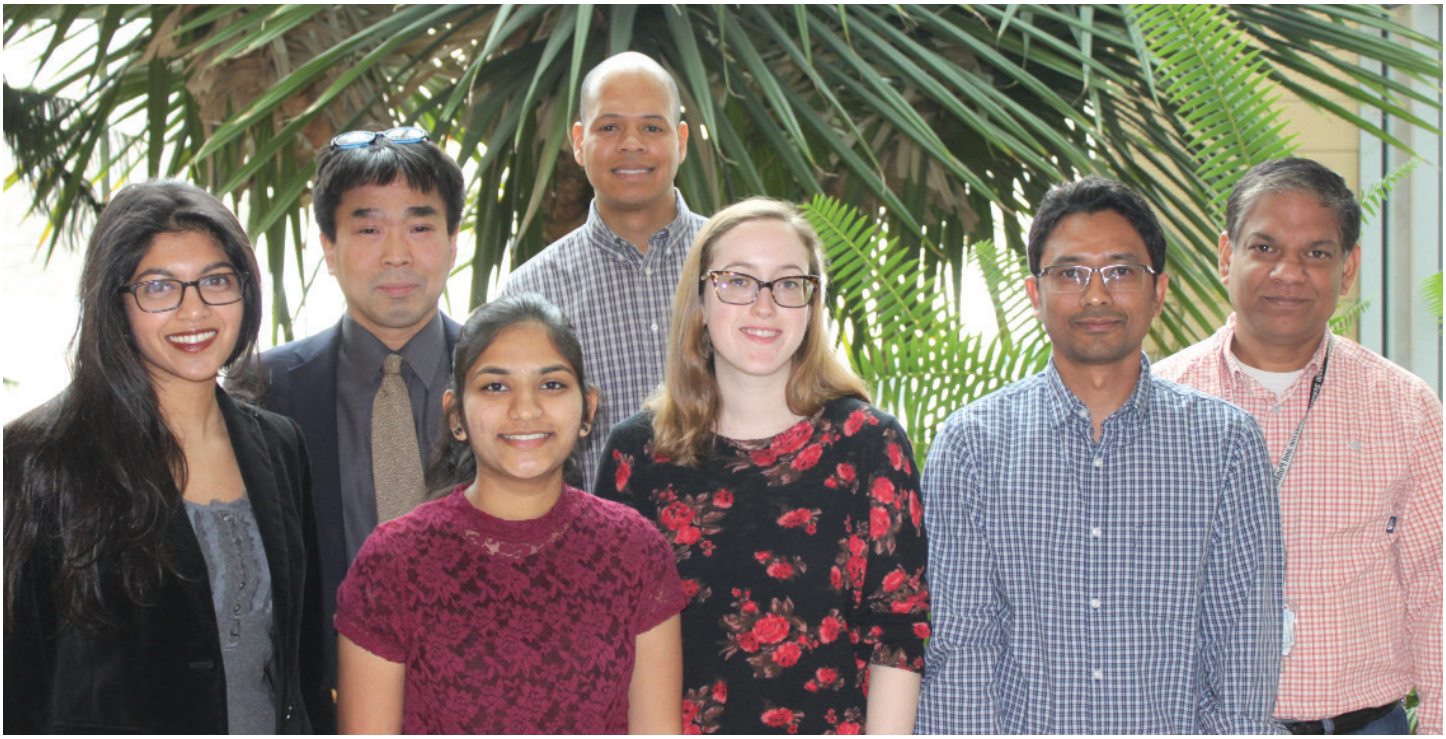
Meet our 2018 SCRMC Training Award winners and their SCRMC faculty mentors below. (*Photo by Jordana Lenon*)

At far left is Nisha Iyer, postdoctoral associate, with her mentor Randolph Ashton (center back), assistant professor of biomedical engineering, College of Engineering.

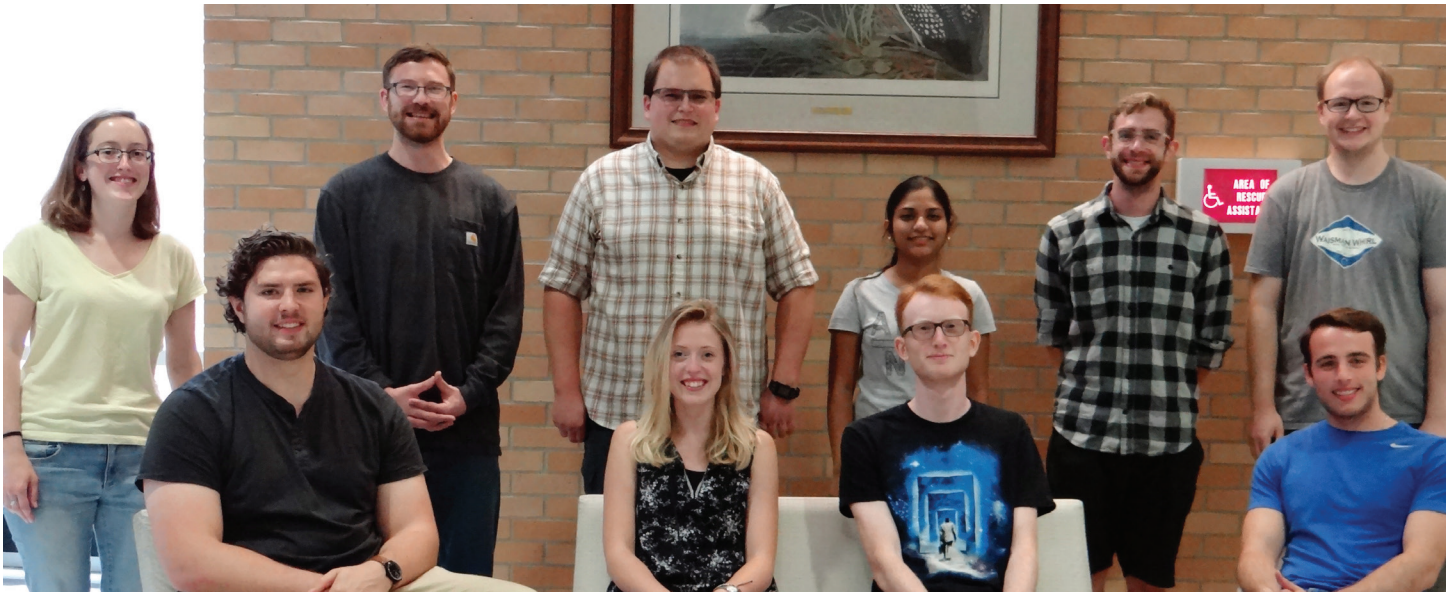
Standing in front is Kaivalya Molugu, graduate student in biophysics. (Not pictured is her mentor Krishanu Saha, assistant professor of biomedical engineering, College of Engineering.) At center is Eileen Lynch, graduate student in cellular and molecular pathology, and on her right her mentor Masatoshi Suzuki, associate professor of comparative biosciences, School of Veterinary Medicine, also biomedical engineering, College of Engineering.

At far right is Pawan Shahi, postdoctoral associate, and standing behind him is his mentor Bikash Pattnaik, assistant professor of pediatrics-neonatology, School of Medicine and Public Health.

Projects funded are as follows:
Kaivalya Molugu: “Geometric Cues as Potential Regulators of Cell Metabolism in Reprogramming Human Somatic Cells.”
Pawan Shahi: “Blindness is caused by a compound heterozygous mutation: Where do we go from here?”
Nisha Iyer: “Developing regenerative human motor neuron therapies to cure paralysis”
Eileen Lynch: “In vitro modeling of skeletal muscle pathology using ALS patient iPSCs.”



SURF's up!



Our 2018 Summer Undergraduate Research Fellowship (SURF) undergraduates and their graduate student and post-doc mentors are, from the left: Eileen Lynch, co-organizer, Masa Suzuki lab, comparative biosciences; Patrick Kasl (seated) with mentor Andrew Brandl behind him, Bo Liu lab, surgery; Annika Madler (seated) with mentor Dan Radecki behind, Jayshree Samanta lab, comparative biosciences; Jacob Rouw (seated), with mentor Kaivalya Molugu behind, Kris Saha lab, biomedical engineering; Nick Quirini (seated), with mentor Dan Tremmel behind left, Jon Odorico lab, surgery; and Steven Mayerl, standing at far right, co-organizer; David Gamm lab, ophthalmology and visual sciences. *(Photo by Sue Gilbert.)*

Fall 2018 stem cell anniversary events

Crossroads of Ideas

(Morgridge Institute for Research)

7 p.m., Oct. 16, 2018

"The Ethical Landscape of Stem Cell Science," with SCRMC expert panelists.

Free admission, Discovery Building

330 N. Orchard St..

Wednesday Nite @ the Lab

(Wisconsin Alumni Association)

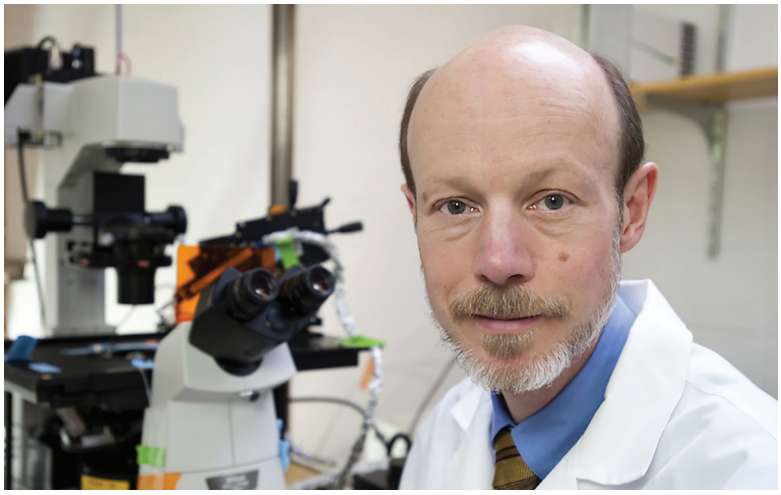
7 p.m., Oct. 31

Dr. Timothy Kamp, SCRMC Director, reviews 20 years of stem cell research.

Free admission, Biotechnology Center

425 Henry Mall.

These are just two of several events on tap this fall: Learn more here!



Timothy Kamp. M.D., Ph.D., SCRMC Director, professor of medicine, cell and regenerative biology, School of Medicine and Public Health. *(Photo by Jeff Miller)*

Our Mission

The UW–Madison Stem Cell and Regenerative Medicine Center (SCRMC) operates under the School of Medicine and Public Health and the Office of the Vice Chancellor for Research and Graduate Education. The center provides a central point of contact, information and facilitation for campus stem cell researchers.

The center's mission is to advance the science of stem cell biology and foster breakthroughs in regenerative medicine through faculty interactions, research support and education.

Our Goals

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

Make a Gift

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

Your gift can support:

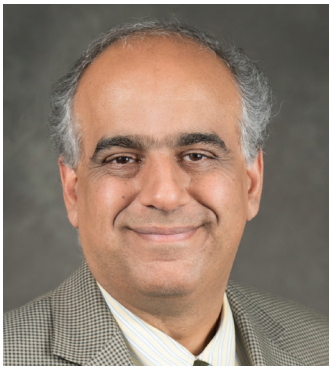
- Basic, preclinical or clinical research.
- Education and training for students and post-doctoral fellows.
- An unrestricted fund that gives the center maximum flexibility to take advantage of new opportunities.

Please contact Lisa Oimoen at 608-308-5328 to make a gift in support of our important work.

You may also donate on line here.

For additional queries, please write, call or visit our website.

UW–Madison Stem Cell and Regenerative Medicine Center
8457 WIMR II
1111 Highland Avenue
Madison, WI 53705
Tel: (608) 263-2982
www.stemcells.wisc.edu



In Spring 2018, SCRMC faculty members and physicians Christian Capitini (left) and Peiman Hematti (right) treated a young leukemia patient at UW Health's American Family Children's Hospital with her own, genetically modified immune cells. As the first gene therapy approved in the United States, CAR T therapy is being explored as a treatment for blood cancers that do not respond well to chemotherapy. Capitini, Hematti and many other SCRMC members are working on cell, stem cell, gene editing, tissue engineering and other approaches to advance therapies for cancer, heart disease, stroke, degenerative diseases, auto immune disorders, spinal cord injury, blindness, diabetes and much more.

Editing and design: Jordana Lenon

Printed at UW–Madison Digital Publishing and Printing Services