

JAN 20- FEB 21

# YEAR IN REVIEW

**Institute for Regenerative Medicine**



**PennIRM**  
Institute for Regenerative Medicine

## From the Director

After a year unlike any other, we wanted to take a moment to reflect on the positives in our IRM community: collaboration, creativity, and a commitment to answering fundamental questions in the field of regenerative medicine. We also want to look ahead to the exciting days to come as we continue our relentless pursuit of discoveries in this ever changing field. I hope this year-in-review gives you a sense of how special the Institute for Regenerative Medicine is and encourages you to engage with our scientists, trainees, and staff.




**Ken Zaret, Ph.D.**

Joseph Leidy Professor of Cell and Developmental Biology  
IRM Director

## About the IRM

The Institute for Regenerative Medicine (IRM) is a community of experts working to create a future where diseases are cured with cellular solutions. Our mission is to understand how cells and tissues are formed and to apply that knowledge to next generation diagnostics and therapies. We are proud to have members from 4 Penn schools, the Children's Hospital of Philadelphia, and the Wistar Institute. The IRM serves as a hub for researchers by funding collaborative research projects, hosting impactful seminars, and catalyzing STEM outreach in the Philadelphia area. For more information, visit our website at [irm.med.upenn.edu](http://irm.med.upenn.edu).

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- **Sharing Science in Philadelphia and Beyond**
- **Working Together to Fund the Future**
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## Fostering New Research Directions

As a Type 3, University-wide research center, the IRM emphasizes collaboration across disciplines, departments, and Schools. We are particularly interested in leveraging our resources to bring researchers together to tackle new areas and develop projects that are **innovative and competitive for external research funding**.

In light of the challenges of the COVID era, we doubled down on this approach. Even as pandemic precautions made remote and shift work the norm, the IRM directed funding to **scientific teams** interested in combining their strengths while pursuing important new lines of research. The resulting projects draw upon the deep, diverse expertise found in laboratories across the University and the Children's Hospital of Philadelphia.

### *COVID-19 Collaborative Research Grants (CRGs)*

The IRM frequently solicits proposals for CRGs, with good reason. Questions in regenerative medicine impact so many different biomedical areas it just makes sense to partner with other Penn and CHOP units to support vital research areas.

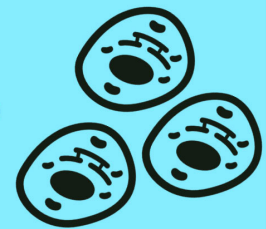
In March of 2020—as the seriousness of the COVID-19 pandemic set in—the IRM pivoted this program to focus on how techniques in use in our researchers' labs could provide insights into the novel coronavirus's effects on tissues throughout the body. Using **donor-provided funds**, the IRM is supporting 2 collaborative teams as they apply their expertise to coronavirus research:

- Penn Vet's Andy Vaughan and Montserrat Anguera are exploring the question of why more men than women become severely ill and die from COVID-19. They will explore whether virus-targeted *ACE2* escapes X-linked inactivation in women and how hormones influence *ACE2* levels in lung cells. (Co-sponsored by Penn Vet)

- Sydney Shaffer (PSOM), Arjun Raj (SEAS), Sara Cherry (PSOM) and Ophir Shalem (PSOM) are applying their experience with RNA fluorescence in situ hybridization (RNA FISH) to rapidly detect viral RNA in different tissue types, including placenta. They are also screening cells to identify host factors SARS-CoV-2 uses to replicate and infect other cells. (Co-sponsored with the Departments of Bioengineering and Pathology & Laboratory Medicine)

### Fast facts about IRM Research

80+ LABS



4  
PENN  
SCHOOLS

+ CHOP AND THE  
WISTAR INSTITUTE

>\$60 M  
NEW EXTERNAL  
FUNDING IN 2020



## 2021 IRM Retreat Collaborative Seed Grants

With COVID-19 preventing an in-person meeting, the IRM hosted a unique virtual retreat dedicated to the discussion of potential new areas of collaboration (see more below). Following a productive afternoon, the IRM opted to invest **\$28,000 of donor-provided seed funds** into 7 concepts presented to our research community. These funds are intended to spark the initial experiments necessary to acquire data sufficient for external multi-PI proposals:

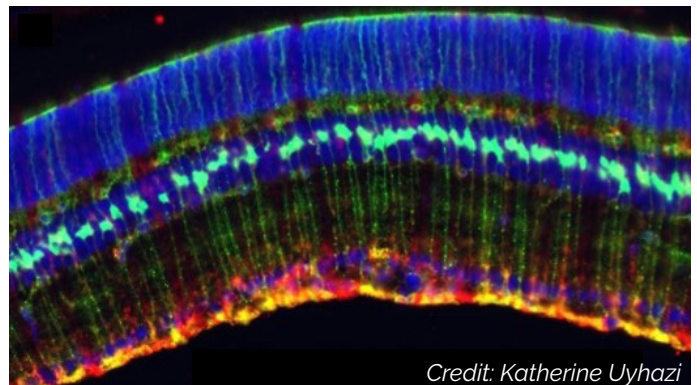
- Sandra Ryeom (PSOM) and Colin Conine (PSOM): Transcriptome analysis of in vitro differentiated sperm
- Andres Blanco (Penn Vet) and Kirk Wangenstein (PSOM): Generation of pan-transcription factor-focused CRISPRa libraries
- Kyla Ortved (Penn Vet), Ling Qin (PSOM) and Zhiliang Cheng (SEAS): Investigation of EGFR distribution in horse cartilage
- Bomyi Lim (SEAS) and Montserrat Anguera (Penn Vet): Generation of live cell imaging system to investigate X-linked mRNA dynamics in immune responses
- Mustafa Mir (CHOP) and Nico Plachta (PSOM): Imaging dynamic molecular processes in live mouse embryos using emerging advanced microscopy technologies
- Pantelis Rompalas (PSOM) and Wenqin Luo (PSOM): Identifying factors that mediate the regulation of epidermal stem cells by sensory nerves
- Isaac Chen (PSOM) and Stewart Anderson (CHOP): Generation of interneuron-supplemented forebrain organoids with controlled cell ratios

## Commonwealth of Pennsylvania Health Research Formula Funds (HRFF)

The IRM was also pleased to support 5 applicants for Commonwealth of Pennsylvania. These proposals showcase the breadth of research happening across the IRM and focus on

several disease areas that are promising future candidates for regenerative therapies, including degenerative conditions such as arthritis and macular degeneration. Projects are expected to begin in 2021 pending final approval from the Pennsylvania Department of Health.

- Chider Chen (Penn Dental) will study how stem cells responsible for maintaining facial bones change their metabolism over time and, based on the study, evaluate specific small molecules to reverse degenerative bone loss in adults.
- Kyla Ortved (Penn Vet) will collaborate with researchers in the Perelman School of Medicine to test a new nanoparticle therapy for osteoarthritis in a horse model as the next step toward a cartilage-boosting therapy for human patients.
- Alex Hughes (SEAS) will generate tissue engineering models of the kidney to examine the biochemical signals and physical forces that lead to proper development versus congenital kidney defects.
- Kacy Cullen (PSOM) will use human-derived stem cells to build muscle grafts pre-loaded with blood vessels and nerves as a major new step towards treating people with traumatic muscle injuries.
- Katherine Uyhazi (PSOM) will test whether cells in the eye can be coaxed into forming photoreceptors capable of reversing macular degeneration.



Credit: Katherine Uyhazi



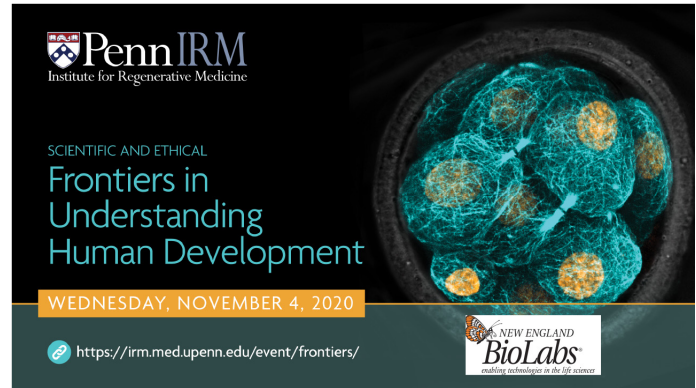
## Serving as a Hub for Regeneration Researchers

The IRM aims to be the meeting place for stem cell and regenerative biologists, engineers, and clinicians at Penn. In the past year more than **700 faculty members, trainees, and staff members attended IRM events**. With most people working remotely at some point in 2020, we pivoted to virtual versions of our standing seminars and symposia and expanded our offerings to include skills development sessions and conversations about diversity and equity in science. Here are the ways we engaged the Penn community—and others—in 2020 and early 2021:

### Major Symposia

**Engineering Cell & Tissue Organization** Held on February 5, 2020 in the Smilow Center for Translational Research's Rubenstein Auditorium, and co-sponsored by Penn Engineering and Leica Microsystems, this wide-ranging symposium brought together more than 200 researchers focused on cell- and tissue- design thinking. Faculty from PSOM and SEAS joined experts from across the world and 20 trainee presenters to share the latest findings in this multidisciplinary area.

**Frontiers in Understanding Human Development** Held virtually on November 4, 2020, this symposium explored the science and ethics of new technologies for modeling the first stages of life, including in vitro embryo models; chimeras of animal hosts seeded with human cells; the use of human induced pluripotent cells (iPSCs) to generate germ cell precursors and embryo-like structures; and the cellular mosaics created by uterine transplants. More than 200 people from inside and outside Penn registered for this event, which was generously funded by the University Research Foundation and New England Biolabs.



### Scientific Retreats

**IRM Retreat 2020: Vision for the Next 5 Years** Held at the Franklin Institute on January 30, 2020, this retreat brought together 100+ faculty and trainees to share their research and outlooks for the years ahead. Featuring talks focused on outreach and communication and cross-IRM programs, this event was sponsored by biotechnne, StemCell Technologies, and Neta Scientific.

**IRM Retreat 2021: Reconnect** As a way to engage our research community remotely, the January 26, 2021 virtual retreat focused entirely on collaborations. Speakers discussed the keys to successful collaborations and pitched their ideas for future team science efforts to the broader IRM community. In light of the strong response to these concepts, the IRM distributed donor-funded seed grants to presenters to initiate their new lines of research (see above). Areas of interest will also be explored in future IRM events and programs.



## Recurring Scientific Seminars

**Stem Cell Club (SCC)** Our monthly meeting focused on junior faculty and trainees. Each SCC features two thematically-linked speakers and highlights an area of interest in regenerative biology.

**Faculty Lunch** A monthly small group discussion for IRM-affiliated faculty. One faculty speaker presents on emerging work from his or her laboratory and engages in a lively back-and-forth with peer scientists.

**Distinguished Seminar Series (DSS)** The IRM proudly continues its sponsorship of the multi-department and institute DSS, which seeks to bring high profile scientists to campus for the benefit of our researchers and trainees.

**Advances in Musculoskeletal Regeneration** Now in its sixth year, this series focuses on research

by scientists, clinicians and engineers working to repair or rebuild muscles, bones, tendons, and cartilage.

## Special Events

**Science & Bias** As a contribution to the ongoing discussions of racial equity in STEM, the IRM has hosted sessions with outside experts covering aspects of racial bias and its influence on our daily lives. Previous seminars have included presentations from Adam Benforado (Drexel) on bias in law and Dannelle Gutarra Cordero (Princeton) on racism in scientific curricula.

**Skills development** The IRM hosts occasional seminars and workshops devoted to improving knowledge or skills in a topic area of interest to the IRM community, particularly trainees. Over the past year we have hosted virtual trainings devoted to grant writing, Adobe Illustrator (with Penn Libraries) and pre-print servers.

## Remembering John Gearhart

In May, we were saddened by the loss of John Gearhart, stem cell pioneer and former IRM Director. Friends, family, and former lab members gathered for a virtual toast in his honor. A short memorial post for John can be found on the IRM website.



## Sharing Science in Philadelphia (and Beyond)

Led by Dr. Jamie Shuda, IRM faculty, trainees, and staff continued to engage students outside of Penn during the pandemic, providing the same high-quality outreach that is a hallmark of IRM programs.

As with research, recent outreach and education programs required creativity to solve the challenges of social distancing. Our major programs jumped online, and a new virtual series, IRM@Home, was launched to provide content for local students and teachers looking to fill gaps in remote learning schedules. IRM@Home provided **10 live presentations** and question & answer sessions for Philadelphia high schoolers looking to learn more about regenerative medicine and STEM careers.

Even with the obstacles posed by COVID-19, IRM outreach programs reached a major milestone

in 2020: **3000 students (and 44 teachers) in Philadelphia served!**

For her years of dedication to STEM education, Jamie and her collaborator Dr. Steven Farber (Carnegie Institution of Washington) were awarded the 2020 Bruce Alberts Award for Excellence in Science Education from the American Society for Cell Biology (ASCB). ASCB particularly noted the pair's work on Project BioEYES, an international program that teaches students scientific skills through experiments with zebrafish.



## Working Together to Fund the Future

The IRM relies on philanthropy to fuel innovative studies and support our high impact outreach programs. We appreciate the support of all our donors and particularly thank those who made commitments over the past year:

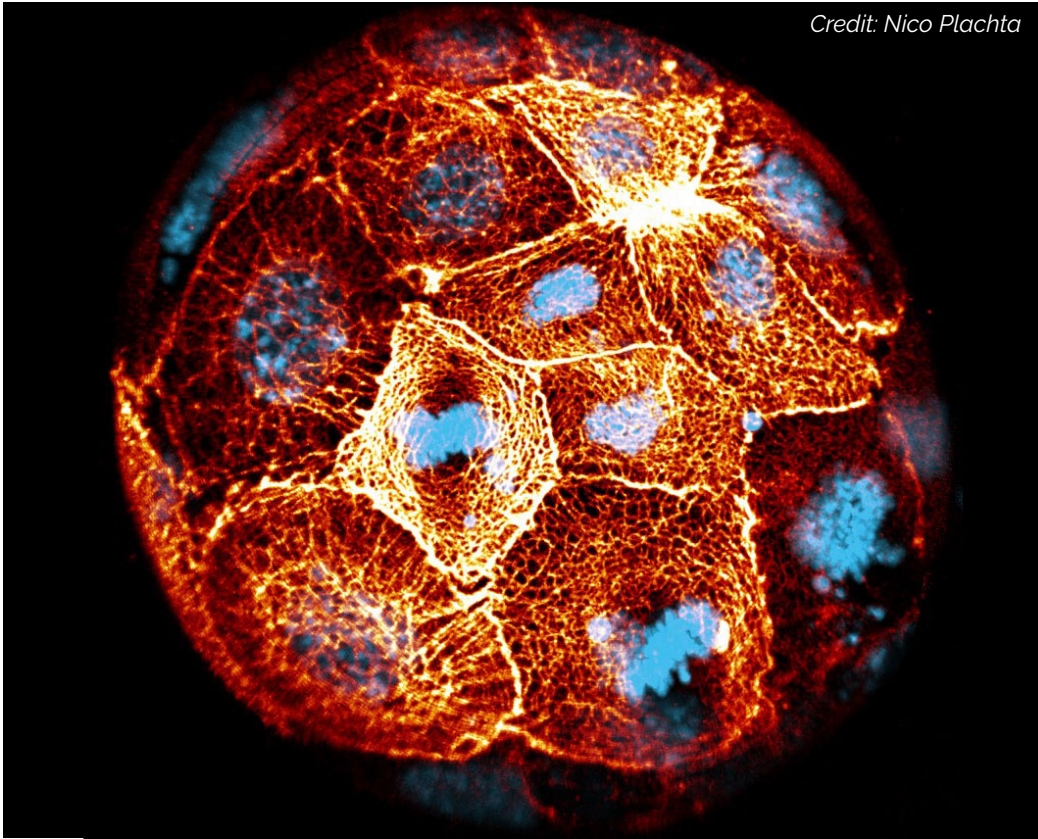
- The children of Elaine Redding Brinster donated **\$2.5 million** to endow an award recognizing individuals for exceptional biomedical discoveries. See below for more information on this exciting initiative.
- Mickey and Larry Magid pledged **\$1 million** to endow the Mickey and Larry Magid Discovery Fund to support outstanding research by IRM faculty.
- Tim Zaro, a previous IRM supporter, contributed **\$20,000**. These funds are being used to support collaborative projects

emerging from the IRM's 2021 retreat.

- The Gareatis Foundation contributed **\$10,000, bringing their total historical contributions to \$50,000!** These monies will continue to support IRM research.
- The W.W. Smith Charitable Foundation granted **\$100,000** in support of Project BioEYES.







Credit: Nico Plachta

## Looking Ahead

As biologists, clinicians, and engineers working on regenerative medicine, we know that the future is a chance to rebuild and repair better than before. The IRM has many exciting things on the horizon. This spring, we will host a special symposium focused on hematopoietic stem cells covering research into both the basic biology of blood-forming stem cells and their use in cutting edge therapies. In the fall, we will host a crosscutting symposium to explore how the cells of the immune system interact with stem cells throughout the body. We are also looking forward to awarding the first ever Elaine Redding Brinster Prize in Science or Medicine. All the while, IRM researchers will continue to push the field of regenerative medicine forward. The past year may have been unusual, but just like the stem cells we study, IRM scientists are always focused on renewal.

### What to watch for

#### The 1st Annual Elaine Redding Brinster Award

In honor of their mother, whom they credit for their own successes, the children of Elaine Redding Brinster have endowed an annual prize of **\$100,000** to recognize pioneers in biomedical science for their critical discoveries.

The IRM is thrilled to steward this award and we cannot wait to make the first selection. As travel and meeting restrictions relax, we will continue to plan for this exciting occasion.

Who will the first winner be?