



IEM INSTITUTE FOR
ENGINEERING IN
MEDICINE



ANNUAL **2022
2023** REPORT

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IEM INSTITUTE FOR ENGINEERING IN MEDICINE

Director's Message

I am proud to share that IEM experienced great success this past year as we furthered our mission of improving biomedical technology and clinical care across Minnesota and beyond.

This year alone, IEM helped bring in over \$60M worth of grants for research teams and surpassed the \$2M mark in our Clinical Immersion Program (which has now hosted groups from 17 companies). IEM worked with Calvin Mackie, President and CEO of STEM NOLA, to jump start new outreach and engagement opportunities with different communities in the Twin Cities – something that will broaden community involvement in engineering and medicine. Our Innovation pillar also worked hard to upgrade the Innovation Fellows program and carry out the ongoing search for a new Bakken Medical Devices Center director.

Looking ahead, we are particularly excited to participate in the development of the Minnesota Innovation Exchange, a potential hub on the east side of the Minneapolis campus that promises to further enhance Minnesota's national reputation in biomedical engineering. This once-in-a-generation opportunity will bring together academic, industry, and entrepreneurial researchers to expand the very concept of biomedical engineering. This hub also promises to be a resource for educating STEM students of all ages in numerous aspects of biomedical engineering research and commercialization.



John Bischof
Director

Although it is very exciting to witness so much change and potential, I have to admit that change can be hard. We're sad to say goodbye to our Innovation pillar Co-Director, Carla Pavone, who retired from the University in May. Over the past four years, she has catalyzed initiatives in IEM and ATP-Bio that support scientists, clinicians, and engineers as they expand the medtech field and care. We are currently in the process of finding a new Innovation Co-Director, but are grateful that Carla has agreed to consult with us as we expand entrepreneurship training and commercialization pipelines.

I'll conclude with a request: stay in touch. It's through engagement with partners, new and old, that we learn about rich opportunities to explore new ideas and expand on what we have already accomplished. Together, we will strive to develop unique initiatives that fulfill our vision for innovative, impactful, and equitable biomedical engineering and commercialization in Minnesota and beyond.

From the Deans



Jakub Tolar
Medical School

"IEM is a crucial Medical School partner, helping form teams to tackle big medical problems with innovative science and engineering."



Andrew Alleyne
College of Science & Engineering

"IEM continues the University's legacy of bringing together engineers and medical scientists to make important advances in health care."

IEM Organization

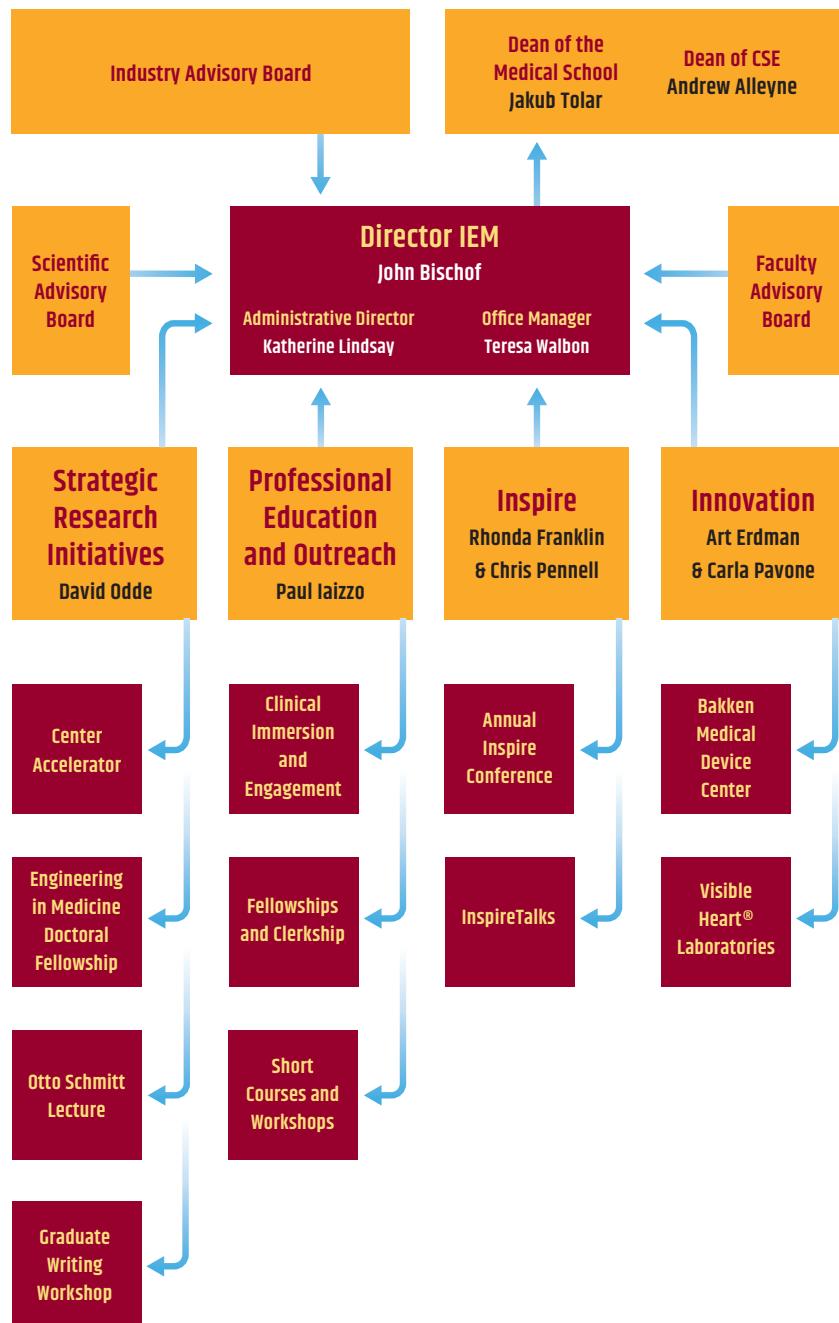
IEM is organized into four pillars, and each pillar manages programs that advance IEM's mission. As the following pages show, these programs – and the talented faculty and staff who lead them – are the driving force behind IEM's goals of advancing transdisciplinary collaboration in medicine and engineering, building connections between academic research and industry, and inspiring new generations to launch careers in STEM.



Katherine Lindsay
Administrative Director



Teresa Walbon
Office Manager



Strategic Research Initiatives

IEM's Strategic Research Initiatives (SRI) pillar enables faculty, students, and the IEM community to address big medical challenges by combining biomedical research and engineering.

The Center Accelerator supports faculty as they form large, multidisciplinary teams to tackle complex medical questions. More specifically, SRI helps teams develop long-term research plans and, when the time is right, apply for center-level funding from government and private funding sources.

The IEM Doctoral Fellowship and the new Graduate Intensive Writing Workshop support accomplished graduate students whose research aims to transform an area of medicine through innovative engineering.

The annual Otto Schmitt Distinguished Lecture enables the IEM community – which includes University and industry leaders – to engage a national leader in biomedical engineering on campus.

Center Accelerator

PG 6

Graduate Intensive Writing Workshop

PG 8

IEM Doctoral Fellowship

PG 8

Otto Schmitt Distinguished Lecture Series

PG 9



David Odde
SRI Director



Alena Talkachova
SRI Assistant Director



Michael Lotti
SRI Program Manager



Amanda Hayward
SRI Assistant Program Manager

Center Accelerator

\$100M

in new grant proposals

30

faculty from the Medical School and the College of Science and Engineering took part in Center Accelerator proposals

12

universities, companies, and institutions were a part of Center Accelerator proposals

2022

#8

NIH FUNDED
PUBLIC MEDICAL
SCHOOL

In 2022, the Blue Ridge Institute boosted the Medical School's rank from 13th to 8th among public universities and from 29th to 21st overall. Over \$20M from successful

Center Accelerator proposals will be part of the Medical School's 2023 Blue Ridge total, and we aim to make that number grow each year.

The Center Accelerator helps multidisciplinary medical and engineering teams prepare and apply for center-level funding and large training grants to address significant medical challenges. In 2022-2023, the Center Accelerator team, led by Michael Lotti, helped put together over \$100M worth of grant proposals. Taking advantage of the new ARPA-H program and other emerging opportunities, we hope to double that number in 2023-2024.

Biopreservation turned out to be a major Center Accelerator theme in 2022-2023. Teams led by Erik Finger, Tom Hays, and John Bischof secured over \$8M to develop and share methods for preserving pancreatic islets, fruit flies (which are important models for genetic research), and whole livers and kidneys.



John Bischof



Erik Finger



Tom Hays

75%

of Center Accelerator proposals support the Medical School's Blue Ridge rankings

IEM Center Updates

IEM centers bring together faculty expertise, dedicated resources, and key academic and industry collaborators to pursue groundbreaking research and development with high potential for real-world impact. With nine center-level proposals pending and new proposals that will be submitted in 2023-2024, we are hopeful that this page will get more crowded – or spill over to two pages – in next year's Annual Report.



Advanced Technologies for the Preservation of Biological Systems

ATP-Bio continues to accelerate the ability to "stop biological time." The Center now includes six institutions, over 30 faculty, nearly 100 trainees, and 16 industry partners.

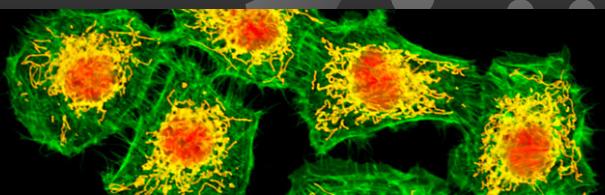
atp-bio.org



REVEAL

The REVEAL team has finalized all clinical protocols and data management plans for testing vagus nerve stimulation in humans. 2023-2024 will be dedicated to clinical studies and hosting a NIH-sponsored conference on the stimulation of peripheral nerves.

mcaneuromod.org/reveal



Cancer Bioengineering Initiative

New biosensors, simulators, and research partnerships marked CBI's year. CBI also hosted a national conference dedicated to improving cancer imaging.

cancerbioengineering.umn.edu



Postdoctoral Training Centers

Two training programs funded by NIH - one focused on neuroimaging, the other on neuromodulation commercialization - are funding seven postdoctoral fellows committed to expanding the horizons of brain research and treatment.

tntp.umn.edu
z.umn.edu/neuroimaging-postdoc

Graduate Intensive Writing Workshop

Engineering in Medicine Doctoral Fellowship

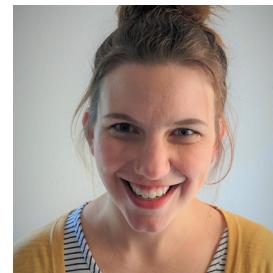
Innovative experiments and modeling aren't enough for scientific success – you have to write about your accomplishments clearly and compellingly. But since most PhD candidates in science and engineering fields weren't English majors (and may not even be native English speakers), some extra help is often needed.

Throughout 2022-2023, SRI assistant director Alena Talkachova teamed up with professional science writer and editor Ellen Morgan to design the Graduate Intensive Writing Workshop. The 10-session, in-person Workshop combines presentations, cohort discussion and review, and one-on-one work with Ms. Morgan to guide early drafts into publishable manuscripts.

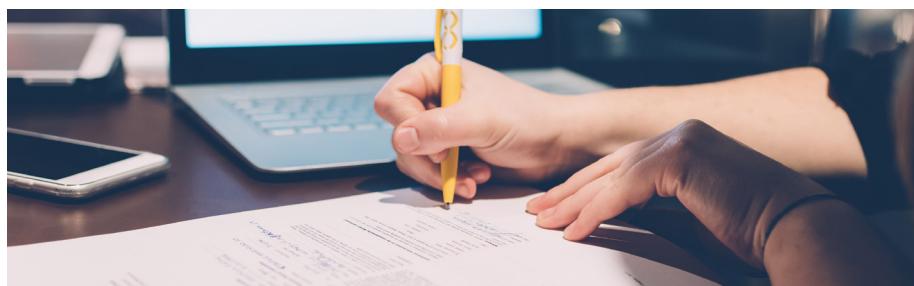
A pilot Workshop will be held in the fall of 2023, and plans are underway to organize a second Workshop in the spring of 2024. Check the IEM website for more information and to apply for the spring 2024 Workshop.



Alena Talkachova



Ellen Morgan



Engineering in Medicine doctoral fellows are accomplished graduate students who promise to be future leaders in driving medical advances through engineering. The fellowships support their doctoral dissertation research for one year.

Until 2023, applications for the Fellowship were accepted during the summer, right after winners of the University's Interdisciplinary Doctoral Fellowship (IDF) were announced. Since the University delayed the IDF announcement until December 2023, IEM will likely accept applications in January 2024. Check the IEM website for updates.

Applicants must:

- be a PhD student in good standing in an IEM member's lab
- have completed all required coursework
- have a dissertation topic that is directed to transforming an area of medicine through highly innovative engineering
- incorporate collaboration with at least one IEM member from the Medical School and one from CSE. (Exceptions for faculty in CBS, CFANS, and CLA are considered.)

IEM Otto Schmitt Distinguished Lecture Series

Each year, we host a distinguished leader from academia, industry, or government to address a challenge that can be met by combining engineering and medicine. The speaker also meets with student and faculty groups to discuss developments in the field and establish connections for potential collaborations.

In the spring of 2023, Dr.

Richard Kuntz, retired senior vice president and chief medical officer at Medtronic, presented "A MedTech Leader's Perspective on the Digital Health Revolution." The full lecture is available for viewing on the IEM website.

The 2023-2024 Otto Schmitt lecture will be given by Dr. Elazer Edelman, a medical device pioneer who holds engineering faculty appointments at MIT and Harvard Medical School.



A MEDTECH LEADER'S PERSPECTIVE ON THE DIGITAL HEALTH REVOLUTION

Dr. Richard Kuntz

Senior VP, Chief Medical and Scientific Officer
Medtronic (retired)



"How Engineering Facilitated an Explosion in Medical Innovation"

SAVE THE DATE

October 17, 2023

7:00-10:30 am

Twin Cities
UMN Campus



Elazer Edelman
Massachusetts Institute of
Technology
Harvard Medical School

Professional Education & Outreach

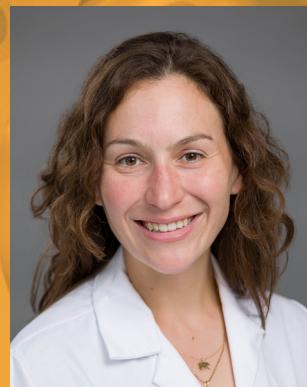
PEO continues to expand and cement interactions with industry and academic leaders as we welcome them for courses, clinical immersions, and partnership opportunities. These interactions broaden the reach of IEM and amplify our unique contribution to the medical innovation ecosystem in Minnesota and beyond.

We expanded Clinical Immersion to include more departments and companies, only to find that demand keeps growing. Likewise, our cardiac anatomy short course continues to be well-attended, so we aim to offer more such opportunities in 2023-2024. And Clinician Engagement continues to be a popular way to explore ideas for new medical technology without risky investments.

In other words, PEO has a bright, busy future. We hope you can be a part of it.



Paul Iaizzo
PEO Director



Anna Budde
PEO Assistant Director

Clinical Immersion

PG 11

Clinician Engagement

PG 12

Short Courses & Workshops

PG 13

Augustine MD/MS Fellows

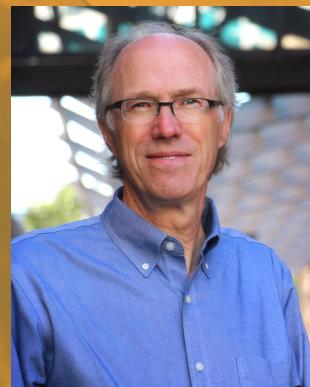
PG 14

Medical Device Clerkship

PG 14

Industry Fellows

PG 14



William Durfee
PEO Co-Director of Clinician Engagement

Clinical Immersion

The Clinical Immersion program gives medtech industry professionals the opportunity to dive into clinical environments to better understand how medical technologies are used. While each clinical immersion is designed in collaboration with Medical School faculty and residents to meet specific company needs, the immersions generally include procedure observations, interactions with clinicians, participation in department conferences, and patient rounding.

During 2022-2023, we nearly doubled the number of immersions we hosted in 2021-2022. The immersions partnered with specialists in pediatric cardiology, interventional

endoscopy, obstetrics and gynecology, electrophysiology, gynecologic oncology, urology, and adult and pediatric patient care.

Looking to 2023-2024, we hope to form collaborations with more medtech companies and potentially involve more Medical School departments.

\$2.2M
**total Clinical Immersion fees
that have supported resident
training**

22
immersions in 2022-2023

17
medtech companies participated

7
**clinical areas now host Clinical
immersions**



Ken Rosen
Head of Industry & Outreach
Programs



Jarice Sherman
Community Relations Outreach
Coordinator



Clinician Engagement

FIND THE PROBLEM

INVENT THE SOLUTION

IMPLEMENT AND TEST

The Clinician Engagement program connects clinicians with the University's innovation ecosystem – and vice versa – to advance medical technology. Connections are made at all steps of the research-to-commercialization pipeline.

The program also facilitates training in medical engineering. Clinicians are often partnered with undergraduate and graduate design teams, which can include students from the Medical School, College of Science and Engineering, College of Biological Sciences, and even the Carlson School of Management.



William Durfee
Director of Clinician Engagement

118
projects facilitated

64
projects completed

47
clinicians collaborated

6
new clinical departments
engaged (34 in total)



Short Courses & Workshops

Short Course #1: Cardiac Physiology and Anatomy

Advanced Cardiac Physiology and Anatomy (PHSL 5510) is IEM's most popular short course. This year was our largest turnout yet with 160 participants (127 from industry) from all over the US. The week-long course includes lectures, small group discussions, and hands-on anatomy work covering cardiac performance, heart disease, surgical procedures, cardiac devices, and other topics.

Next offering: January 8-12, 2024. University students can take the course for 2 credits or, by adding a research project, 3 credits.



Short Course #2: Anatomy and Physiology of the Pelvis and Urinary System

25 students (two from industry) participated in the 3-day Anatomy and Physiology of the Pelvis and Urinary System (PHSL 5525) course, which consisted of morning lectures on the pelvis, perineum, and urinary system and afternoons in labs and grand rounds.

Next offering: January 3-5, 2024

PEO is currently designing a new short course on cardiac electrophysiology for the 2023-2024 academic year.

Workshops

We offered two workshops in 2022-2023:

Academy of Innovation Workshop at the International Conference for Innovations meeting in Tel Aviv, which featured lectures on medical technology innovation, stories from highly experienced medical technology entrepreneurs, and hands-on biomedical ideation and prototyping.

Innovation Workshop during IEM Innovation Week, which included lectures and hands-on design activities dedicated to the early-stage innovation and development process for medical devices.

We plan to offer these two workshops again in 2023-2024.



Augustine MD/MS Fellowship

Medical Device Clerkship

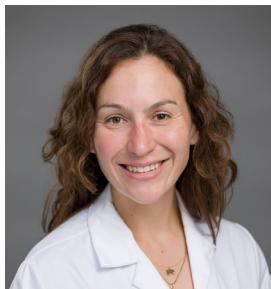
Industry Fellows

The Augustine MD/MS Fellowship, which is managed in conjunction with the Medical School's associate dean of strategy and innovation Dr. Clarence Shannon, offers Medical School students the opportunity to complete a MS in biomedical engineering – complete with a research project – between their second and third years. We saw three graduates of the program in 2022-2023 and, as of this writing, expect at least one in the next two years.



Clarence Shannon

IEM will offer a new one-month "Introduction to Medical Device Innovation" Clerkship Program to fourth-year medical students in April 2024. The Clerkship, which was developed by PEO assistant director Dr. Anna Budde, will give medical students skills to make engineering connections throughout their residency and beyond to participate in medical technology innovation and provide the best care for their patients.



Anna Budde

IEM Industry Fellows serve as ambassadors from medical technology companies to the University. Quarterly meetings between IEM leadership and the 30+ Industrial Fellows aim to enhance the innovation ecosystems of the University and the state of Minnesota.

To the right are the newest Industry Fellows, inducted in September 2022 at the IEM Annual Conference.



Maria Miller
W.L. Gore



Daniel Sigg
Medtronic



David Black
Schwegman Lundberg & Woessner



Danny Gelfman
Medtronic

Inspire

IEM's Inspire Program shows students in grades 6-12 and college how combining the strengths of engineering and biomedical research can solve complex health problems. We aim to inspire these students to pursue careers in STEM fields and to build mentor relationships.

We were more than pleased that Dr. Calvin Mackie, president of STEM Global, accepted our invitation to be a keynote speaker at the Design of Medical Devices Conference during Innovation Week 2023 (see p. 22 for more details and IEM's website for a video of Dr. Mackie's full talk). Dr. Mackie's presentation, along with several meetings with local industry and community leaders, has put Inspire at the center of discussions around forming a "STEM Twin Cities" organization that will bring new STEM education opportunities to hundreds of Twin Cities youth each year.

We're also pleased that we successfully competed for a new mentorship grant for engineering students that will start interacting with students in Spring 2024. Another reason that 2023-2024 will be an exciting year for the Inspire Program!

Inspire Conference

PG 16

InspireTalks

PG 16



Rhonda Franklin
Inspire Co-Director



Chris Pennell
Inspire Co-Director



Ken Rosen
Head of Industry & Outreach Programs

Inspire Conference

InspireTalks

The 5th annual Inspire Conference was held at McNamara Alumni Center and focused on Type 1 and Type 2 Diabetes. 428 students from 28 high schools attended and explored ways to apply STEM to Diabetes and learn how to navigate STEM career pathways. Dr. Elizabeth Seaquist, Head of the

Department of Medicine, delivered the keynote and was joined by 24 other science and engineering faculty members, clinicians, medical students, and medical technology professionals who delivered TED-like talks in breakout sessions. The 2023 Inspire Conference will focus on heart disease.



InspireTalks are Zoom sessions that connect high school students with medical and biomedical professionals from academia and industry. Speakers share their own path from high school to their current STEM careers while educating students about the latest

research and development in their fields. In 2022-2023, eight InspireTalks took place with Minneapolis Southwest High School. We hope to reach out to more schools next year through multi-school webinars.

Innovation

The aim of the Innovation Pillar is to support scientists, clinicians, and engineers as they transform cutting-edge discoveries and developments into innovative health technologies.

In the past year, we focused intensely on three tasks: revise and re-launch the Innovation Fellows program at Bakken Medical Devices Center (BMDC), find a new director for BMDC, and bring the famous Visible Heart® Laboratories into IEM. The next few pages capture our mostly successful year.

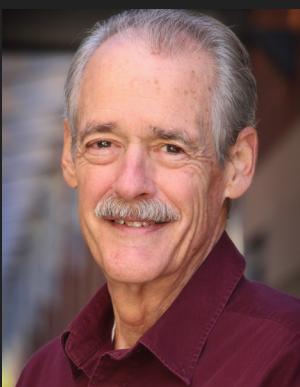
Our biggest news is that Carla Pavone, the Innovation Pillar Co-Director since its inception three years ago, retired from the University in the spring. Pavone has been a senior lecturer at the Carlson School of Management, director of the Gary S. Holmes Center for Entrepreneurship, co-leader of MIN-Corps and the Great Lakes I-Corps Hub, and co-leader of ATP-Bio's Innovation Ecosystem. Her dedication to commercialization education in all these organizations – and in countless venues inside and outside the University – will no doubt continue to bear fruit for years to come. We wish her a happy retirement!

Earl E. Bakken Medical Devices Center

PG 18

Visible Heart® Laboratories

PG 19



Art Erdman
Innovation Co-Director



Carla Pavone
Innovation Co-Director

Earl E. Bakken Medical Devices Center

44

tours

25

students in summer innovation course

57

clinician-initiated innovation projects

89

past Innovation Fellows

The Earl E. Bakken Medical Devices Center (BMDC) provides expertise and equipment to help faculty, students, and industry professionals conduct research, training, and outreach related to medical devices.

As of this writing, IEM is still in the process of searching for a new BMDC director.

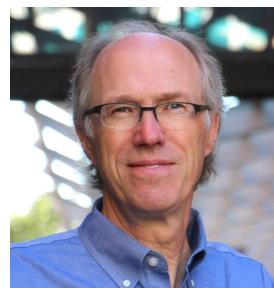
After a one-year hiatus, Innovation Fellows has been re-launched, with the first Fellows expected to start in October. Fellows can now be part-time or full-time, and the new program focuses more on the middle steps of the concept-to-commercialization journey. Fellows can also now be employees in industry.



Innovation Fellows Program

The Innovation Fellows Program was on a pause this past year as Will Durfee and others developed a "2.0" version of the program that will focus more on the middle phases of the innovation process and moving ideas towards commercialization.

The pilot Innovation Fellows Program will launch in Fall 2023 with a small group of students.



William Durfee
Director



Gwen Fischer
Associate Director



Matthew Johnson
Associate Director

Visible Heart® Laboratories

The Visible Heart® Laboratories (VH Labs) are now a part of IEM!

Dr. Paul Laizzo leads VH Labs in affiliation with Medtronic, Inc. and 12 other departments at the University. For 25 years, VH Labs has provided medical education and cardiac research using 3D printing technology, virtual reality, and anatomic models. Ongoing research ranges from cellular and tissue studies to organ and whole body investigations and is focused in five main areas: 3D modeling, cardiac physiology, patient care, skeletal muscle, and medical devices.



Paul Laizzo
Director

1,500+
students, faculty, and industry professionals toured VH Labs

50
3D models donated for training

25
short-term and long-term research projects

16
published articles in 2022-23



IEM Annual Conference

The IEM Annual Conference included keynote talks from innovative University of Minnesota researchers (right), networking and team-building sessions, and a poster session that highlighted research by students of IEM faculty and affiliated groups.

300+
attendees

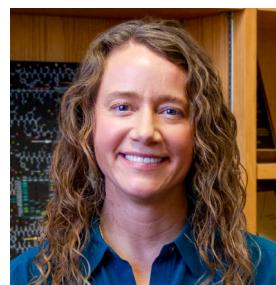
60+
posters presented



Andrew Alleyne
Dean, College of Science &
Engineering



Genevieve Melton-Meaux
Professor of Surgery and
Health Informatics



Theresa Reineke
Distinguished McKnight Professor
Department of Chemistry

IEM Innovation Week



Workshops

In addition to the regular Innovation Workshop (described on p. 13), we hosted two standard-based workshops: one on the basics of medical device regulation, and one on modeling and simulation standards within the medical device industry.



**SAVE
THE
DATE**

IEM Innovation Week 2024
April 8-12, 2024
Twin Cities
UMN Campus

1,390
participants

Design of Medical Devices Conference

As usual, the 5.10k fun run kicked off one of the largest medical device conferences in the world. Then over 800 participants enjoyed dozens of sessions, a poster competition, and keynote presentations from professionals in industry, academia, and STEM education.



IEM Career Mixer

Over 200 trainees – from undergraduates to postdoctoral fellows – had the unique opportunity to network and establish relationships with medtech industry professionals.



MN Neuromodulation Symposium

This year's Symposium brought together over 400 scientists, engineers, clinicians, industrial practitioners, and entrepreneurs. The talks and poster sessions were, for the first time, organized around neuromodulation of homeostatic mechanisms such as the vagus nerve, organ-specific nerves, and interactions between central and peripheral nerves.

// This is the best conference I have attended as a medical device entrepreneur. Academic research, advances in industry, and strategic knowledge in regulatory and commercialization are all present at this conference.

DMD Participant



IEM Distinguished Keynote Calvin Mackie

Re-Thinking STEM Outreach and Engagement: Building Capacity through Building Community

A new DMD event had a new kind of DMD speaker. Dr. Calvin Mackie, President and CEO of STEM NOLA, gave the first-ever luncheon keynote presentation. Dr. Mackie is an award-winning mentor, inventor, author, former engineering professor, internationally renowned speaker, and successful entrepreneur. STEM NOLA, the flagship affiliate of STEM GLOBAL Action, has developed a whole-community engagement model that directly addresses the historical challenges and barriers that underserved and under-resourced communities face in accessing STEM education. Dr. Mackie's keynote presented an overview of STEM NOLA's

core model and building blocks for a potential STEM Twin Cities.

To complement Dr. Mackie's talk, we hosted a distinguished STEM education panel discussion after the IEM Career Mixer, which was moderated by Inspire Program Co-directors Chris Pennell and Rhonda Franklin. The panelists (pictured below) were Calvin Mackie, Jacqueline Berry (K-12 Education Strategy and Communications Manager of 3M Gives), James Burroughs II (Government and Community Relations, Equity and Inclusion Officer of the Children's Minnesota), Leroy West (President, Summit Academy OIC of Northside STEM District), Rosalind Palma Martins (Conway Community Center at Sanneh Foundation), and Thulani Jwacu (Director, Kitty Andersen Youth Science Center of Science Museum of Minnesota).





Scientific Advisory Board

Industry Advisory Board

Faculty Advisory Board

IEM's advisory boards provide guidance to IEM leadership and promote IEM within the University and with local and national organizations. Members of the Scientific Advisory Board are national biomedical engineering leaders at academic institutions across the United States and Canada. The Industry Advisory Board is comprised of leaders in prominent biomedical companies. The Faculty Advisory Board is composed of eminent University of Minnesota faculty from the Medical School, the College of Science and Engineering, and the College of Biological Sciences.

- **Guillermo Aguilar, PhD**

James and Ada Forsyth, J. Mike Walker '66 Department of Mechanical Engineering, Texas A&M University

- **Warren Chan, PhD**

Institute of Biomedical Engineering and Terrence Donnelly Centre for Cellular and Biomolecular Research, University of Toronto

- **Naomi Chesler, PhD**

Edwards Lifesciences Center for Advanced Cardiovascular

- **J. Fernando Bazan, PhD**

Bioconsulting LLC

- **Achin Bhowmik, PhD**

Starkey

- **Matthew Cooper, MD, MBA, FACS, FCAMA**

3M Health Care

- **Dominique Seetapun Davidow, PhD**

Beckman Coulter Diagnostics

- **Liza Davis, MS**

Boston Scientific

- **Sebastian Eriksson Giwa, PhD**

Sylvatica Biotech, Elevian

- **Ed Hedblom, PharmD**

3M Health Care

- **David M. Knapp, PhD**

Boston Scientific Foundation, Boston Scientific

- **Michael Garwood, PhD**

Center for Magnetic Resonance Research, Department of Radiology

- **Tom Hays, PhD**

Department of Genetics, Cell Biology, and Development

- **David Largaespada, PhD**

Masonic Cancer Center, Department of Pediatrics

- **Genevieve Melton-Meaux, MD, PhD**

Senior Associate Dean for Health Informatics, Department of Surgery

- **Tay Netoff, PhD**

Center for Neuroengineering, Department of Biomedical Engineering

Technology, Biomedical Engineering, University of California Irvine

- **Claudia Fischbach, PhD**

Physical Sciences Oncology Center on the Physics of Cancer Metabolism, Biomedical Engineering, Cornell University

- **Alexander Revzin PhD**

Biomedical Engineering, Mayo Clinic

- **Tim Laske, PhD**

AF Solutions, Medtronic

- **Sean O'Neil**

DiaspoCare, Solera Health

- **Erik Scott, PhD**

Ampersand LLC, Medtronic (retired)

- **Mark Stevenson, MBA**

Veranex

- **Eric Varghese, MS**

4C Medical

- **Dale Wahlstrom, MS**

Act 3, LLC, Pelvital USA, Inc.

- **Adrienne Watson, PhD**

World Precision Instruments, Therillume

- **Brenda Ogle, PhD**

Stem Cell Institute, Department of Biomedical Engineering

- **Nikolaos Papanikopoulos, PhD**

Minnesota Robotics Institute, Department of Electrical and Computer Engineering

- **Theresa Reineke, PhD**

Department of Chemistry

- **Clarence Shannon IV, MD**

Associate Dean of Strategy and Innovation, Department of Anesthesiology

- **Jerrold Vitek, MD, PhD**

Udall Center of Excellence in Parkinson's Disease Research, Department of Neurology



IEM INSTITUTE FOR
ENGINEERING IN
MEDICINE



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