BIOSCIENCES INITIATIVE

Report on Progress, June 2021

BIOSCIENCES
UNIVERSITY OF MICHIGAN

MESSAGE FROM THE PRESIDENT

The importance of discovery in the biological sciences has taken center stage as the deadliest global pandemic in more than a century has transformed our world and created immediate opportunities for life scientists to help protect and enhance human life. The identification of SARS-CoV-2 as the cause of COVID-19, the determination of its genetic sequence, the establishment of a sensitive and specific diagnostic test, and the development of highly effective vaccines in under ten months further reinforces the critical importance and tremendous potential benefits of investments in research.

By supporting top researchers through our Biosciences Initiative, we are working to propel the University of Michigan to the forefront of the life sciences.

Launched four years ago, our Biosciences Initiative has committed $150 million to advance discovery at the highest levels and leverage U-M's comprehensive excellence. We have established programs in support of nine major scientific research initiatives, are hiring 30 new tenure lines, improved discovery resources, and enhanced synergy across the life sciences and related disciplines.

This report details the progress of our Biosciences Initiative. We're developing cutting-edge technology available to all of our faculty, recruiting leaders and the best new young faculty in emerging areas of the biosciences, and exploring new paths to train the next generations of life scientists.

The initiative also has helped us to secure new resources and inspired collaborations across 14 of our schools and colleges.

All of the elements are in place for U-M to fully achieve our potential during this era of unprecedented opportunities for discovery. Thanks to our faculty, Provost Susan M. Collins, Director Roger Cone, and the leading scientists of the Biosciences Initiative Coordinating Committee, we are emerging from the COVID-19 pandemic well-positioned to drive rapid advances in the biosciences — and uphold our mission to serve the public through excellence in research and education.

The Biosciences Initiative is becoming a beacon for talented researchers and scientific ambition, the high-risk, high-reward lines of inquiry that require a long-term institutional commitment, the wild ideas and the deep commitment to solving problems. It has been an honor to work with the U-M community to bring this initiative to life, and I join you in celebrating your important successes.

Mark S. Schlissel, M.D., Ph.D.
President

Biosciences Initiative Coordinating Committee (BICC)

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HUDA AKIL
Gardner C. Quarton Distinguished University Professor of Neurosciences; Quarton Professor of Neurosciences in the Molecular & Behavior Neurosciences Institute; Professor of Psychiatry; Research Professor and Co-Director of Molecular & Behavior Neurosciences Institute, Medical School

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Liaison to the President; Special Counsel to the President

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Richard G. Cornell Distinguished University Professor of Biostatistics; Professor of Biostatistics, School of Public Health

REBECCA CUNNINGHAM
Professor of Emergency Medicine, Medical School; Vice President for Research, Health Sciences, Office of Research; Director, Injury Center; Professor of Health Behavior and Health Education, School of Public Health, Interim Vice President for Research

NISHA DSILVA
Donald A. Kerr Endowed Collegiate Professor of Oral Pathology; Professor of Dentistry, School of Dentistry; Professor of Pathology, Medical School

LOLA ENIOLA-ADEFESO
Professor and Vice Chair for Graduate Studies in Chemical Engineering; Professor of Biomedical Engineering; Professor of Macromolecular Science and Engineering; Director of the Cell Adhesion and Drug Delivery Lab; Associate Director for the NIH Cellular Biotechnology Training Grant; Senior Fellow, Society of Fellows, College of Engineering

ERIC FEARON
Emanuel N. Maisel Professor of Oncology; Director, Rogel Cancer Center; Professor of Internal Medicine, Pathology, and Human Genetics, Medical School

DANIEL FORGER
Professor of Mathematics, College of Literature, Science, and the Arts; Research Professor, Computational Medicine and Bioinformatics, Medical School

DAVID GINSBURG
James V. Neel Distinguished University Professor of Internal Medicine and Human Genetics; Warner-Lambert/Parke-Davis Professor of Medicine; Professor of Internal Medicine, Human Genetics, and Pediatrics, Medical School; Research Professor, Life Sciences Institute

RICHARD GONZALEZ
Amos N. Tversky Collegiate Professor of Psychology and Statistics; Professor of Psychology and of Statistics, College of Literature, Science, and the Arts; Professor of Marketing, Stephen M. Ross School of Business; Research Professor and Director, Research Center for Group Dynamics, Institute for Social Research; Research Professor, Center for Human Growth and Development; Professor of Integrative Systems and Design, College of Engineering

STEVE KUNKEL
Acting Chief Scientific Officer, Michigan Medicine; Senior Associate Dean for Research, Endowed Professor of Pathology Research, Department of Pathology, Medical School

JOERG LAHANN
Wolfgang Pauli Collegiate Professor of Chemical Engineering, of Materials Science and Engineering, Biomedical Engineering, and Macromolecular Science and Engineering; Director, Biointerfaces Institute, College of Engineering

ANNA MAPP
Associate Dean for Academic Programs and Initiatives, Horace H. Rackham School of Graduate Studies; Edwin Vedejs Collegiate Professor of Chemistry, College of Literature, Science, and the Arts; Research Professor, Life Sciences Institute

THOMAS SCHMIDT
Professor of Internal Medicine, Professor of Microbiology and Immunology, Medical School; Professor of Ecology and Evolutionary Biology, College of Literature, Science, and the Arts

SRIJAN SEN
Frances and Kenneth Eisenberg Professor of Depression and Neurosciences, Associate Professor of Psychiatry, Research Associate Professor, Molecular and Behavioral Neuroscience Institute, Medical School, and Associate Vice President for Research in Health Sciences

TRISHA WITTKOPP
Professor of Ecology and Evolutionary Biology and Molecular, Cellular and Developmental Biology, Chair, Department of Ecology and Evolutionary Biology, College of Literature, Science, and the Arts

DONALD ZAK
Alexander H. Smith Distinguished University Professor of Ecology, Arthur F. Thurnau Professor, Burton V. Barnes Collegiate Professor, Professor of Natural Resources and of Environment, School for Environment and Sustainability; Professor of Ecology and Evolutionary Biology, College of Literature, Science, and the Arts

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Report edited by Emily Kagey, Director of LSI Marketing and Communications, and designed by Rajani Arora, LSI Multimedia and Social Media Specialist.

EXECUTIVE SUMMARY

In 2015, the President's Advisory Panel on the Biosciences created a vision for advancing biosciences research, with the goal of markedly elevating the impact of the University of Michigan.Their report identified four areas of focus as particularly essential to achieving this goal:

1. Building on the breadth of excellence across a broad array of fields, schools, colleges, and institutes
2. Rewarding excellence and risk-taking
3. Investing in emerging areas and state-of-the-art discovery technologies
4. Improving synergy, communication, and coordination

President Schlissel then launched the Biosciences Initiative (BSI), providing $150 million in funds and 30 tenure lines, to achieve the goal.

Throughout the 2017-2018 academic year, the Biosciences Initiative Coordinating Committee (BICC) gathered input from multiple sources, including a series of town halls held across the U-M campus and a retreat at the National Academy of Sciences with some of the nation's leading funding officers from federal agencies (NSF and NIH) and private biosciences foundations. Using this information, the BICC developed a budget allocation model (page 71) and a series of programs and competitions to address the four areas of focus identified in the report. These initiatives were all designed to encourage transdisciplinarity across schools, colleges, and institutes; make resources available to all; and advance emerging areas of science and technology while increasing synergy across the biosciences research enterprise.

2015

SEPTEMBER: Report of the President's Advisory Panel on the Biosciences published

OCTOBER: President Schlissel announces the new Biosciences Initiative

2017

AUGUST: Biosciences Initiative Coordinating Committee appointed

NOVEMBER: BSI launches program to expand the BSSP to all biosciences

BSI begins hosting town halls to gather faculty input (fall 2017 through January 2018)

2018

FEBRUARY: BSI announces its first RFA for Scientific Research Initiatives (SRI) and Exploratory Research opportunities

APRIL: BSI Team travels to Washington, DC, to meet with federal funding agencies and biosciences foundations

OCTOBER: BSI announces five SRI and four Exploratory Research grant awards, totaling up to $45 million

2019

FEBRUARY: Second RFA announced

BSI offers new Core Lab Funding program

New Michigan Research Cores database launches

JUNE: Inaugural BSI faculty member joins the Natural Products Drug Discovery initiative

OCTOBER: BSI hosts Ideas Lab Workshop on Predicting Human Performance

BSI provides first funding to enhance U-M research cores ($5.1 million in funding for four projects)

DECEMBER: BSI announces three SRI grants and one Exploratory Research grants, totaling more than $20 million

2020

APRIL: Due to the pandemic, BSI pivots from third RFA and approves investment in Michigan Center for Infectious Disease Threats SRI

2021

JUNE: BSI announces first MBioFAR awardees

ADVANCE EMERGING AREAS OF SCIENCE

Based on the results of two annual rounds of competition, the BSI has now allocated $132.7 million and all 30 tenure lines to fund 9 major Scientific Research Initiative (SRI) programs, leaving an additional $17.3 million for future investments. Five outstanding new faculty have already been recruited into these programs, with one additional recruitment pending approval by the administration and the Board of Regents.

THE 9 INITIATIVES ARE:

Expanding Natural Product Drug Discovery at U-M
This initiative's Natural Products Discovery Core is operating and available to U-M investigators, and has already initiated an industry collaboration focused on a critical cancer target that has been inaccessible to conventional small molecule drugs. The initiative has hired faculty member, Roland Kersten, who focuses on novel peptide natural products made by plants.

RNA Biomedicine: An Engine for Synergy, Excellence and Global Leadership at U-M
The growing importance of RNA in biomedicine was recognized by the BICC's funding of this initiative, a full two years before the emergence of the COVID-19 pandemic and the development of the world's first RNA vaccines. This initiative has already recruited two new faculty members to U-M, Stephanie Moon and Chase Weidmann.

The Institute for Global Change Biology
This new institute seeks to develop comprehensive understanding of the biological changes effectuated by climate change and other global impacts of the Anthropocene. Their first goal was to recruit a director — and the critical importance of this work is reflected in their success in recruiting a nationally leading ecologist and member of the National Academy of Sciences for the director position, pending approval by the administration and the Board of Regents.

From Cells to Atoms: The Future of Cryo-Electron Microscopy at U-M
This initiative is expanding the use of single particle cryo-electron microscopy and advancing the field in a whole new direction, cryo-electron tomography. This new field, which seeks to determine the high-resolution structures of molecular machines within their cellular environments, will revolutionize our understanding of the function of the cell. The BSI's investment in this groundbreaking technology allowed this initiative to outcompete Princeton for its first hire, Shyamal Mosalaganti.

The Michigan Concussion Center
While the prevalence of traumatic brain injury (TBI) in contact sports and the military is well known, there is much less awareness about the significant problems that concussion and TBI pose for the growing elderly population. This Center will take advantage of U-M's nationally leading School of Kinesiology and Medical School to create one of the first comprehensive programs looking at diagnosis, etiology, and treatment of concussion and TBI.

BioInnovations in Brain Cancer
While early detection, targeted therapeutics, and cellular therapeutics have led to tremendous advances in the treatment for many cancers, life expectancy for patients with brain cancers has not increased significantly. Building on novel expertise in nanoparticle science, this initiative will focus, in particular, on the development of better methods for drug delivery to the brain.

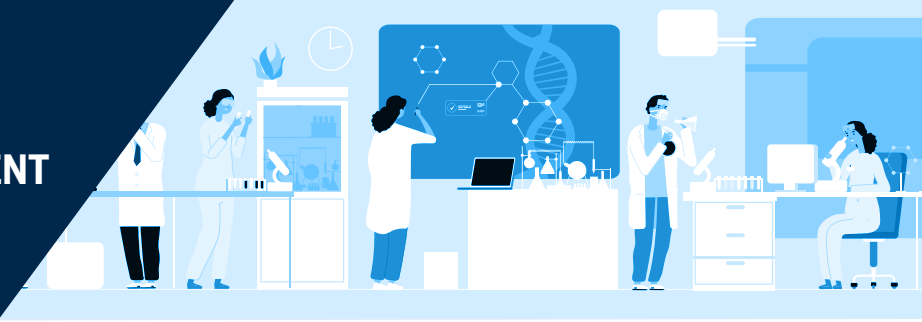
Engineering Cell Programmable Biomaterials for Dental and Musculoskeletal Health
Building on the School of Dentistry's nationally leading expertise in biomaterials research, this initiative is advancing new technologies to actually program biomaterials to be responsive to their unique tissue environments. Their first faculty recruit, Maria Coronel, studies development of biomaterials for the treatment of type I diabetes and is also recognized as the BSI's first faculty hire under the Provost's anti-racism initiative.

Single Cell Spatial Analysis Program
Transcriptomics of populations of cells and single cells has been tremendously impactful in the biosciences. This initiative will focus on the next frontier — the development and application of technologies that allow the spatial mapping of transcriptomics data — to understand the true biology and function of complex tissues and organs. This initiative has already assisted with the recruitment of HHMI Investigator Tzumin Lee.

The Michigan Center for Infectious Disease Threats
Formed in the very early days of the COVID-19 pandemic, this initiative will prepare U-M to address both the current pandemic and other infectious disease threats in a more effective way. Already, this group of investigators has deployed reagents for SARS-CoV-2 surveillance throughout South America and Southeast Asia and is one of four groups in the nation funded by the NIH to study the dynamics of SARS-CoV-2 immunity induced by infection and vaccination in health care workers.

The BSI also has created several additional programs and competitions focused on three major areas: enhancing faculty recruitment and development, improving discovery resources, and improving communication and synergy across the biosciences.

ENHANCE FACULTY RECRUITMENT AND DEVELOPMENT



The BICC identified the **Biological Sciences Scholars Program (BSSP)** as one of the most successful mechanisms for highly competitive recruitment of new assistant professors at U-M. This competition of competitions provides additional funds to enhance offers for candidates who are clearly in the top 5% to 10% of all U-M searches in a given year, who often receive offers from top peer institutions. This program was only operative in the Medical School, however, and only provided funds for four candidates per year. The BICC negotiated with the BSSP to expand its purview across the life sciences and provided funds for four years to recruit an additional four candidates in schools and colleges outside of the Medical School. To date, nine candidates have been recruited using this mechanism.

The BICC is also committed to improving diversity, equity, and inclusion in faculty recruiting. The BICC has advanced a **BSI DEI hiring program** under the auspices of the provost's office, funding four positions in the SRI program for candidates with outstanding credentials in advancing DEI. The BICC also has committed $3 million in cost-share funds for faculty hiring under Vice Provost for Equity and Inclusion Robert Sellers' application for the **NIH FIRST award**.

Many universities struggle to retain mid-career faculty; the best and brightest of these scholars understandably receive offers from top peer institutions that often include funds to launch new high-risk, high-reward discovery programs. To enhance our top mid-career faculty members' capacity to advance new research directions, the BICC created the **Mid-career Biosciences Faculty Achievement Recognition (MBioFAR) program**. This program reviews faculty promoted to associate professor and full professor each year, selects the top two to four scholars, and awards a substantial discretionary research fund ($500,000). The first three awardees for this program were announced in June 2021 (see page 53).

The SRI and MBioFAR programs are naturally focused on established faculty. To advance the careers of junior faculty and further encourage cutting-edge transdisciplinary research, the BICC created the **Ideas Lab program**. Based on the NSF Ideas Lab, this program brings together 25 interested faculty at any rank in an intensive three-day retreat to design research projects that address a specific problem. A central problem is defined in advance, and faculty compete to participate based in the transdisciplinary skills and creativity they can bring to the problem. Funding is earmarked in advance to fund three to five transdisciplinary teams that coalesce during the retreat.

The BICC plans to fund three or four Ideas Labs. The first lab, Predicting Human Performance, recruited faculty from 11 schools and institutes: the College of Engineering; the College of Literature, Science, and the Arts; the Law School; the Life Sciences Institute; the Medical School; the Ross School of Business; the School of Dentistry; the School of Kinesiology; the School of Music, Theatre, and Dance; the School of Public Health; and the Stamps School of Art and Design. This program helped create transdisciplinary research teams never before experienced by most faculty.

> **It was such a privilege to be part of the ideas lab. I got to meet amazing scholars who are thought leaders in their respective disciplines. These are people whom I would not have met otherwise, and being able to envision what interdisciplinary research could achieve was a transformative experience for me. I also loved that junior faculty were encouraged to take risks and to think big.**
>
> **— Julia J. Lee,** Assistant Professor, Ross School of Business

INVEST IN DISCOVERY RESOURCES

In its analysis of the state of core resources at U-M, the BICC quickly determined a critical need for identification and communication of these resources to stakeholders. An initial review identified 11 core laboratories listed on the Medical School's Biomedical Research Core Facilities (BRCF) website. In collaboration with BRCF staff, the BICC hired a full-time analyst to identify all recharge centers in the life sciences, collect information on their services and instruments, and collate this information on a single searchable website. The new Michigan Research Cores website now provides ready access to 95 core laboratories for U-M investigators; the Medical School has committed to maintaining this site.

To keep discovery technology at the cutting edge for all U-M investigators, the BICC also funds new core resources through two mechanisms: the SRI programs, and a rolling RFA for new cores and for the addition of instrumentation to existing cores. The BICC has invested $5.6 million to date in the latter program, bringing new mass spectrometers and the first light sheet microscope to U-M core facilities, upgrading our nuclear magnetic resonance facilities, and providing the latest discovery software, to name a few improvements.

Importantly, the BICC has structured these programs to improve accountability, sustainability, and equitable access across cores, and to stimulate future acquisition of federal equipment funds. Awardees of core funds are required to list their resource on the Michigan Research Cores website and to manage their resource using MiCores software. Cores funding also requires a plan to make the core sustainable through recharge and/or grant/unit funding by the end of three years. The BICC also funded a program to encourage existing cores to transition to MiCores.

Finally, to improve the acquisition of NSF and NIH funds for equipment purchases by U-M investigators, the BICC identifies instruments that are likely candidates for federal funding and, rather than funding these instruments, provides cost-share and application assistance for these items.

IMPROVE COMMUNICATION AND SYNERGY

The BICC has created numerous avenues for improved communications and synergy across the life sciences at U-M. In addition to the Michigan Research Cores website, the BSI publishes an opt-in newsletter and an opt-in weekly events listing for the life sciences community.

Michigan Research Cores website
(nearly 12,000 unique users, and more than 1,500 hits/month)

opt-in newsletter
(477 subscribers)

opt-in weekly events listing
(283 subscribers)

More Importantly, all of the BSI programs were designed to provide lasting improvements in communication, transdisciplinarity, and synergy among life sciences faculty and research programs at U-M. For example, the nine SRI programs, if successful, will permanently knit together research across multiple schools and colleges in a warp and woof that contrasts with the current siloed research structure at the institution. While junior researchers are normally intently focused on their individual scholarship, the Ideas Labs will create opportunities for these scholars to create bonds with diverse scholars, and participate in transdisciplinary research activities at an early formative period of their careers.

CURRENT STATUS AND FUTURE DIRECTIONS

The work of the BSI thus far has focused heavily on building structures for future success. As we move past the interruptions brought by the pandemic and related hiring/spending freeze, most BSI programs are at an exciting moment, poised to move forward with execution of their respective visions.

Of the $150M committed to the initiative, $133M has been allocated.

Of the 30 faculty positions allocated, five recruitments have been completed and one is pending.

Furthermore, signs of powerful return on investment, summarized in the Conclusion, are already appearing. Biosciences research initiatives are recruiting faculty of exceptional talent; several new types of large programmatic funding awards resulting directly from BSI programs have already been acquired; a first philanthropic gift has been made, and others are in discussion; and, most importantly, new types of collaborations and interactions across the schools and colleges are forging a whole new structure for discovery research at U-M.

We are at an important juncture for the BSI. The current BICC members completed their term in June 2021, and a new group of leading U-M scientists is being brought on. All BSI programs are long-term investments, and are reviewed and funded annually. Thus, the new BICC, with input received from this report, will play a critical role in assisting BSI grantees to succeed, adjusting program management as needed, and creating structures for long-term management and sustainability of BSI programs.

BSI: BY THE NUMBERS

AUG 2017

DATE LAUNCHED

2 4 5 3 1

COMPETITIVE FUNDING PROGRAMS CREATED

9

SCIENTIFIC RESEARCH INITIATIVES CREATED

8

CORES CREATED OR ENHANCED

N W 5 E S

EXPLORATORY RESEARCH AWARDS

6

FACULTY HIRED UNDER SRIs

(including 1 pending leadership approval)

10

FACULTY RECRUITMENTS ASSISTED

$133M ALLOCATED

$150M FUNDING TOTAL

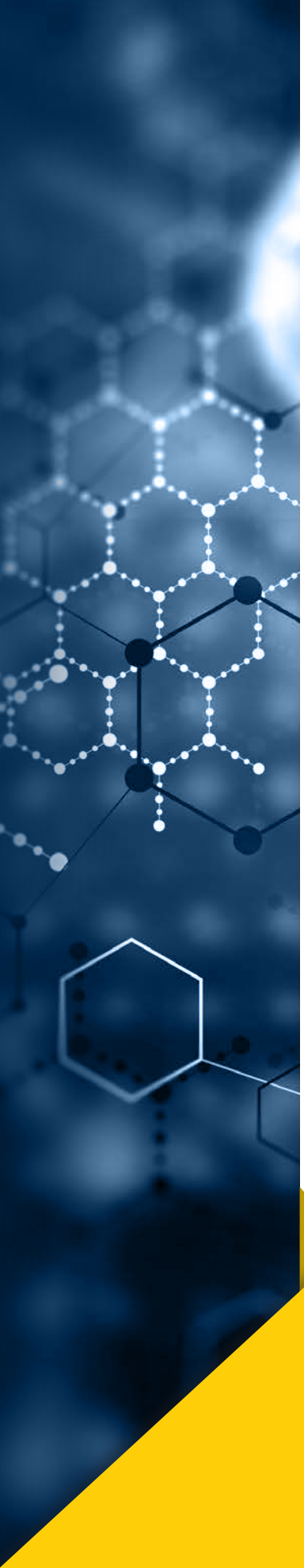
BSI: By the Numbers

WHO'S ENGAGED?

694
TOTAL FACULTY ENGAGED

106
FACULTY IN FUNDED PROJECTS

14
SCHOOLS, COLLEGES & INSTITUTES



INTRODUCTION

In 2015, the President's Advisory Panel on the Biosciences convened and recommended that U-M should enhance its efforts to become a magnet for the best biosciences faculty, postdoctoral researchers, and graduate students in the world. Achieving that goal requires building on our inherent strengths across disciplines to identify activities to advance research, education, core resources and administration in the biosciences. President Mark Schlissel announced the formation of the Biosciences Initiative (BSI) and commissioned a new multidisciplinary faculty committee, chaired by Vice Provost and Life Sciences Institute Director Roger Cone: the Biosciences Initiative Coordinating Committee (BICC).

The BICC began meeting in summer 2017 to address their committee charge of strengthening research and education in the biosciences across the university through strategic leadership, coordination, and alignment across the campus. They worked to enhance the visibility of the biosciences for both internal and external audiences and to create more opportunities for community, collaboration, and coordination among those doing biosciences research at U-M.

Under the committee's leadership, the BSI has primarily catalyzed the development of research programs, resources, and practices that tap into U-M's great breadth. The BICC was structured to be an advisory panel to the president and provost, and all major programs and funding decisions require their pre-approval.

Other primary objectives of the BICC are to improve quality and strategic coordination in faculty hiring, to identify emerging areas of strength, and to identify other opportunities where campus investment can help catalyze research impact.

In addition, the committee has helped to rationalize investment in core facilities and other forms of research support across campus. The coordinating committee helps identify promising research areas in the biosciences that are ripe for additional investment, including new faculty hires and equipment or other tools and capabilities that enable progress and actuate collaboration.

In August 2017, the President formally launched the initiative. The BICC subsequently hosted a series of town halls with U-M faculty to gather their input on the important biosciences problems and to identify ways to optimize processes for addressing them.

With great excitement, the BSI announced its first request for applications (RFA) for Scientific Research Initiatives and Exploratory Research opportunities in February 2018. The BICC has since funded another four competitive funding programs (Biological Sciences Scholars Program, Ideas Labs, Core Labs Funding and the MBioFAR midcareer awards),

Nearly four years since the launch, and following a year-long hiatus during the pandemic, it is now timely to review and report on the progress made and uncover plans for the future.

PROGRAMS

With a focus on funding cutting-edge interdisciplinary research, enabling expert faculty hires, bolstering collaboration, and facilitating postgraduate education across the biological sciences at U-M, the Biosciences Initiative has created and supported a variety of competitive funding programs, described in detail in the following sections.

1. **Advancing Emerging Areas of Science**
2. **Faculty Recruitment and Development**
3. **Discovery Resources**
4. **Synergy and Communication**

Advancing Emerging Areas of Science: Scientific Research Initiatives, Scientific Synergy Initiatives, and Exploratory Research Programs

In February 2018, the BSI published a request for applications (RFA) to allow all investigators on the Ann Arbor campus to compete for funds and tenure lines in support of research programs in emerging areas of the biosciences.

The RFA was designed to fund programs that:

01 advance significant emerging areas of science

02 engage faculty and receive support from deans and directors across multiple schools, colleges, and institutes

03 have the potential to make U-M a leader in the field

04 provide a path to sustainable funding upon the conclusion of BSI support

The initial RFA proposed three program types: Scientific Research Initiatives (SRIs), Scientific Synergy Initiatives (SSIs), and Exploratory Research programs. The SSI and SRI programs were intended to advance emerging areas of science and allowed the funding of core resources, administrative costs, and recruiting of up to three (SRIs) or five (SSIs) new faculty members. Funding of existing research programs and pilot funding programs were generally not allowed, since the BICC felt that existing research could be advanced using federal funding mechanisms and that U-M already had a plethora of programs for pilot funding. Budget caps were not announced for the SSI and SRI programs, in order to prevent applicants from the tendency of writing budgets up to a budget limit; extensive budget justifications were required for these applications. The SSI option was terminated after the first year, because only one application was submitted and faculty appeared more comfortable requesting three faculty recruits.

The Exploratory Research program was created to support early-stage research activities, including workshops, sabbaticals, and fostering partnerships between U-M and other organizations. The intent was to encourage U-M faculty to explore emerging research opportunities, without requiring the level of commitment associated with a full SRI application. A $100,000 budget limit was imposed for Exploratory Research proposals.

The application process involved submission first of a letter of intent, reviewed by the full BICC. In two annual rounds of competition, 32 SRI/SSI proposals were received, and 15 were invited to submit a full proposal. Full SRI/SSI proposals were reviewed and scored by the BICC and by three external content experts each. An external advisory board — consisting of Tachi Yamada, M.D.; Jack Dixon, Ph.D.; Jennifer West, Ph.D.; and Gail Mandel, Ph.D. — was independently consulted to review the final list of proposed awardees. Exploratory Research proposals were reviewed by the BICC.

On Oct. 29, 2018, the BSI publicly announced funding for four SRIs and one SSI requesting 14 faculty lines and totaling up to $45 million. Twelve Exploratory Research proposals were received, and four were funded for a total of $400,000. On Dec. 9, 2019, the Biosciences Initiative publicly announced four SRI grant awards requesting nine faculty lines, totaling up to $20 million; one Exploratory Research proposal was funded.

In the spring of 2020, as the BSI was preparing to launch a third and final round of competitions, the COVID-19 pandemic struck. The BICC decided to cancel the final competition and recommend to the president the creation of a Michigan Center for Infectious Disease Threats, allocating three faculty positions and a budget of up to $15 million. Later in 2020, the BICC recommended the addition of two faculty lines and $7 million to the Institute for Global Change Biology, to assist with their recruitment of a director.

With these nine programs, the BSI has now completed its allocation of funds and tenure lines under the SRI category.

Remarkably, the nine SRI programs have yet to have a full recruiting season. The first SRIs awarded in October 2018 took time to organize and prepare for recruiting, as expected, and thus engaged in limited recruiting in the FY19 season. The FY20 recruiting season was terminated prematurely due to the COVID-19 pandemic, and U-M instituted a hiring freeze for the FY21 season.

To date, five faculty members have been recruited into RNA biomedicine (two), natural products drug discovery (one), cryo-electron microscopy (one), and cell programmable materials (one); and a sixth recruit, the director of the Institute for Global Change Biology, is pending. Importantly, all five new faculty members have received the highly competitive Biological Sciences Scholars designation, indicating that the Biosciences SRI programs are recruiting at the highest possible level. The Biosciences funding was directly responsible for this success; in the case of Shyamal Mosalaganti, for example, the cryo-electron microscopy program was able to compete against an offer from Princeton for this candidate because of the nationally competitive microscopy resources funded by the BSI.

Scientific Research Initiatives

Year	Letters of Intent Submitted	Full Proposals Submitted	Proposals Awarded by BSI
2018	16	9	5
2019	16	5	3
2020	1	1	1
Total	32	15	9

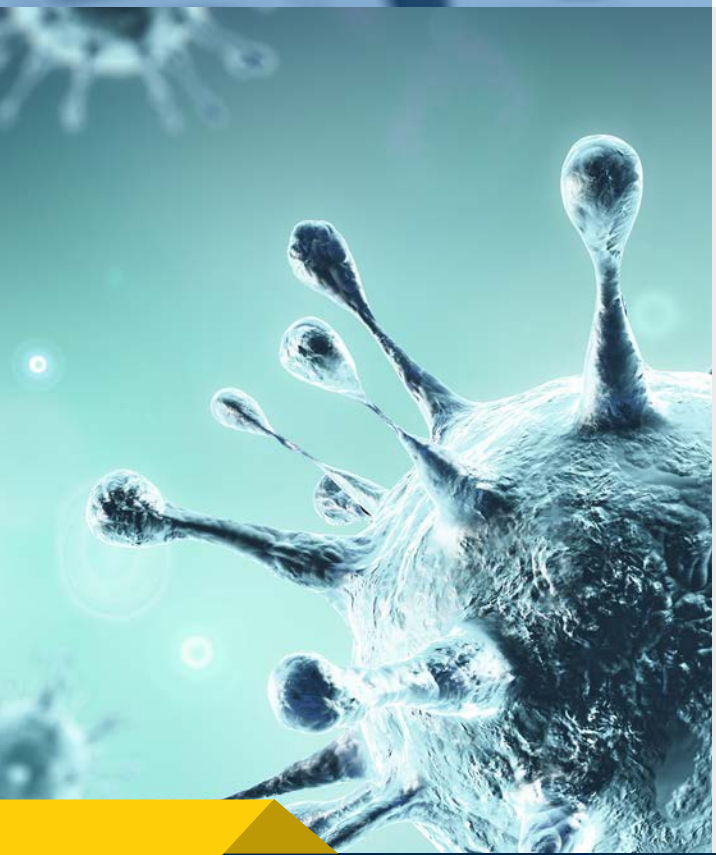
*As a result of the 2020 COVID-19 pandemic, the BICC committed to stand up a program in infectious disease threats, in place of the final RFA.

Exploratory Research Programs

Year	Full Proposals Submitted	Proposals Awarded by BSI
2019	12	4
2020	3	1
Total	15	5

DEI BACKGROUND

A key element in the president's Biosciences Initiative is the hiring of 30 new faculty members. Diversity, equity, and inclusion are critical components of the Biosciences Initiative and all its funded programs. Recruiting and hiring is no exception. The BSI requires all hiring committees to take STRIDE training. The Committee on Strategies and Tactics for Recruiting to Improve Diversity and Excellence (STRIDE) provides information and advice about practices that will maximize the likelihood that diverse, well-qualified candidates for faculty positions will be identified and, if selected for offers, recruited, retained, and promoted at U-M. The STRIDE committee leads workshops for faculty and administrators involved in hiring. Additionally, the BICC directly allocated funds for improving diversity, equity, and inclusion within the biosciences. Two programs specifically designed to advance DEI within the biosciences are described in more detail in the section on faculty recruitment and development.



COVID-19 IMPACT

In March 2020, the United States slowed to almost a standstill as the COVID-19 pandemic spread rapidly across the globe. The University of Michigan was not immune to the effects of the virus and, for the safety of its students, faculty, and staff, began to shut down or alter many regular operations. The research enterprise at U-M was significantly impacted, much of it halting due to university and state restrictions, especially regarding in-person work.

Along with many others, the Biosciences Initiative and its grantees felt the strain of pausing important research, hiring plans, and projects throughout spring and summer 2020. With the research pulse at U-M beginning to beat again in summer 2021, it is critical to take stock of how the pandemic affected BSI research programs and how they plan to respond once the pandemic restrictions lift.

In the following sections, learn more about BSI's nine Scientific Research Initiative grantees and their achievements to date.

SCIENTIFIC RESEARCH INITIATIVE

Expanding Natural Product Drug Discovery at U-M (2018)

VISION STATEMENT

To achieve greater scope in basic research in natural product sciences while strengthening translational opportunities, and to augment an already strong natural product discovery effort and create a formal core that includes state-of-the-art infrastructure, expanded scientific talent, and a sustainable business model for the purification and molecular identification of natural products with novel biological activities.

Image credit: Stephanie King, U-M Life Sciences Institute

"Our work facilitates the drive to identify new disease targets and create high potential for developing effective therapeutics against a broad range of human diseases.
–David Sherman

PRINCIPAL INVESTIGATORS:

David Sherman, Ph.D.
LSI; Pharmacy

Ashootosh Tripathi, Ph.D.
LSI; Pharmacy

BACKGROUND

Academic drug discovery is a crucial enterprise at research-intensive universities, and these efforts have been expanding at the U-M over the past 15 years. Not only does this work facilitate the drive to identify new disease targets, train the next generation of scientists, and support basic research, but it also offers a fantastic opportunity to build sustainable funding sources through the licensing of technology and high-value molecules. Access to small molecules that offer potential to generate strong composition-of-matter intellectual property is a cornerstone of a sustainable drug discovery program. This program involves 10 participating investigators and five schools and colleges.

The Expanding Natural Product Drug Discovery initiative is positioned to fill important gaps in an already unique strength at U-M: its one-of-a-kind natural products drug discovery capabilities. To do so, this program will add three new faculty hires in the field of natural product sciences and build a state-of-the-art Natural Products Discovery Core (NPDC) in the Life Sciences Institute. These additions will provide effective, responsive, and high-value access to new chemical matter, positioned readily for downstream transformation into unique, bioactive, patentable small molecules with high potential for development into effective therapeutics against a broad range of human diseases.

PROGRESS

Natural Products Discovery Core

The NPDC provides the U-M research community with broad access to unique small molecules with high potential as proprietary molecular probes and drug leads.

Researchers from the following schools, colleges, and institutes at U-M have been involved in this work and have used, worked on, or learned from BSI-funded equipment:

- Biointerfaces Institute
- College of Engineering
- College of Literature Sciences & the Arts (LSA)
  - Department of Chemistry
  - Department of Earth and Environmental Sciences
- College of Pharmacy
  - Department of Medicinal Chemistry
- Michigan Medicine
  - Department of Microbiology and Immunology
  - Department of Neurology
  - Department of Pharmacology
  - Rogel Cancer Center
- School of Dentistry

The NPDC was shut down for almost three months and core equipment was idle during the COVID-19 pandemic. Although use of core equipment has resumed, mandated density limits and access to the LSI have dampened activity. For example, any member of the community was allowed building entry 24/7 pre-pandemic, and there were no designated shifts. For several months during the pandemic, the access was limited to an AM or PM shift based on the density in the core. While in the core, people must be mindful of personal space and maintain social distancing between all lab members.

Access is now 24/7, but limits continue on the allowable number of individual researchers in the core at one time. To comply with density limits, core members must contact other members to ensure the numbers stay within the maximum. This is limiting and stressful for some projects that may exceed shift timing due to unexpected technical issues. The NPDC's numerous collaborators are also severely constrained in their ability to visit the core to conduct research.

ROLAND KERSTEN, PH.D., was the first faculty member hired through the Biosciences Initiative and was selected from a diverse pool of international and excellent candidates.

Faculty hiring

Roland Kersten, Ph.D., was the first faculty member hired through the Biosciences Initiative and was selected from a large, diverse pool of highly innovative candidates.

A thought leader and exceptional researcher, Roland Kersten is a natural product chemist who has joined the Expanding Natural Products Drug Discovery at U-M Scientific Research Initiative as an assistant professor in the College of Pharmacy's Department of Medicinal Chemistry. He teaches medicinal chemistry and the isolation of medicinal products to undergraduate, graduate, and professional pharmacy students.

The field of medicinal chemistry involves the application of a number of specialized disciplinary approaches all focused on the ultimate goal of drug discovery. George Garcia, Ph.D., Chair of Medicinal Chemistry notes that "Kersten's accomplishments in the emergent, underexplored and high-impact field of modern plant natural product sciences, as well as his broad skills required for this role, make him a phenomenal fit. We couldn't be more excited to announce that he has accepted a position here at U-M with Pharmacy's Medicinal Chemistry faculty."

Kersten joined U-M from the Whitehead Institute for Biomedical Research at MIT, where he most recently focused his research on unraveling ribosomal peptide biosynthesis in plants. His interests include the chemistry, biosynthesis, ecology and pharmacology of specialized metabolites produced by microbes, algae and plants. Throughout his career, he has worked closely with internationally renowned researchers in medicinal chemistry.

Equipment

- Agilent Rapid Fire
- Biotage V10 Touch System with Solvent Manager and Automation
- Biotage Selekt Bruker
- Shimadzu Prep HPLC

FUTURE DIRECTIONS

A primary objective of the Natural Products initiative is to map the entire U-M NPDC microbial repository and natural product extract library using genomics, chemical profiling, biological activity, and bioinformatics to establish a robust pipeline for identifying novel and known molecules as potential pre-clinical candidates.

As university recruiting opens back up, the Natural Products initiative plans to restart the faculty recruiting process. Staff hiring for NPDC is also critical, following the loss of one team member to the biotechnology industry. The projected growth in the portfolio of projects indicates the need to hire at least one additional full-time staff scientist with expertise in microbial metabolite isolation and structure elucidation.

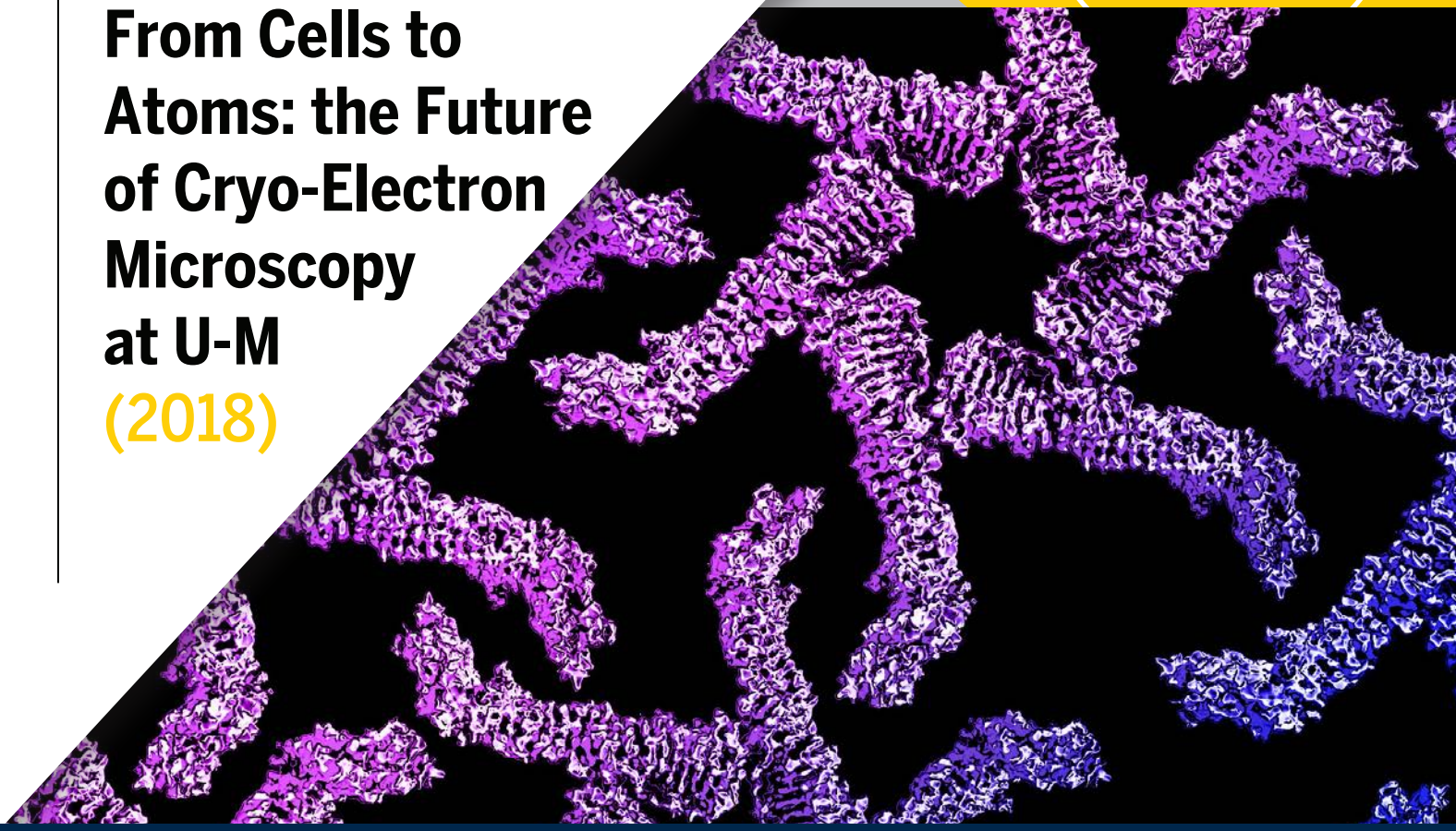
A key objective of the Natural Products program is to hire two additional faculty (one senior and one junior). One junior faculty (Kersten) has been hired, and a very compelling senior hire has been identified. Moving forward, the Natural Products program plans to resume work to finalize the senior hire and initiate the final junior hire.

A second objective is to plan an international symposium relating to Natural Product Sciences that will include lectures and workshops by experts from around the world. This is now likely to happen in FY22/23.

A third continuing objective is to develop a sustainable Natural Products Discovery Core with an international reputation for conducting cutting-edge research. The scope of the research includes drug discovery, specialized metabolomics, and translational biocatalysis relating broadly to improving human health.

SCIENTIFIC RESEARCH INITIATIVE

From Cells to Atoms: the Future of Cryo-Electron Microscopy at U-M (2018)



VISION STATEMENT

Make the intellectual and infrastructure investments required to keep U-M at the leading edge of this rapidly evolving field and to lower the educational and technical barriers for researchers at U-M to incorporate cryo-EM into their own cutting-edge research programs.

Image: Cryo-EM structure of a VacA hexamer toxin from microbe *H. pylori*.
Image credit: Ohi lab, U-M Life Sciences Institute

"

The University of Michigan now has one of the best facilities in the country. With Biosciences Initiative funding, we're going to increase cryo-EM discovery, and develop a pioneering research program in cryo-electron tomography. **–Melanie Ohi**

PRINCIPAL INVESTIGATORS:

Michael Cianfrocco, Ph.D.
LSI; Medical School

Melanie Ohi, Ph.D.
LSI; Medical School

Janet Smith, Ph.D.
LSI; Medical School

BACKGROUND

Cryo-electron microscopy (cryo-EM) is the structural analysis of samples embedded in vitreous ice and has produced stunning insights to the molecular mechanisms of biological processes. This program, which involves five participating investigators and two schools/colleges, uses cryo-EM to answer questions about the form and function of biological "machines" that play key roles in human health and disease.

New technological gains have expanded the reach of cryo-EM to explore the next scientific frontier: structures of complexes in their native cellular environment, known as cryo-electron tomography (cryo-ET). BSI funding for this program has continued the journey in cryo-EM development at U-M, moving the field toward its full potential for addressing challenging biological questions and enabling major developments spanning from sample preparation to user education and data processing.

The cryo-EM Scientific Synergy Initiative goals include:

- **Expand access to cryo-EM across the U-M campus.**
- **Improve the cryo-EM data acquisition pipeline for single-particle cryo-EM.**
- **Bring new faculty expertise to campus so that U-M can develop a program in cryo-ET, to stay at the cutting edge of this rapidly developing field.**

Advancing this vision will result from acquisition of a second Titan Krios microscope to increase the amount of single particle cryo-EM on campus, conversion of the microscope facility to a research core, acquisition of the instrumentation necessary for cryo-ET, and recruitment of faculty with expertise needed to develop a program in cryo-ET.

From Cells to Atoms: the Future of Cryo-Electron Microscopy at U-M is governed by three committees to accomplish these goals:

- **Advisory committee**
- **Correlated Light and Electron Microscopy (CLEM) search committee**
- **Cryo-Electron Tomography (cryo-ET) search committee**

PROGRESS

Awarded in October 2018, the cryo-EM program has made significant progress on their program goals in the three years since BSI funding.

Faculty hiring

SHYAMAL MOSALAGANTI, PH.D.

The Cryo-EM Scientific Research Initiative's goal is to attract, recruit, and foster a community of scientists from diverse backgrounds who want to use cryo-EM techniques to answer challenging biological questions.

This program launched two faculty searches looking for applicants with expertise in cryo-ET and correlated light and electron microscopy (CLEM). The cryo-EM program ensured that the faculty positions were widely advertised in a number of venues. Once potential candidates were identified in the faculty hiring search process, each candidate was required to answer the following question: "What are your plans for promoting equity, diversity, and inclusiveness in your lab environment?"

As a result of these searches, the cryo-EM program successfully recruited and hired cryo-ET expert Shyamal Mosalaganti, Ph.D., in fall 2020. With his BSSP designation, Mosalaganti receives special support and connections that will help him grow as a leader in bioscience research at U-M.

He will work as a research assistant professor in the Life Sciences Institute and serve as an expert for the cryo-EM initiative. His primary appointment is assistant professor in Cell & Developmental Biology, and his secondary appointment is in Biological Chemistry.

Equipment

- The Glacios, purchased with BSI funds, is located in the Biological Sciences Building and has been in use since research operations resumed in May 2020. The microscope is open for users to screen grids and collect data.
- The Titan G4, purchased with BSI funds, was installed in fall 2020. This microscope opened in spring 2021 and is currently semi-operational.
- The Aquilos, purchased with BSI funds, was installed beginning November 2020. This instrument is planned to open for U-M users in late-summer 2021.
- The Titan G2, already present in the facility, has been restarted after the construction shut-down. The cryo-EM team projects this instrument will be open for users by summer 2021.
- The Arctica, already present in the facility, is now back online. This instrument reopened for users to screen grids and collect data as of September 2020.
- The Chameleon, purchased with BSI funds, was delivered and installed in March 2020. This equipment is available by contacting the cryo-EM staff.

Growth on campus

Ohi and Cianfrocco have participated in more than 40 meetings with faculty interested in beginning electron microscopy projects. These meetings included faculty from 24 departments and six units. In these meetings, they discussed scientific goals and proposed ways that the cryo-EM facility can facilitate the researchers' scientific projects. These meetings have led to almost 50 additional trainees since November 2018, who have received one-on-one instruction on how to operate the electron microscopes.

Funding from BSI has also allowed this initiative to expand the number of scientists trained to independently use the facility (approximately 90 training sessions).

There are now 50 total users trained on the microscopes from across the campus:

- College of Literature, Science, and the Arts
  - Department of Chemistry
  - Department of Molecular, Cellular, and Developmental Biology
  - Department of Biophysics
- College of Pharmacy
  - Medicinal Chemistry
- Life Sciences Institute
- Medical School
  - Department of Biological Chemistry
  - Department of Biological Sciences
  - Department of Human Genetics
  - Department of Microbiology and Immunology
  - Department of Pharmacology
- School of Dentistry
- School of Engineering

FUTURE DIRECTIONS

After a year of construction for the installation of new state-of-the-art cryo-electron microscopes (delayed significantly by COVID-19), the U-M cryo-EM facility opened in spring in 2021 for use by the broader U-M research community. The facility maintains the university's status as a leader in cryo-EM technology for single particle cryo-EM, cryo-ET, and micro-electron diffraction with four cryo-EM instruments, focused-ion beam milling of cells, and sample preparation devices. The cryo-EM team also welcomed their new faculty colleague, Mosalaganti, who brings the first cryo-electron tomography expertise to campus and begins to move structural biology directly into the cell.

As this program continues to move forward and grow, the PIs are committed to upholding DEI practices and training. In September 2020, all staff attended a workshop through the Association of Biomolecular Resource Facilities called "Communications Workshop - Dialogue between Core Scientists and Core Administrators" to improve their communication with a diverse set of users and stakeholders.

The initiative is recruiting for a second faculty member: a CLEM position, which will hold a primary appointment in Michigan Medicine's Department of Cell and Developmental Biology. All members of the committee for hiring will be required to take the STRIDE workshop, and all candidates will be asked to provide a DEI statement in their application.

This scientific initiative's equipment updates are an incredible step forward in the available cryo-EM capabilities U-M researchers have at their disposal. The facility is open to both U-M and external researchers through a recharge rate, as of July 1, 2021. In addition, Ohi has received an NIH S10 award to fund a computer cluster for faculty using the cryo-EM facility for in vitro and in situ analysis of molecular machines.

As they continue, this team hopes to obtain funding in the future for expanded computation. By 2025, they aim to offer cryo-ET as a service for U-M researchers, in addition to the cryo-EM services they are currently building.

SCIENTIFIC RESEARCH INITIATIVE

RNA Biomedicine: An Engine for Synergy, Excellence and Global Leadership at U-M (2018)

VISION STATEMENT

To propel U-M to the forefront of the RNA Biosciences in the nation, with tremendous promise for discovering the next RNA-based breakthrough biology and technology right here on campus by enacting linchpin hires and establishing innovative campus-wide resources.

Image: Artist rendering of an RNA structure. Image provided courtesy of Nils Walter

RNA science is at the forefront of the responses to the COVID-19 pandemic caused by an RNA virus. RNA-based vaccines will save millions of lives during this pandemic and the next ones. With its prescient support of the Center for RNA Biomedicine, the Biosciences Initiative is investing in leading-edge cross-disciplinary RNA research that will translate into revolutionary therapeutics.
–Nils Walter and Mats Ljungman

PRINCIPAL INVESTIGATORS:

Mats Ljungman, Ph.D.
Medical School; Public Health

Nils Walter, Ph.D.
LSA; Medical School

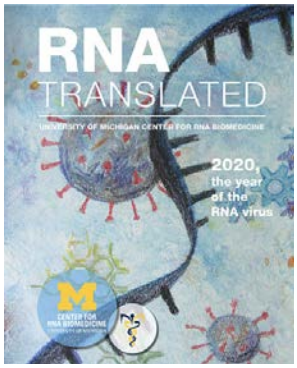
BACKGROUND

Revolutionary discoveries in the biosciences recently have revealed that ribonucleic acid (RNA) is critical for most aspects of human health, and that its misregulation is responsible for many diseases. Recent research shows that the range of cellular RNAs has expanded to include short and long non-coding RNAs. Although discoveries uncovering their full functions in human physiology are only beginning to emerge, it's already understood that these short and long non-coding RNAs profoundly impact all cellular processes, from stem cell differentiation to cancer. These revelations provide an unprecedented opportunity to invest in advanced studies of RNA as a gateway to precision medicine.

Emerging in parallel are revolutionary new technologies for RNA analysis, ranging from single molecule microscopy and next-generation sequencing to genome editing, ushering in an abundant era of both discovery research and medical translation in RNA biomedicine that is beginning to go "viral." In response to these opportunities, a grassroots effort of unmatched proportions — involving approximately 150 faculty from across campus — began in 2016 to move the University of Michigan toward a leadership position in the biosciences by forming the nascent Center for RNA Biomedicine. Now, we will leverage the enthusiasm, energy and synergy of this emergent movement by creating a comprehensive Biosciences Scientific Research Initiative in RNA, enacting multiple foundational faculty hires and implementing innovative campus-wide resources, with the goal of establishing Michigan as a world leader in RNA biomedicine. This program involves eight participating investigators and three schools/colleges.

The center's leadership consists of two co-directors, an Executive Committee, a Strategic Advisory Board, and a Student & Postdoc Council. The center has also benefited from the guidance and recommendations from several development officers affiliated with the Office of University Development, Medical School and College of Literature, Science, and the Arts.

Co-director Nils Walter, with appointments in Chemistry, Biophysics, and Biological Chemistry represents the College of Literature, Science & the Arts, while co-director Mats Ljungman, with appointments in Radiation Oncology and Environmental Health Sciences, represents the Medical School and the School of Public Health. Together, they collaborate with an Executive Committee of eight members who democratically decide on questions of relevance to center operations. The Executive Committee members meet monthly, volunteering their time and commitment to contribute to the center's numerous activities. They see their role as supporting the RNA research community at large. The RNA center's Strategic Advisory Board is made up of faculty leaders across the University and meets annually. The Student & Postdoc Council meets monthly.



The cover of the Annual RNA Magazine (first issue published September 2020) created by the public relations specialist hired in January 2020.

PROGRESS

The center fosters collaborations between many disciplines and brings together diverse expertise to research highly complex RNA mechanisms. While much of the research is in basic science, the collaborations have triggered insights and facilitated synergies, with knowledge transfer that could lead to therapies for conditions ranging from prostate cancer to COVID-19, ALS to virus interventions, or Fragile X syndrome to cellular engineering.

Two key metrics describe the resulting collective impact:

According to the SAW database, the 158 U-M RNA faculty are involved in raising on average $200M per year in research expenditures.

According to Altmetrics, in the past academic year, these faculty have produced 507 research publications, of which 402 resulted in 12,216 mentions across 11 sources of attention.

Faculty hiring

The first 2018–2019 recruitment cycle led to the successful hire of one junior faculty, Stephanie Moon, Ph.D., who started Jan. 1, 2020, in the Department of Human Genetics. Moon brings to Michigan extensive experience in the regulation of messenger RNA translation, single molecule level localization, and degradation in the contexts of stress and human disease.

Prior to coming to the U-M, Moon was a Howard Hughes Medical Institute postdoctoral fellow with Roy Parker at the University of Colorado, Boulder. She received her Ph.D. in pathology from Colorado State University. Some of Moon's achievements include:

- 2020–2022 Brain & Behavior Research Foundation NARSAD Young Investigator Grant ($70,000)
- 2020 Neuroscience Scholar, University of Michigan
- 2019 Biological Sciences Scholar, University of Michigan
- 2018–2020 National Institutes of Health Loan Repayment Program Award, National Center for Advancing Translational Sciences (NCATS) Pediatric-extramural program

Chase Weidmann, Ph.D., is the second RNA faculty hire, filling the position focused on RNA protein interaction profiling. Weidmann is scheduled to start in September 2021, with an appointment in the Department of Biological Chemistry in the Medical School with a Biological Sciences Scholars Program (BSSP) designation.

Weidmann brings expertise in RNA biochemistry, molecular biology, chemical probing, next-gen sequencing and bioinformatics. At U-M, he will build a program aimed at elucidating long non-coding RNA function using high-throughput chemical probing of RNA:protein complexes.

Weidmann received his Ph.D. in Biological Chemistry from the University of Michigan in 2015. From 2015 to 2020, he was an American Cancer Society postdoctoral fellow with Kevin Weeks at the University of North Carolina – Chapel Hill. He is currently a postdoctoral research Scholar with Ben Major at the Washington University School of Medicine in St. Louis.

Junior faculty search

The 2019-2020 hiring efforts represented a close collaboration with the chairpersons from six departments across campus: Cell & Developmental Biology; Molecular, Cellular & Developmental Biology; the Life Sciences Institute; Biological Chemistry, Human Genetics, and Biomedical Engineering.

In July 2019, the RNA SRI advertised their faculty positions in Nature and Science. They received 75 junior and six mid-career applications. The Executive Committee, which doubles as the search committee, narrowed down the pool to 12 junior candidates. Seven of these applicants were invited by different departments for faculty interviews, and two of them withdrew their applications (three of the top candidates were not invited by departments.) One offer was verbally extended to a female junior faculty candidate shortly before the U-M hiring freeze, but they were not able to follow through on their interest. Subsequently, her husband received an offer from the RNA Therapeutics Institute at the University of Massachusetts Medical School, where she is now looking for a comparable position.

Mid-career to senior faculty search

Nine mid-career and one senior faculty who were identified in the 2018–2019 search were invited to present seminars in the 2019–2020 RNA Innovation Seminar Series. After reviewing feedback questionnaires from partnering search committees, two candidates have risen to the top and are in discussion with the department of Biological Chemistry. The search committee engaged in high-level discussions with one senior faculty candidate from Duke University, who eventually withdrew his candidacy after considering the U-M salary offer not attractive enough.

Through this hiring process, the center's Executive Committee has identified additional mid-career to senior faculty members to invite to their 2020–2021 Virtual RNA Seminar Series, which is currently paused.

As U-M is ramping up its activity and releasing the expenditure and hiring freeze, they look forward to posting their positions again.

Events

The 2019-2020 RNA innovation seminar series featured talks from 14 external speakers (10 of whom were identified by our Executive Committee as potential senior to mid-career candidates for the BSI faculty positions). The twice monthly presentations covered a wide range of topics, from bioinformatics to translational medicine and from cell biology to structural biology. Over 50% of the speakers were female.

Due to the COVID-19 pandemic, the 5th Annual Symposium, "From RNA Biology to Medicine," had to be rescheduled to 2021. The program included a welcome and introduction from U-M President Mark Schlissel, five high-profile RNA research speakers, and 35 poster presentations from across the University. Over 300 participants were expected.

Communication

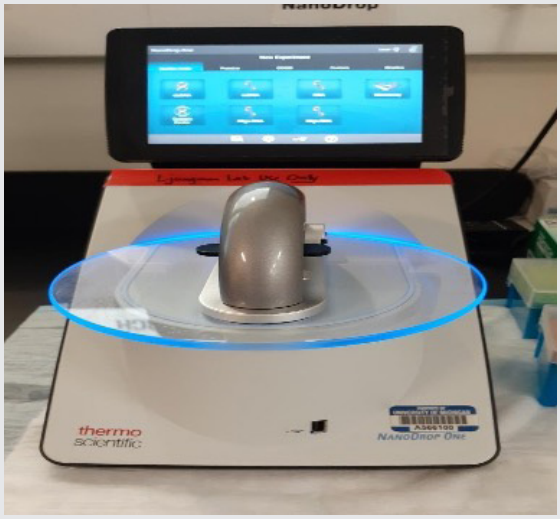
In late January 2020, the center utilized funds raised from the Endowment for Basic Science (EBS) together with BSI funds to hire a public relations specialist to help amplify and strengthen the center's communication activity. Several tools have been updated and deployed, including the website and Twitter account, @umichrna (>2,300 followers as of May 2020, with a steady increase of about 70 followers/month). The Transcript, the weekly newsletter, goes to a list of about 600 subscribers and has an opening rate of over 45% on average, with a click rate of about 15%. Scientific press releases and blog stories are regularly published to promote research and RNA community members' activity. A development brochure has also been created, and a larger annual magazine is being developed.

Equipment

1. SMART Core: New equipment has not yet been purchased; the overall funds are not sufficient for a more significant upgrade. The existing equipment is operational. Usage by existing users has been reduced considerably by the pandemic since the re-open to outside users in August, and training of new users has been curtailed. Projects requiring in-person collaboration between staff and users have been limited.

2. Bru-seq Core: Purchased small equipment:
   - NANODROP ONE SPECTMTR (July 2019)
   - HERA VIOS 160I CO2 SST TC 120V (June 2019)

   The Bru-seq core equipment is currently operational. The core was shut down between March 20 and June 18, 2020.



Research development

Grant Sprints are facilitated sessions that bring scientists together to brainstorm, elaborate and draft grant proposals. Two Grant Sprints were facilitated in October (N. Walter, M. Ljungman, M. Castro) and December (M. Koutmos, A. Frank, B. Ruotolo), which resulted in several internal and external grant applications.

Research community

A Student & Postdoc Council was established in fall 2019, at the recommendation of the center's Executive Committee. Its goal is to involve students in the center's governance, create closer ties within the next generation of scientists and offer collegial support to these young scientists. The Council was awarded a grant by the international RNA Society, has successfully launched a journal club to review publications by upcoming seminar speakers, and created the RNA Skills Share — a network of researchers sharing skills and information across departments. It has also planned outreach and networking events that were rescheduled due to the pandemic. The modalities for a Scholar Exchange program have been drafted.

FUTURE DIRECTIONS

We have already made two key faculty hires with BSI support and are building on this success as we work to hire three more faculty colleagues.

The RNA PIs and managers are still actively partnering with U-M department Chairs and have pivoted their recruiting strategy to "building a pipeline" for when the hiring freeze is lifted. The aim is to be ready to make offers immediately once there is the green light. The main goals still left to accomplish are: 1) hiring faculty, 2) building the research community, and 3) creating the Center's sustainability plan.

SCIENTIFIC RESEARCH INITIATIVE

The Institute for Global Change Biology (2018)

VISION STATEMENT

To provide the interdisciplinary scientific basis to manage biological systems under Global Change.

Image: Forest fire in Klamath National Forest, Yreka, California. Image credit: Matt Howard, Unsplash stock images

The Institute for Global Change Biology is poised to make the University of Michigan a leader, nationally and internationally, in the field of climate and global change, and we anticipate increasing research funding opportunities for our dozens of affiliated faculty. **–Allen Burton**

PRINCIPAL INVESTIGATORS:

Allen Burton, Ph.D.
SEAS; LSA

Inés Ibáñez, Ph.D.
SEAS

Knute Nadelhoffer, Ph.D.
LSA

Allison Steiner, Ph.D.
Engineering

BACKGROUND

Global change biology (GCB) seeks to understand the biosphere's responses to human activities, including climate shifts, land-use conversion, release of pollutants, and species introductions. Although organisms have modified the earth's climate in the past, current human activities are exerting an unprecedented impact on the rate of environmental change. These environmental challenges are complex and difficult to approach; simply identifying the trends or organisms' responses to stressors is not enough. Research needs to shift towards generating forecasts that combine changes, impacts, and responses to assist science-based decision-making relevant to society. To assist in the development of environmental policy and decision-making addressing global change impacts and responses, we will need to integrate GCB research with ecological forecasting.

The BSI has helped fund the creation of the Institute for Global Change Biology (IGCB), whose vision is to provide the interdisciplinary scientific basis to manage biological systems under global change. Through the IGCB, the global change scientific community at the U-M will have the support and institutional infrastructure to collaborate in more fundamental and impactful ways. This program involves four participating investigators and three schools/colleges.

The IGCB will answer needs by fostering research to understand and forecast the interactive effects of global change drivers on organisms and ecosystems.

The mission for the institute is to:

The BSI support serves as a planning grant to launch the program and create the institute; a larger, more comprehensive program is expected to follow.

The IGCB is currently governed by a faculty steering committee. A deans/chairs committee and external advisory committee will be formed upon recruitment of a full-time director for the program.

Faculty hiring

Awarded in 2018, the IGCB program has focused on a national search for the institute director. As this document was being completed, a nationally-leading ecologist and member of the National Academy of Sciences was recruited to be the first director of the IGCB, pending approval by the administration and the Regents of the University of Michigan.

FUTURE DIRECTIONS

The IGCB has an exciting year ahead. The new director will bring a giant boost in visibility to the ICGB and the University of Michigan. New initiatives will include the hiring of three junior-level faculty to jump-start the IGCB and have their homes within IGCB-affiliated departments and schools. The IGCB team anticipates continuing with another round of funding for two action groups and postdoctoral fellows, supporting additional global-change seminars across campus, and hosting an international conference.

SCIENTIFIC RESEARCH INITIATIVE

The Michigan Concussion Center (2018)

VISION STATEMENT

To maximize societal and individual health through the relentless pursuit of concussion knowledge, and to be the recognized leader in concussion research and clinical practice for a positive impact on patient health.

Steven Broglio (left) of the School of Kinesiology and kinesiology student Griffin Feinberg discuss football impact biomechanics and how they relate to brain function. Each arrow indicates a head impact. Image credit: Scott Soderberg, Michigan Photography

"We certainly have great faculty here [at U-M]. Resources here are phenomenal. But what we have lacked is bringing everybody together under a formal structure. The BSI funding will allow us to do that and set us on a path to becoming the leader and best in concussion research—not only domestically, but around the world.
–Steven Broglio

PRINCIPAL INVESTIGATOR:

Steven P. Broglio, Ph.D.
Kinesiology

BACKGROUND

Concussion, or mild traumatic brain injury, has received increased focus and concern among clinicians, researchers, sporting organizations, military personnel and athletes, and is now a major public health concern facing the medical community and society at large in the United States and worldwide. Due to many factors, concussion research is in its infancy, with substantial gaps in our fundamental understanding of injury prevention, pathophysiology, diagnostics, management, acute and long-term outcomes, and the financial impact for players and team owners. Faculty at the University of Michigan have a strong track record in many aspects of concussion research and clinical care, but the university lacks leaders in the areas of basic injury neuroscience and interventions that will advance us to the international forefront of concussion research.

With support of the BSI, the Michigan Concussion Center will coalesce existing faculty and staff with new hires into a formal Concussion Center that will be self-sustaining within five years. Steven Broglio, program PI, believes this is possible by capitalizing on over $300 million (FY 2017) in research funding allocated by the Department of Defense and National Institutes of Health, along with additional funding from various foundations and private organizations aimed at addressing these concerns.

The Center's structure revolves around three cores with distinct, mutually supportive functions:

- The **Research Core** functions as the foundation, supporting and integrating outstanding U-M faculty to promote innovative research collaborations.
- The **Clinical Core** will exist symbiotically with the Research Core by identifying clinically relevant questions, serving as an access point to patient populations for study, and translating cutting edge Research Core findings into clinical care when appropriate.
- The **Outreach Core** will help fulfill the mission of the center and the university through public engagement of the research findings among the relevant stakeholders (e.g., clinical providers, legislatures, sporting organizations) and providing educational opportunities (e.g., conferences, web content).

Synergies of Excellence

Support for the Concussion Center among U-M administration, faculty, and staff has been exceptional, with over 50 members representing more than 20 schools, departments, and institutes across U-M, including partnerships with U-M Athletics and U-M Recreational Sports.

The Michigan Concussion Center is governed by an Executive Committee, Faculty Council, and Advisory Board.

With support of the Bioscience Initiative, the Michigan Concussion Center will coalesce existing faculty and staff with new hires and will become a self-sustaining center.

PROGRESS

The Concussion Center has purposely moved forward in executing our strategic plan where possible under the current constraints. Our strategic plan has been broken down into three key elements. In this challenging time, the center has made significant progress toward these three goals; however, efforts have been significantly dampened by the pandemic.

1) Identify and lead on societal challenges: The center developed a research roadmap with specific grant strategies.

2) Build and maintain stakeholders: The center established a faculty membership model; launched monthly membership meetings and an internationally attended quarterly speaker series; and established partnerships with U-M Athletics, U-M Recreational Sports, and Detroit Public Schools. While convening has been made more challenging by the inability to hold face-to-face meetings, we have made strides toward building partnerships with key stakeholders via remote meetings attended internationally.

3) Build infrastructure for large-scale research: We have identified two large-scale research projects and are in the initial stages of convening team members for proposal development. We are also developing a stakeholder needs assessment to form a future business plan to help sustain the center. The two large-scale research projects would leverage the expertise of planned BSI faculty hires.

Faculty hiring

One senior faculty member and three junior faculty members were identified and screened prior to the hiring freeze. The Executive Committee continue to maintain contact with them and will move forward with on-campus interviews. As it is unlikely that they will fill all three positions (one senior and two junior) with the current group of applicants, they believe an additional search cycle will be necessary to fill all of the allotted slots. They also believe that this next search cycle may benefit from the outreach activities the center has purposefully engaged in during the pandemic, increasing their thought leadership profile and national exposure.

As faculty members are brought on board, they will be integrated into the structure, with positions on the Executive Committee or Faculty Council. These and other steps will be taken to build collaborations within the center membership and between other centers and institutes to support pilot and external grants with the intent of including the new faculty members on large scale grant applications.

FUTURE DIRECTIONS

Faculty recruiting will be a major focus for the Michigan Concussion Center during the coming year. We have just posted these positions and are excited to start this activity following the pandemic. We are also currently contracting with the NCAA and DOD for renewal of our ongoing project evaluating the neurological health of former athletes and service academy members with concussion up to 10 years after graduation. This is a multi-institutional contract for $42M. Finally, we are looking to transform our relationship with the Detroit schools into research programs in concussion.

SCIENTIFIC RESEARCH INITIATIVE

BioInnovations in Brain Cancer (2019)

VISION STATEMENT

Capitalize on a recent U-M grassroots initiative to create a brain cancer thrust area within the Biointerfaces Institute (BI) that will become a world leader in development and translation of new advanced technological innovations for brain cancer patients.

Image credit: Svitlana Pavliuk, Shutterstock images

With our Bioscience Initiative funding, we hope to bring together world-class technology and brain cancer scientists at the University of Michigan and beyond, with the ultimate aim of creating and translating to the clinic technological innovations to improve the prognosis of brain tumor patients.
–Steven Schwendeman

PRINCIPAL INVESTIGATORS:

Maria G. Castro, Ph.D.
Medical School

Steven Schwendeman, Ph.D.
Pharmacy

BACKGROUND

Many biomedical research scientists dream of technological discoveries that will someday successfully treat sick people. This project proposes to make those dreams a reality for brain cancer treatment and prognosis by creating a brain cancer thrust area within the Biointerfaces Institute at U-M. With the BSI funding for this project, U-M has the potential to become a world leader in the development and translation of advanced technological innovations for helping brain cancer patients. This program involves 28 participating investigators and four schools/colleges.

The vision will be achieved in the following ways:

- **Top-tier strategic hires**
- **Research core labs for technology development, preclinical evaluation, and translation**
- **Biointerfaces–brain cancer challenge grants**
- **Engagement activities including international symposia, seminars, journal clubs, and boxed-lunch meetings**
- **External advisory board meetings**
- **IP filings and prosecution, start-ups, and community outreach**

The Biointerfaces Institute, with its interdisciplinary strength, institute infrastructure, and state-of-the-art facilities, is an ideal setting to recruit three top-flight scientists to build on the initiative's team. This proposal originates from the most successful Biointerfaces Institute Challenge seed grant, led by Castro (co-PI), which has resulted in multiple successful NIH proposals and grants, publications, and patents with Biointerfaces Institute scientists.

PROGRESS

Due to hiring and spending limitations put in place in response to the COVID-19 pandemic, the BioInnovations in Brain Cancer SRI has not yet been able to hire any new faculty or purchase equipment with BSI funding for this program. No cores are yet operational, either.

FUTURE DIRECTIONS

The BioInnovations in Brain Cancer initiative aims to adopt a transformative approach, rooted in interdisciplinary ideation and collaboration, to drive innovation and translation that will deliver technological breakthroughs and a real impact on brain cancer patients' lives.

This initiative will leverage scientific excellence and embolden our community of scholars to tackle this devastating disease by providing a framework that is bolstered by state-of-the-art research infrastructure and an expansive range of scientific and community-building activities. Three new faculty hires will deepen and broaden the expertise of the faculty in key strategic research areas. Three newly-established research cores will accelerate the assessment and validation of innovations through technology development, animal testing and translation. Proposed programmatic activities—including seminars, workshops, and active engagement with internal and external stakeholders—will enrich the community of faculty, patients and their families, foundations, and learners in order to elevate the visibility of the initiative to achieve maximal impact.

SCIENTIFIC RESEARCH INITIATIVE

Engineering Cell Programmable Biomaterial for Dental and Musculoskeletal Health (2019)

VISION STATEMENT

To bring a new approach to U-M by identification of complex patterns and signatures in musculoskeletal and oral tissues in time and space, and incorporating this information into materials design as well as designing sensors into materials that can report on the status of tissue development.

Image credit: Cudazi, iStock images

> Support from this Biosciences award has created a gateway for regenerative medicine at U-M, helping coalesce investigators across campus, and providing teams with tools to understand how cells organize in 3D. This basic knowledge enables the development of novel materials that can mimic and control biological niches in a dynamic manner, further enabling the rational development of therapeutics. **–David Kohn**

PRINCIPAL INVESTIGATORS:

Kurt Hankenson, Ph.D.
Medical School

David Kohn, Ph.D.
Dentistry; Engineering

Lonnie Shea, Ph.D.
Engineering

Jan Stegemann, Ph.D.
Engineering

BACKGROUND

Musculoskeletal, oral and craniofacial tissues—including bone, cartilage, muscle, ligaments, and skin—are composed of multiple cell populations that are well organized to fulfill functional requirements. Leveraging existing expertise in biomaterials and musculoskeletal tissue engineering, this project aims to fill critical gaps at U-M in imaging and computational design of materials. With support from the Biosciences Initiative, these investigators plan to develop advanced materials that control the programming of cells and the resulting spatio-temporal organization into functional 3D tissues. This program involves four participating investigators and three schools/colleges.

The Biomaterials Scientific Synergy initiative program goals include:

- Hire a program manager
- Recruit three new faculty members
- Finalize equipment purchases
- Develop concept and foci of collaboratory
- Hire staff
- Challenge grant competitions
- Implement educational programming: annual symposia, workshops, training modules
- Enhance team building for competitive extramural grants

PROGRESS

The Engineering Cell Programmable Biomaterials SRI had only a short period of time to achieve any goals before the COVID-19 pandemic brought progress to a halt. Leadership has still met monthly and has met several no-cost milestones for the launch phase of this SRI:

1. We organized regenerative medicine researchers across campus under a single banner to enable this community of scholars to enhance research activities and undertake new and larger opportunities. A website was launched in November 2020 as a one-stop gateway to promote and enhance research and educational activities in regenerative medicine at UM.
2. A physical home for Regenerative Medicine has been committed to, including co-located space for the program director, program manager, administrator, and a conference room.
3. Launching this SRI was also integral to obtaining new NIH funding to lead a national regenerative medicine center and being able to submit a concept paper to the NSF EFRI program.

The initiative has been delayed in launching critical aspects of the SRI, most importantly faculty searches, hiring a program manager to run day-today operations, organizing a launch symposium, designing challenge grant competitions, and assessing capabilities of equipment for the collaboratory.

Towards the goal of establishing a collaboratory, PIs have pursued two tracks. They are working with Waters to assess the capabilities of their new MALDI-IMS system for mapping protein gradients on tissue sections non-destructively, although they did lose about four months during the shutdown due to the pandemic. In parallel, they have initiated discussions with Brian Ross and the Center for Molecular Imaging about elevating the system on U-M's campus into the center. Should this (earlier generation system) prove sufficient, this would free up BSI resources to pursue other equipment, such as new birefringence measurement systems that give vector images of alignment from histological sections under static or loaded conditions.

As a new SRI, the majority of milestones remain to be completed, with a phase lag (launch phase now in year 2; elevation phase now in years 3 to 5; transition phase now in years 5 and 6).

Faculty hiring

Maria Coronel, Ph.D., Department of Biomedical Engineering, Medical School and College of Engineering

Coronel brings expertise in biomaterial fabrication, tissue engineering, and immunology to the Cell Programmable Biomaterials SRI. At U-M, she plans to build a research program that will develop unique biomaterials for the treatment of type I diabetes and other autoimmune diseases.

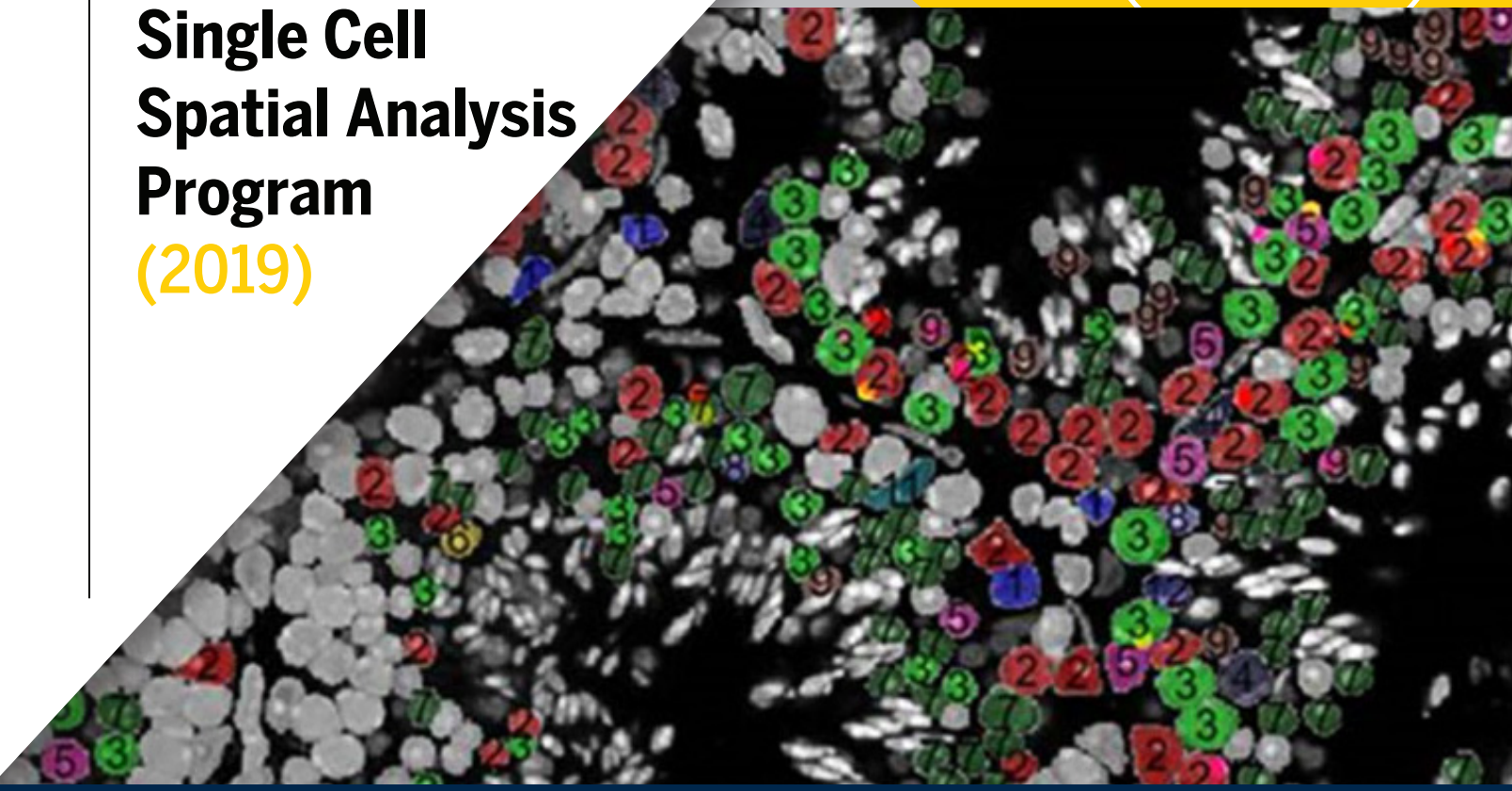
FUTURE DIRECTIONS

Health care is the largest economic burden in the United States. The Cell Programmable Biomaterials SRI program introduces a transformative approach to reducing this burden by designing materials capable of detecting disease progression, delivering an intervention, and providing feedback on the quality of treatment to titrate the intervention. Complex biological processes, such as disease progression, wound healing, and infection include many simultaneous and related sub-processes for which materials can promote healthy outcomes. This program is developing new classes of biomaterials that exhibit tissue-like properties and are integrated with chemical, mechanical, photonic, or electrical sensors. Enormous societal and economic benefit will be realized if catastrophic disease or injury is mitigated by the creation of responsive materials capable of guiding treatment.

Once the pandemic-related restrictions lift and U-M operations are back to normal, the first steps to get back on track will be hiring a program manager, in addition to slowly working towards the rest of the SRI goals. This program also plans to assess capabilities of the MALDI-IMS system for mapping protein gradients on tissue sections non-destructively as the first step toward establishing a collaboratory.

SCIENTIFIC RESEARCH INITIATIVE

Single Cell Spatial Analysis Program (2019)



VISION STATEMENT

Develop U-M into a global leader in applying high resolution, spatially-resolved multi-omic analysis of cells within tissues to drive next-generation solutions in biology and human health.

Spatial distribution of germ cell developmental states in the mouse testis based on highly-multiplexed single-transcript in situ hybridization. Image credit: Sue Hammoud lab working with Jun Li and Arvind Rao

> This program envisions building a collaborative community focused on spatial transcriptomics analysis projects by hosting seminars and workshops, mentoring, referrals and highly leveraged projects for platform development and scientific exploration. **–Evan Keller**

PRINCIPAL INVESTIGATORS:

Justin Colacino, Ph.D.
Public Health

Evan Keller, Ph.D.
Medical School

Jun Li, Ph.D.
Medical School

Sunitha Nagrath, Ph.D.
Engineering

Arvind Rao, Ph.D.
Medical School

Tom Wilson, M.D., Ph.D.
Medical School

BACKGROUND

This program plans to bring next-generation, cellular, high-content technology to a tissue spatial context. Providing tissue spatial context to cellular transcriptomes, proteins and DNA variations will transform our understanding of complex tissues. With the opportunity for three new expert faculty recruits and strengthened shared resources, the Biosciences Initiative support will benefit not only the recruits, but also the large number of existing faculty looking to pursue scientific questions that were inaccessible with past technologies.

This program envisions building a collaborative community focused on spatial transcriptomics analysis projects by hosting seminars and workshops, mentoring, referrals and highly leveraged projects for platform development and scientific exploration.

The Single-Cell Spatial Analysis program involves six participating investigators and four schools/colleges, and it is governed by an internal executive committee.

PROGRESS

While waiting for pandemic-related hiring and spending restrictions to lift, the program has made progress. A plan has been developed for moving forward with recruitment, and the Single Cell hiring team will be working with the Office of Diversity, Equity, and Inclusion to ensure they follow optimal DEI practices for future hiring.

The team also is delineating whether and what services should fall within established cores and whether they will offer a virtual core that will help guide U-M investigators to interact with the many different cores that exist at the university and impact the single cell and spatial analysis areas.

Once the restrictions lift, the group will begin immediately with the below tasks:

- Enhance its website
- Hire a program administrator and scientific manager
- Advertise for faculty recruits
- Make a capital equipment purchase using BSI and matching dollars funds
- Open a pilot project program to foster spatial analysis research
- Invite paid outside speakers

FUTURE DIRECTIONS

The Single Cell Spatial Analysis Program launched at an ideal time at U-M. The field is exploding, resulting in the prestigious journal *Nature Methods* declaring spatial transcriptomics as 2020's Method of the Year.

In the coming year, to enhance the university's prominence in this space, the SCSAP will invest in multiple new technologies to complement existing resources, as well as develop teams that will allow U-M investigators to generate and interpret their spatial data in a single-cell context. An additional priority is to rapidly build our user community to maximize cross-campus multidisciplinary collaborations and knowledge sharing.

Furthermore, a major goal is to maximize the degree to which the spatial technologies we are implementing lead to fully realized biological and medical applications, which we will realize, in part, through initiating a Pilot Project Program.

SCIENTIFIC RESEARCH INITIATIVE

Michigan Center for Infectious Disease Threats

Image credit: Production Perig, Adobe Stock images

Our goal is to accelerate infectious disease research, to prevent and predict the emergence of infectious diseases, and to expand public health capabilities to respond to epidemics and pandemics. The center will connect programs across the university and fill critical research gaps in order to bring a multidisciplinary response against infectious diseases. **–Aubree Gordon**

PRINCIPAL INVESTIGATOR:

Aubree Gordon, Ph.D.
Public Health

BACKGROUND

Just prior to the rise of the unprecedented COVID-19 crisis in Michigan, the Biosciences Initiative had announced the third and final round of funding for the annual request for applications (RFA) in two categories: Scientific Research Initiative (SRI) and Exploratory Research funding opportunities. However, as a result of this pandemic, the BICC committed to stand up a program in infectious disease threats in place of the final RFA.

In 2020, the BICC recommended funding of the Michigan Center for Infectious Disease Threats (MCIDT) as a Scientific Research Initiative program. It focuses on establishing U-M as a leader in infectious disease threats and positioning the university to respond to the COVID-19 pandemic and other future pandemics. The MCIDT program, directed by Aubree Gordon, is governed by an Executive Committee and involves seven participating investigators and five schools/colleges. Biosciences funds allocated and faculty positions provided to this final SRI program were initially restricted under the presidential budgetary guidelines announced April 20, 2020, and thus the initiative is just now being launched.

MCIDT seeks to leverage the wealth of expertise across the campus to solve critical problems related to the surveillance, diagnosis, treatment, and control of diseases caused by SARS-CoV-2 and other emerging pathogens.

Although U-M has impressive strengths in many areas associated with infectious diseases, the expert faculty are spread across multiple schools, with no formal structure to align these efforts. MCIDT arose in spring and summer of 2020 as a proposed center to coordinate and enhance studies of emerging infectious diseases at U-M.

Creating synergies across U-M's multiple schools and departments will enable MCIDT to contribute to global scientific efforts and serve the needs of the university and the state of Michigan. These cross-collaborations can heighten the university's competitive status for the recruitment of scientists to fill critical research area gaps.

The MCIDT mission is three-fold:

Serve as a convening and coordinating force for the field, helping to assemble multidisciplinary research teams to address immediate and critical challenges faced by the university and its health system, our surrounding communities, and the state of Michigan.

Invest in research infrastructure and core facilities to support basic and translational research into COVID-19 and future pandemics.

Use targeted faculty recruitment to complement existing institutional strengths and nucleate a sustainable community of researchers that will tackle current and future biothreats.

In addition to investments in facilities, resources, and faculty, MCIDT seeks to:

- Maintain a sustainable, synergistic community that addresses current and future biothreats.
- Host a monthly seminar series with invited speakers.
- Host an annual retreat of affiliated faculty featuring research in progress talks.
- Following the Mcubed model, provide seed money for pilot projects that involve faculty from multiple units. These ongoing interactions and projects will spur the development of collaborative grant (e.g. multi-PI R01, P01, and U19) proposals.
- Build bridges to Michigan State University, Wayne State University, surrounding hospital systems, and state and local governments.

With successful completion of these objectives, MCIDT can establish the university as a leader in infectious disease threats and position U-M to respond to the current COVID-19 pandemic and future pandemics.

ADDITIONAL FUNDING

In July 2020, the NIH awarded Gordon a large contract for screening immunity against SARS-CoV-2. The study will investigate the level and duration of protection afforded by natural infection of the virus in health care workers, examine immunological risk factors for infection outcome and examine immune response to infection across the disease spectrum.

FUTURE DIRECTIONS

Our world will see more infectious diseases, and the center's plans are laid to fight COVID-19 and future pandemics by bringing together researchers and others devoted to this work. Through core activities, investments in infrastructure, and targeted faculty recruitment, the center will enable scientific research across campus and build public health capacity locally, as well as globally. The center will serve as a convening and coordinating force, as they help assemble multidisciplinary research teams to address immediate, critical challenges.

The center has already made targeted investments in research projects related to SARS-CoV-2 and will continue to work with key stakeholders to further develop the specialized pathogens research infrastructure at our institution. By design, they will complement existing institutional strengths and nucleate a sustainable community of researchers aimed at tackling current and future biothreats.

Exploratory Research

When issuing the annual scientific RFA, the Biosciences Initiative allowed proposals for Exploratory Research programs. These are focused on early-stage experimental activities in biosciences research.

The BSI awarded five Exploratory Research proposals in two funding cycles:

Image credit: Mariko_s, Adobe Stock images

Principal investigator
Christopher Friese, Ph.D.
School of Nursing

Co-investigators:

Jeff DeGraff, Ph.D.
Ross School of Business

Sarah Hawley, Ph.D.
Medical School

Kenneth Resnicow, Ph.D.
Public Health

1 Applying an Innovation Framework to Improve Health in Rural Populations (2018)

Faculty members affiliated with The Center for Improving Patient and Population Health (CIPPH) have demonstrated expertise in improving the health and well-being of at-risk populations. Examples include improving the treatment experience for patients with cancer, applying simulation science to enhance clinical preparedness, and using novel web-based interventions to reduce environmental hazards.

The Applying an Innovation Framework to Improve Health in Rural Populations project vision is to bring this diverse expertise together in novel ways to transform the well-being of individuals who are historically underserved, with an emphasis on rural residents. To advance this vision, a state-of-the-science workshop will be developed to identify the most pressing gaps in rural health conducive to Michigan faculty expertise, apply an innovation framework to forge partnerships with experts and key stakeholders, and secure robust, sustainable funding.

Principal investigator
Sundeep Kalantry, Ph.D.
Medical School

Co-investigators:

Uhn-soo Cho, Ph.D.
Medical School

Yali Dou, Ph.D.
Medical School

Shigeki Iwase, Ph.D.
Medical School

Kaushik Ragunathan, Ph.D.
Medical School

2 Enabling Single-Cell and Locus-Specific Chromatin Proteomics at U-M (2018)

Single cell transcriptional profiling has revealed considerable heterogeneity of gene expression even within genetically identical populations of cells. These differences are postulated to contribute to cell fate decisions both during normal development and in diseases, yet the source of this transcriptional heterogeneity is unclear. Changes in the chromatin state of defined loci are prime candidates to underlie transcriptional heterogeneity between cells with an apparently identical developmental potential. However, single-cell chromatin profiling and single-locus chromatin proteomics remain a significant hurdle in the field of chromatin biology, especially at increasingly low-input and higher resolution levels.

With support from the Biosciences Initiative, we will develop, import, and distribute to the U-M research community reagents and technologies that will enable single-cell and locus-specific chromatin proteomics. This capability will help illuminate fundamental mechanisms underlying cell- and locus-specific transcriptional heterogeneities both during normal development and in disease.

Principal investigator
Jonathan Sexton, Ph.D.
Medical School

Co-investigator:

Andrew Alt, Ph.D.
Life Sciences Institute

3 Establishing the U-M Re-Targeting Discovery Platform: Creating Pilot Translational Infrastructure for Drug Repurposing (2018)

The traditional drug development process has a timeline of 11–18 years and costs approximately $1–3 billion dollars to bring a novel drug to market. This timeline results in a decades-long delay between advances in basic biomedical science and effective therapies for unmet medical needs. Discovering new uses for existing drugs can offer the shortest path from initial discovery to clinical use as well as reduce the cost of development and reduce risk in commercialization.

The U-M Re-Targeting Discovery Platform will create a drug repurposing platform consisting of a comprehensive collection of clinically-evaluated small molecules and an associated informatics resource to enhance drug discovery and translational medicine research at the University of Michigan. This clinically-evaluated compound collection will stimulate innovation and help address unmet medical needs by connecting the wealth of biological models in the U-M research community with highly translatable and actionable hits from in vitro screening.

Principal investigator
David Antonetti, Ph.D.
Medical School

Co-investigators:

Ann Miller, Ph.D.
LSA

Anuska Andjelkovic-Zochowska, M.D., Ph.D.
Medical School

Asma Nusrat, M.D.
Medical School

4 The Role of Tissue Barriers in Health and Disease (2018)

Multicellular organisms require maintenance of defined environments provided by tissue barriers for proper function. Nearly every organ system in the human body requires some degree of barrier formation — whether it is in epithelial sheets coating organs or lining ducts, or in endothelial tubes of vessels. These barriers are often disrupted in disease conditions. However, developing methods to safely and specifically deliver therapeutics across these barriers remains a major challenge, particularly for diseases of the nervous system.

The Biosciences Initiative funding provides an opportunity to build upon the University of Michigan's current strength in barriers biology by further developing our expertise and encouraging new collaborations among barriers researchers. The focus of The Role of Tissue Barriers in Health and Disease is to recruit outside experts to work alongside U-M experts to facilitate two multi-day workshops on emerging areas for the Michigan Barriers Biology community.

5 Strengthening Emerging Model System Biology at U-M (2019)

Centered around answering basic and disease-related biological questions, this project aims to improve the university's organismal repertoire by increasing its diversity of model systems.

To accomplish this goal, this multidisciplinary group of researchers proposes to design and host a seminar series focused on emerging model system biology, featuring leaders in these topics. Visiting experts will give a public seminar highlighting how they use emerging model systems to address important biological questions.

Principal investigator:

Ken Cadigan, Ph.D.
LSA

Co-principal investigators:

Laura Buttitta, Ph.D.
LSA

Cora MacAlister, Ph.D.
LSA

Tim James, Ph.D.
LSA

Anthony Antonellis, Ph.D.
Medical School

BSI INVESTMENTS IN EXISTING PROGRAMS

Precision Health Michigan Genomics Initiative

The Precision Health Michigan Genomics Initiative is a collaborative research effort among physicians and researchers at U-M with the goal of harmonizing patient electronic medical records with genetic data to gain novel biomedical insights.

Precision Health at U-M seeks to provide unprecedented insights into human health and disease. An individual's state of health is determined by the interaction of genes, environment, and behavior. Powerful new tools developed through this initiative allow researchers to collect large amounts of detailed genetic, physiological, and environmental data and use these data to predict and prevent disease or optimize individual treatment. The BSI committed $10 million to support this initiative for three years, from FY18 through FY20.

Michigan Neuroscience Institute

VISION

Establish a broad institute that encompasses both a virtual entity that links and enhances neuroscience across the entire U-M campus, as well as a physical research site that houses core neuroscience faculty and resources.

BACKGROUND

Neuroscience is a young and exciting field that addresses one of the great challenges of modern science: understanding how the brain gives rise to ideas, emotions, perceptions, motivations, actions and consciousness. This knowledge is not only intrinsically fascinating but is key for treating and preventing brain disorders, which present a staggering burden on humankind.

In the Medical School, the the Molecular and Behavioral Neurosciences Institute (MBNI; a physical entity that has allocated space and existing primary faculty appointed in partnership with numerous departments across schools) has served for over 60 years as a key locus of neuroscience research on campus, producing distinguished national and international leaders as well as important contributions to neuroscience research.

Significant opportunities have recently accelerated efforts to invest in, coalesce, and unite the neuroscience community across the university. Huda Akil, Ph.D., and Stan Watson, M.D., Ph.D., who have stated their desire to step down as co-directors of MBNI, expressed the hope that the search for their replacement could help to create a mechanism to catalyze increased collaboration among neuroscientists and neuroscience-related programs across campus. The university began a dialogue and set out to identify new leadership that could develop a robust, cross-campus neuroscience institute. As a first step in this process, the Regents of the University of Michigan changed the name of MBNI to the Michigan Neuroscience Institute (MNI) on December 5, 2019. The BSI has committed $20 million to launch the new Michigan Neurosciences Institute and will assist with a national search for a dynamic leader in the neurosciences to direct the new program.

Enhancing Faculty Recruitment and Development

BIOLOGICAL SCIENCES SCHOLARS PROGRAM

The Biological Sciences Scholars Program (BSSP) is a junior faculty recruiting mechanism operating out of the medical school since 1998. It assists search committees in recruiting candidates of excellence by offering the special designation of Biological Sciences Scholar and top-off funds that can be added to start-up packages. These funds are not used to replace start-up obligations of the units, but rather to increase these packages to make them more competitive. The BSSP mechanism has been successful in recruiting many of the medical school's top scholars. Typically, only the top 5% to 10% of recruits receive the BSSP designation.

Annually, the BSSP has funding to accept up to four candidates in the Medical School. After reviewing this program, the Biosciences Initiative Coordinating Committee voted unanimously to fund additional BSSP candidates with primary appointments outside the Medical School. The BSSP and Medical School accepted this challenge, and U-M President Schlissel and former Provost Philbert approved this BSI initiative.

The BSI's partnership with the BSSP aims to extend the program's success across the entire biosciences community at U-M. The BICC designated up to $1.6 million annually for three years, starting in 2018, to help recruit up to four assistant professors in the biosciences. Successful candidates are eligible for up to $400,000 in supplemental start-up funding.

The BICC has final approval of the slate of candidates chosen for BSI funding by the BSSP committee. The BICC provides administrative support to the BSSP; works to ensure efficient communication between all biosciences searches and the BSSP; and works to ensure that, over time, all bioscience units have equal access to competition for BSSP funds.

Each Biological Sciences Scholar receives critical support, including world-class colleagues and academic programs, a competitive compensation and benefits package, and a vibrant community. BSSP and BSI committee members are committed to the success of each new scholar throughout their early career. A distinctive feature of the program is the collaborative assessment and recruitment of candidates by top senior scientists across multiple departments, ensuring high standards and exceptional connections for those recruited. The BSI has provided funding for seven of these BSSP scholars

BSSP scholars recruited to U-M, 2018–2021

2018

- **Pierre Apostolides, Ph.D.,** Department of Otolaryngology, Medical School
- **Idse Heemskerk, Ph.D.,** Department of Cell and Developmental Biology, Medical School
- **Wenjing Wang, Ph.D.,** Life Sciences Institute; Department of Chemistry, College of Literature, Science, and the Arts
- **Swathi Yadlapalli, Ph.D.,** Department of Cell and Developmental Biology, Medical School

2019

- **Morgan DeSantis, Ph.D.,** Department of Molecular, Cellular and Developmental Biology, College of Literature, Science, and the Arts
- **Roland Kersten, Ph.D.,** Department of Medicinal Chemistry, College of Pharmacy *(recruited by Natural Product Drug Discovery SRI)*
- **Stephanie Moon, Ph.D.** Department of Human Genetics, Medical School *(recruited by RNA Biomedicine SRI)*
- **Teresa O'Meara, Ph.D.,** Department of Microbiology and Immunology, Medical School

2020

- **Claudia Loebel, M.D., Ph.D.,** Department of Materials Science and Engineering, College of Engineering
- **Shayamal Mosalaganti, Ph.D.,** Life Sciences Institute; Department of Biological Chemistry, Medical School *(recruited by Cryo-Electron Microscopy SRI)*

2021 (in progress)

- **Maria Coronel, Ph.D.**, Department of Biomedical Engineering, Medical School and College of Engineering *(recruited by Cell Programmable Materials SRI)*
- **Chelsey Spriggs**, Department of Cell and Developmental Biology, Medical School
- **Lauren Surface, Ph.D.**, School of Dentistry
- **Chase Weidmann, Ph.D.,** Department of Biological Chemistry, Medical School *(recruited by RNA Biomedicine SRI)*

BIOSCIENCES DEI CLUSTER HIRE AND FIRST AWARD

In an effort to build on existing expertise and enhance the university's capacity to develop cutting-edge scholarship aimed at dismantling systemic racism, a cohort of deans has laid the groundwork for hiring at least 20 new faculty members to focus on anti-racism and racial justice scholarship at the University of Michigan. The Biosciences Initiative submitted a proposal and was approved to participate in this initiative with the recruitment of four candidates with outstanding track records of improving diversity, equity, and inclusion in STEM.

As of June 2020, one candidate has been hired through this initiative, and a second offer is outstanding. The first BSI DEI recruit is Maria Coronel from the University of Florida. Coronel will join the Department of Biomedical Engineering as a member of the Programmable Biomaterials Scientific Research Initiative, studying the interaction between biomaterials and immune function in autoimmune disease, with a focus on type I diabetes.

In addition, the BSI participated in U-M's application for the NIH FIRST (Faculty Institutional Recruitment for Sustainable Transformation) award.

In recognition of the specific problem of a lack of faculty diversity in STEM fields across the nation, this award program aims to "transform culture at NIH-funded extramural institutions by building a self-reinforcing community of scientists committed to diversity and inclusive excellence ... through recruitment of a diverse group of early-career faculty who are competitive for an advertised research tenure-track or equivalent faculty position and who have demonstrated strong commitment to promoting diversity and inclusive excellence."

To further leverage potential NIH funding received from a U-M FIRST award application submitted by Vice Provost for Equity and Inclusion Robert Sellers, the Biosciences Initiative participated in the application process and committed funds for the program.

MID-CAREER BIOSCIENCES FACULTY ACHIEVEMENT RECOGNITION AWARD (MBIOFAR)

The MBioFAR program aims to recognize and provide the most meritorious mid-career faculty with additional discretionary resources to facilitate innovative and higher-risk research that might not otherwise be supported by conventional granting agencies. The program is designed to operate like an internal MacArthur Award; faculty may not apply but rather must be confidentially nominated, and only one to five awards will be made per year.

MBioFAR was created to help ensure continued extraordinary productivity, impact, and a high level of job satisfaction for our most outstanding faculty at the most productive phase of their career. This award emphasizes their value and their work's importance. However, it is imperative that MBioFAR is not used as a substitute for a retention package or other resources from the department/unit.

There are several criteria that enable a faculty member to be considered for the esteemed MBioFAR award:

ELIGIBILITY

Eligible faculty include those who have just been promoted to associate or full professor in the year the award is being offered. (The 2020 award cycle included faculty who were promoted in 2018 and 2019.)

NOMINATION

Department chairs and institute directors may submit up to two highly competitive candidates each year. The provost may encourage specific nominations in discussions with department chairs and institute directors.

REVIEW

A subcommittee of the BICC and selected additional outside members review all nominated candidates, including their CVs, letters of reference, and departmental evaluations as available. Upon review, the committee ranks the nominated candidates and selects up to five awardees to recommend for BICC and U-M presidential approval.

All proposed candidates are vetted through these selection criteria:

Academic excellence
(quality of publications, significant of discoveries reported, national recognition for their discoveries reported and discovery science)

Achievement to date

Promise for the future

Once awarded and announced, the MBioFAR awardees each receive $250,000 per year for two years of discretionary research funds that can be spent at the discretion of the investigator on their research and academic activities. The awarded faculty member must retain a primary appointment at U-M for continued access to their MBioFAR award funds.

In the 2020 MBioFAR round of awards, three faculty were chosen:

DANA DOLINOY, PH.D.

Professor and NSF International Chair of Environmental Health Sciences, and Professor of Nutritional Sciences, School of Public Health

Dolinoy is a toxicologist who studies gene–environment interactions in development and in disease, focusing on the role of nutrition and toxicants on the epigenome. A recipient of the NIH Director's Transformative Research Award, she has made leading contributions to our mechanistic understanding of the exposure levels and toxicity of both lead and the endocrine disrupter bisphenol A (BPA).

AUBREE GORDON, PH.D.

Associate Professor of Epidemiology, School of Public Health

Gordon is a world leader in influenza epidemiology, focused on the dynamics of viral transmission in tropical countries. An NAS Kavli Fellow, Gordon's epidemiological studies have helped provide the data needed to optimize the timing of vaccination in Nicaragua, as well as identified novel immunological findings that impact the design and testing of next generation influenza vaccines. She rapidly shifted her focus to the study of COVID-19 at the beginning of the pandemic and runs one of the four national sites studying SARS-CoV-2 reinfection in health care workers under the NIH IASO (Immunity Associated with SARS-CoV-2) program.

DANIEL RABOSKY, PH.D.

Associate Professor of Ecology and Evolutionary Biology and Assistant Curator of Museum of Zoology, College of Literature, Science, and the Arts

Rabosky is a highly influential ecologist and evolutionary biologist, focused on answering the question, "What is responsible for the unequal composition and distribution of the planet's biodiversity?" To address this problem in macroevolution, he has developed novel mathematical approaches to understanding different rates of speciation across both time and geography. An Associate Curator of the U-M Museum of Zoology, Rabosky is also a great communicator of science; his YouTube video on Amazonian spiders has received over 2.7 million views.

IDEAS LAB

Based on the National Science Foundation Ideas Lab model, the U-M Ideas Lab centers around pursuing innovative ideas to solve biosciences challenges, with a focus on identifying key opportunities and forming interdisciplinary teams.

This high-risk, high-reward research program culminates in a BSI-funded three-day workshop event that gathers 20 to 25 BSI-selected experts from various disciplines to pursue and develop a wide array of potential solutions to a broad challenge posed by BSI.

During the actual Ideas Lab event, a team of mentors works with the participants as they develop a plan and collaborate on solutions to that challenge. The intensive, interactive workshop creates a space for cutting-edge ideas to rise to the top. Participants interested in pursuing similar approaches to the stated problem are allowed to organically coalesce into working teams during the workshop.

In October 2019, the BSI's inaugural Ideas Lab posed a challenge in the area of predicting human performance. The BSI allocated up to $3 million for transformative research programs developed by participants in this U-M Ideas Lab. With the aim of propelling U-M to a position of national prominence in this area of novel, interdisciplinary approaches to predicting human performance based on existing strengths across campus, Daniel Forger, a member of the BICC, professor of computational medicine & bioinformatics, and professor of mathematics, developed and led BSI's first Ideas Lab. Ron Zernicke, professor of orthopaedic surgery, kinesiology, and biomedical engineering, and director of the U-M Exercise & Sport Science Initiative, served as co-director.

The participants were selected from a pool of applicants across the university; 47 faculty members from 14 primary organizations (Architecture & Urban Planning; Art & Design; Business; Dentistry; Engineering; Information; Kinesiology; Law; Literature, Science & the Arts; Life Sciences Institute; Medicine; Music, Theatre & Dance; Public Health) and 35 unique departments applied. Admittance into the lab is competitive, and a structured interview and application process is used to identify highly creative individuals with very diverse research skills.

The Ideas Lab creates an opportunity for assistant professors to form transdisciplinary research partners and engage in high-risk, high-reward research as they are developing their primary research programs. Three-fourths of the applicants were assistant professors.

Five project proposals from the first Ideas Lab were approved by the BICC to move forward:

2INSPIRE: Optimizing breathing for exceptional musical performance

Investigators:

- **James Ashton-Miller, Ph.D.**, professor of biomedical engineering (Engineering)
- **Sophia Brueckner, M.F.A.**, assistant professor of art and design (Art & Design)
- **Joseph Gascho, D.M.A.**, associate professor of music (Music, Theater & Dance)
- **Peng Li, Ph.D.**, assistant professor of biologic and materials science and of molecular and integrative physiology (Dentistry; Medical School; Life Sciences Institute)
- **Muneesh Tewari, Ph.D.**, professor of internal medicine and biomedical engineering (Medical School)

Predicting human connectivity: Assessing the physiological and psychological components of human connections

Principal Investigator:

- **Julia Lee Cunningham, Ph.D.**, assistant professor of management and organizations (Business)

Co-Principal Investigators:

- **James Ashton-Miller, Ph.D.**, professor of biomedical engineering (Engineering)
- **Elisabeta Karl, D.D.S., Ph.D.**, professor dentistry (Dentistry)
- **Peng Li, Ph.D.**, assistant professor of biologic and materials science and of molecular and integrative physiology (Dentistry; Medical School; Life Sciences Institute)

Collaborators/External Consultants:

- **Bridgette Carr, J.D.**, professor of law (Law)
- **Joseph Gascho, D.M.A.**, associate professor of music (Music, Theater & Dance)
- **Ioulia Kovelman, Ph.D.**, associate professor of psychology (Literature, Science, and the Arts)
- **Chia-Jung Tsay, Ph.D.**, associate professor of management (University College London)
- **Zhenke Wu, Ph.D.**, assistant professor of biostatistics (Public Health)

Resilience: Enhancing mechanisms of human resilience for student success and well-being

Pricipal investigator:

- **Sara Aton, Ph.D.** (PI), associate professor of molecular, cellular, and developmental biology (Literature, Science, and the Arts)

Co-principal investigators:

- **Margit Burmeister, Ph.D.**, professor of computational medicine and bioinformatics, human genetics, and psychiatry (Medical School)
- **SangHyun Lee, Ph.D.**, professor of civil and environmental engineering (Engineering)
- **Taraz Lee, Ph.D.**, assistant professor of psychology (Literature, Science, and the Arts)
- **Roland Graf, D.Techn.**, associate professor of art and design (Art & Design)
- **Michal Zochowski, Ph.D.**, professor of physics (Literature, Science, and the Arts)

Consultant:

- **Rich Gonzalez, Ph.D.**, professor of psychology and statistics (Literature, Science, and the Arts)

Toward a neurobiological understanding of creative traits and creative states: A cross-domain approach

Investigators:

Co-principal investigators (Project Leadership Team):

- **Kira Birditt, M.S., Ph.D.**, research associate professor (Institute for Social Research)
- **Mosharaf Chowdhury, Ph.D.**, assistant professor of computer science and engineering (Engineering)
- **Julia Lee Cunningham, A.M., M.P.P., Ph.D.**, assistant professor of management and organizations (Business)
- **Muneesh Tewari, M.D., Ph.D.**, professor of internal medicine and biomedical engineering (Medical School)

Co-Investigators:

- **Stephen M. Cain, M.S., Ph.D.**, assistant research scientist in mechanical engineering (Engineering)
- **Sung Won Choi, M.D., M.S.**, associate professor of pediatrics (Medical School)
- **Natalie Colabianchi, Ph.D.**, associate professor of applied exercise science (Kinesiology)
- **Walter Dempsey, Ph.D.**, assistant professor of biostatistics (Public Health)
- **Joel Gagnier, N.D., M.Sc., Ph.D.**, associate professor of orthopaedic surgery and epidemiology (Medical School)
- **Ron Zernicke, Ph.D., D.Sc.**, professor of orthopaedic surgery, kinesiology, and biomedical engineering (Medical School)

You-M: personalizing student performance at U-M

Principal investigator

- **Ken Kozloff, Ph.D.**, associate professor of orthopaedic surgery (Medical School)

Co-Principal investigator

- **Pete Bodary, Ph.D.,** assistant professor of applied exercise science (Kinesiology)
- **Margit Burmeister, Ph.D.**, professor of computational medicine and bioinformatics, human genetics, and psychiatry (Medical School)

Co-investigators with effort

- **Christopher Brooks, Ph.D.,** assistant professor of information (Information)
- **Taraz Lee, Ph.D.,** assistant professor of psychology (Literature, Science, and the Arts)
- **Adam Lepley, Ph.D.**, assistant professor of applied exercise science (Kinesiology)
- **Srijan Sen, M.D., Ph.D.**, professor of psychiatry (Medical School)
- **Zhenke Wu, Ph.D.**, assistant professor of biostatistics (Public Health)

Consulting investigator

- **Charles Burant, M.D., Ph.D.**, professor of internal medicine (Medical School)

MICHIGAN LIFE SCIENCES FELLOWS

The Michigan Life Sciences Fellows (MLSF) program launched in the fall of 2017 as a mechanism to recruit talented postdoctoral researchers to U-M and to create a unique, multidisciplinary community of scholars by providing additional salary and financial resources, flexibility and freedom to pursue research ideas, and mentorship focused on nurturing and launching truly innovative scientists into groundbreaking careers.

In this highly competitive "super-postdoc" program, fellows receive funding to pursue independent research, as well as strong mentorship, skill-building and additional resources.

MLSF is supported through a partnership between the U-M Life Sciences Institute; Medical School; College of Pharmacy; College of Literature, Science, and the Arts; and Biosciences Initiative. The partnership is designed to enhance the research program of the entire life sciences enterprise across the university and to help train and develop the next generation of scientific leaders.

The fellowship includes top-off funds that raise the annual stipend of $60,000, plus $25,000 annually toward independent research and a $2,000 annual travel stipend. Faculty members are expected to pay the base postdoctoral salaries from grants or departmental funds. Applications are reviewed by a committee made up of members from participating schools, colleges and units. In 2018, the BSI agreed to provide support for administrative and operational costs (which were originally provided by the LSI), and to fully fund one fellow for the next five years in cases where an exceptional fellow is accepted into the program but the faculty mentor lacks funding for the base salary.

MLSF fellows funded in the last three years:

2018 Fellows: 5

- **Farzan Beroz** – LSA; form and structure of living architectures
- **Joshua MacCready** – LSA; bacterial organelle trafficking
- **Brittany Morgan** – LSI; signaling biology in triple negative breast cancer
- **Aaron Morris –** Medical School/Engineering; immune-modifying particles in autoimmune diseases
- **Jennifer Yeung** – Medical School; activation of adhesion G protein-coupled receptors

2019 Fellows: 6

- **Krista Armbruster** – Medical School; lipoproteins' activities in human gut microbiota
- **Jacob Berv** – LSA; avian genome evolution
- **Laura Kirby** – Medical School; SINEs impact on canine genomes and cancer
- **Alexander Knights** – LSI; molecular mechanisms of energy-burning in fat tissue
- **Yilai Li** – LSI; machine learning and AI to improve cryo-EM data processing
- **Mo Siddiq** – LSA; genetic mutational processes in evolutionary divergence

2020 Fellows: 6

- **Michael Kalyuzhny** – Medical School; tree species diversity across forests
- **Einar Olafsson** – Medical School; host-pathogen interactions and virulence genes in toxoplasma
- **Pilar Rivero Rios** – LSI; altered membrane trafficking in neurons
- **Catherine Scull** – LSA; RNA elements: riboswitches
- **Carolyn Walsh** – Med School; immune system and nervous system signaling drives obesity-related inflammation
- **Mingmin Zhang** – LSI; sensation through a neurological focus

The program took a one-year hiatus from new recruitments for 2021, due the COVID-19 pandemic.

University of Michigan Research Cores Funding and Programs

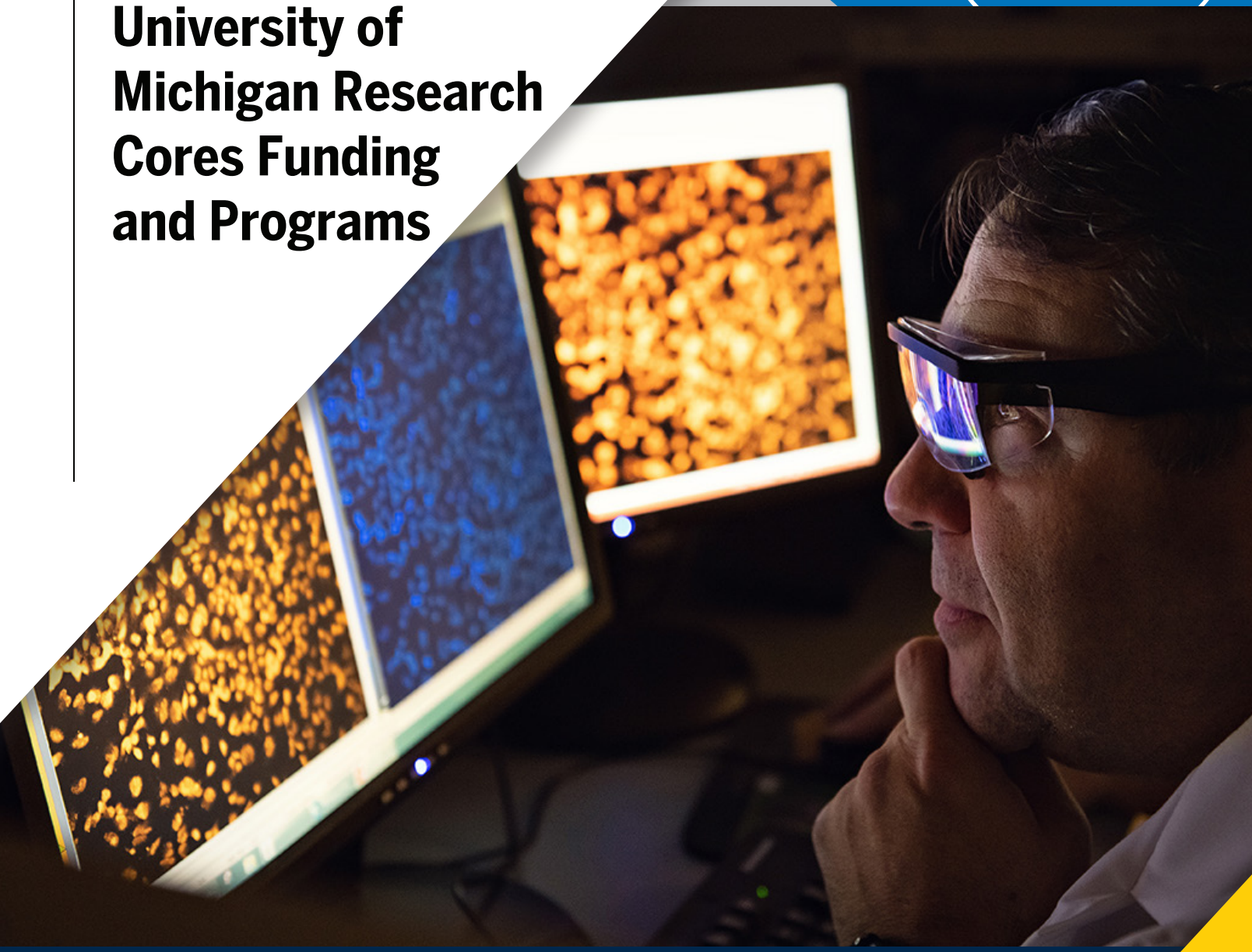
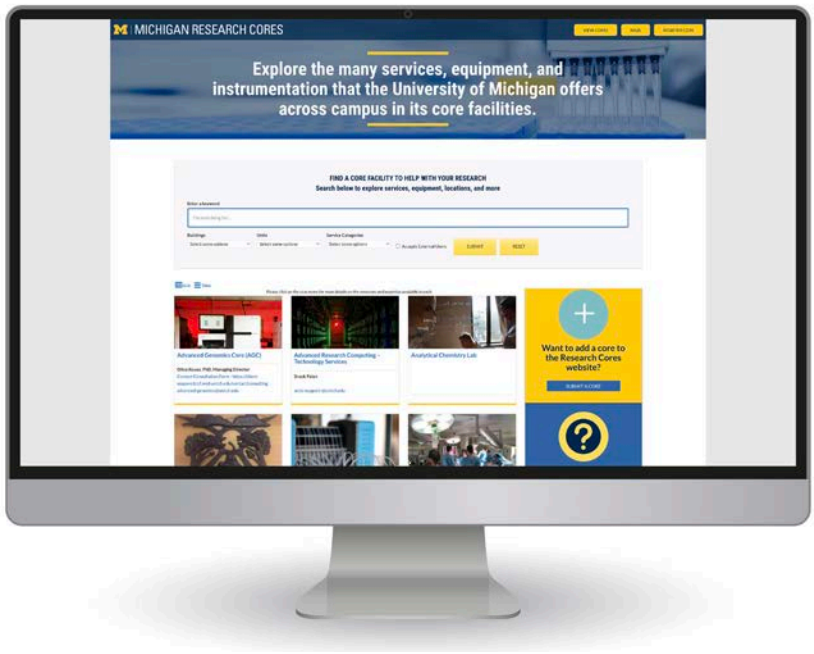


Image credit: Leisa Thompson Photography, courtesy of the U-M Life Sciences Institute

MICHIGAN RESEARCH CORES WEBSITE

The Biosciences Initiative partnered with the Medical School to create a single website that allows users to learn about and explore the many services, equipment, and instrumentation U-M offers across its 95 core facilities. The website includes a search function with capability to filter by services, equipment, locations, and more, so that users can easily find a facility that fits their research needs. As of this report, the website has received 11,811 unique users and averages 50 to 200 page views per day.

The Michigan Research Cores website also provided a common iLabs resource and financial management software to 50 cores—including the Biological Station, which experienced a 30% increase in use because of the website.



CORE LAB FUNDING PROGRAM

Research cores, commonly known as cores, are centralized facilities or labs which offer shared services, shared equipment, resources, or expertise to scientific researchers. Cores are an important resource to students, staff and faculty and can significantly impact research throughout the university. The BSI works to invest in and improve these critical tools and capabilities, enabling progress and catalyzing collaboration.

The BSI's Core Lab Funding Program aims to enhance technology at existing core laboratories and/or create new core laboratories to advance the research capabilities of U-M investigators. Applications are accepted on a rolling basis throughout the year and reviewed by the BICC quarterly. Proposals submitted to this funding program require a plan to make any proposed new cores fully sustainable after a three-year launch period. BSI funds for approved applications can include personnel and renovation costs.

In 2019, the BSI awarded $5.1 million to four research cores to help them acquire and enhance instruments that aid in understanding complex research challenges. Additionally, the BSI has funded the creation of new cores through the Scientific Research Initiatives.

BioNMR CORE

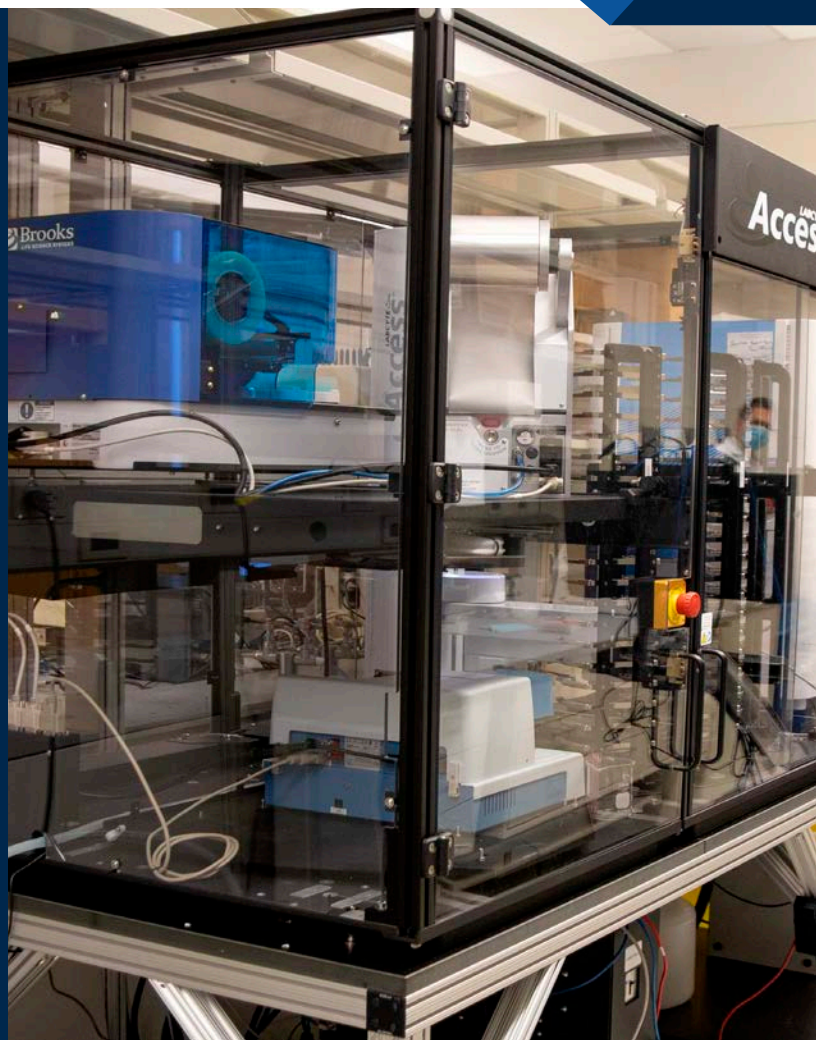
Principal investigator Emily Scott, professor of medicinal chemistry, pharmacology, and biophysics, directs this project.

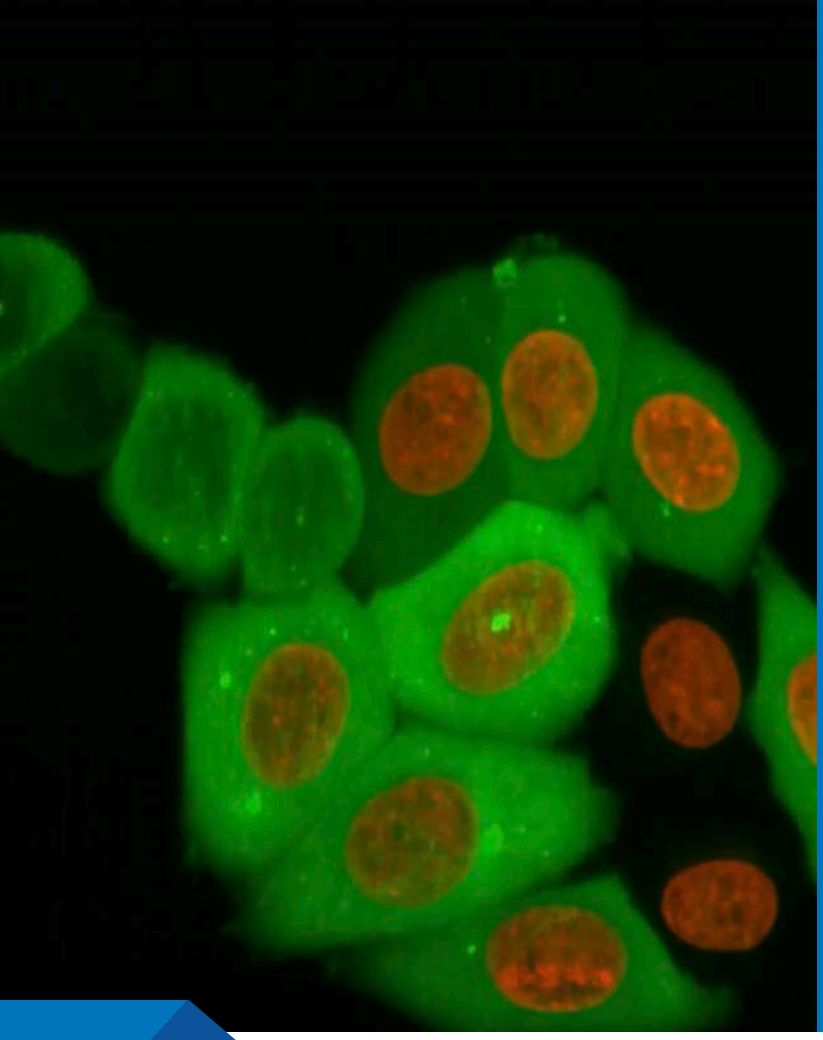
The BioNMR proposal purchased hardware for complete renovation of an old, unsupported 600 MHz NMR instrument in the Chemistry building to a modern, state-of-the-art Bruker 600 MHz NMR spectrometer. A second old Varian 600 MHz NMR spectrometer in Mary Sue Coleman Hall was also upgraded (as part of the NPDC funding, and not the BioNMR Core) and equipped with a cryoprobe and automation. These upgrades significantly improve the speed and sensitivity of the instruments. Both instruments are fully installed, have approved recharge rates and have substantially increased usage.

Biochemists and natural product chemists use these upgraded NMR instruments to determine the structures and dynamics of proteins, RNA, and small molecules.

CENTER FOR CHEMICAL GENOMICS

Led by principal investigator Andrew Alt, director of the Center for Chemical Genomics, the CCG used BSI funds to install an Echo 655, which is the most advanced liquid handler on the market. Called an “acoustic liquid handler,” this instrument uses sound waves to move liquid from a source plate to a destination plate. It can accurately transfer liquids at volumes as low as 2.5 nL (a droplet so small it is barely visible). Most importantly, the liquid never touches anything but air—no pipette tips or pintools. This prevents cross-contamination of any chemical libraries, which are among the CCG’s most valuable assets, and will significantly extend the lifespan of U-M’s chemical libraries. This automated instrument can be used for all high-throughput screening in the CCG, and also increases the speed and efficiency of most drug library screens.





LIGHT SHEET MICROSCOPY

This research core is led by Nils Walter (faculty director) and Eric Rentchler (functional lead).

In September 2020, Biomedical Research Core Facilities installed a Zeiss Lattice Lightsheet microscope at U-M, making it one of four sites in the entire United States with this technology. This is also the first lightsheet technology available in a core lab to all U-M investigators. Lattice lightsheet microscopy uses a thin sheet of light to rapidly and gently collect high-resolution fluorescence images with exquisite subcellular detail. This system is designed for high-resolution, high-speed imaging of cell cultures and the superficial layers of small embryos.

MASS SPECTROMETERS

Principal investigator Brandon Ruotolo, professor of chemistry, is using his Core Lab Funding Program award to fund four mass spectrometers in the Biological Mass Spectrometry Facility, including one instrument that is the first of its kind in the Western Hemisphere. Among other capabilities, these instruments aid drug discovery and biotherapeutics research.

Within one year of funding, the Biological Mass Spectrometry Facility has purchased two new instrument platforms, one of which was set up prior to the COVID-19 research shutdown. Final installation of the additional instruments is awaiting a pending renovation.

MiCORES

Initially adopted by the Medical School's Biomedical Research Core Facilities (BRCF) in fall 2013, Agilent CrossLab iLab Operations Software is a core facility management system designed to support operations for myriad types and sizes of centralized labs and shared resource facilities.

The modular web-based software solution includes functions for resource scheduling (calendars for reserving specific resources), hardware interlock functionality (access control for sensitive or validated equipment), billing and reporting, and time- and cost-tracking against projects.

Through a collaboration between the BSI, the Office of the Vice President of Research (OVPR), and the Medical School Office of Research, the software was branded internally as MiCores. MiCores is currently being implemented in cores, labs, and shared resource facilities across the university community. As of 2021, there were 38 core licenses participating in MiCores.

Workshop on S10s:

- Process guidelines from OVPR
- Best practices and tips, including advice from NIH S10 presentation at national cores conference
- Expert faculty panel of successful applicants

S10s AND NSF LARGE EQUIPMENT SUBMISSIONS

Up-to-date scientific equipment is integral to the success of U-M research areas such as cancer, drug development, diabetes, bioinformatics, and more. To help U-M faculty obtain funding for advanced research instruments, the OVPR and the Biosciences Initiative have partnered to offer an annual NIH S10 Instrumentations Programs webinar. NIH S10 grants support purchases of state-of-the-art research equipment.

This annual webinar explores how S10 proposals differ from more common NIH project proposals, provides a roadmap for preparing a competitive S10 proposal, and points participants to internal resources for help. A panel of U-M faculty who have been successful in obtaining S10 funding describe their experiences as PIs and as NIH S10 reviewers to help participants improve their ideas and strengthen their proposals for the NIH S10 funding opportunity.

Historically, U-M has submitted few S10 applications each year. The goal of this collaboration between the BSI and the OVPR is to bolster S10 activity coming out of U-M. In FY20, three of the five U-M proposals were awarded, for a success rate of 60% (up from the five-year average success rate of 24%). Two submissions are expected in FY21, despite the significant challenges for proposal submissions presented by the COVID-19 pandemic. The next annual S10 workshop will take place in August 2021, gearing toward FY22 proposal planning, increasing proposals and improving success rates.

HOW DOES U-M COMPARE?*

Institution	2016	2017	2018	2019	2020	Total
Stanford University	4	3	7	4	2	20
Vanderbilt University	6	4	3	2	2	17
Washington University	3	2	4	6	1	16
Johns Hopkins University	3	2	4	4	2	15
University of California San Francisco	5	2	2	4	2	15
New York University	5	3	2	1	1	12
Northwestern University	1	1	2	5	3	12
University of Wisconsin Madison	0	1	5	2	3	11
University of Pennsylvania	1	3	2	2	1	9
Cornell University	3	2	1	0	2	8
#11 University of Michigan at Ann Arbor	**2**	**0**	**1**	**3**	**2**	**8**
University of California San Diego	2	2	2	1	0	7
Yale University	1	1	2	1	2	7
University of California Berkeley	1	2	1	2	0	6
University of California Los Angeles	0	1	2	1	2	6
Duke University	3	0	1	1	1	6
University of Virginia	1	1	1	2	1	6
Harvard University	1	0	1	1	1	4
University of Southern California	0	2	1	0	0	3
Massachusetts Institute of Technology	1		1	0	0	2
University of Texas, Austin	1	0	0	0	0	1

*Table shows number of NIH S10 grants awarded per year, by institution

SYNERGY AND COMMUNICATIONS

OVERVIEW

Most of the programs created by the Biosciences Initiative were inherently designed to spark collaboration and synergy across the life sciences at U-M. For example, the SRI application process required that each research program engage stakeholders across a minimum of three departments and/or institutes, and most engaged many more. Funding of the BSSP program was specifically designed to extend this program from just the medical school to all 11 of the units that host research in the life sciences. The Ideas Labs intentionally recruited faculty from a wide diversity of units, including those outside the life sciences; the first program had participation of faculty from 14 units.

In addition, the Biosciences Initiative Coordinating Committee saw the need to create programs, websites such as Michigan Research Cores, and forums to enhance communication across the life sciences.

NEWSLETTER

The BICC is committed to building more awareness of bioscience-related events, expanding biosciences communication and building a broader sense of community at the University of Michigan. To achieve this goal, the BSI created a seasonal e-newsletter that publishes about four times a year.

Since its launch in December 2018, the BSI's newsletter has grown to reach approximately 480 faculty, staff, and students who have subscribed.

CALENDAR

One great advantage of being at the University of Michigan is the enormous opportunity to hear from the many exciting speakers who visit the campus for departmental and initiative seminars, symposia, and other events. Trying to find out who will be visiting, where, and when, however, can be a source of frustration.

To streamline this process, the BSI developed an online calendar that sends a weekly message with the upcoming two weeks' worth of biosciences events, seminars, and speakers from across campus. All biosciences groups can add to this calendar and weekly email by simply tagging their event on Happening@ Michigan with "Biosciences."

The BSI calendar already has significant participation and has the potential to continue growing. Since its launch in 2019, the weekly calendar email following has increased to approximately 280 subscribers. Interested individuals may also access the calendar by visiting the BSI's events webpage or the Happening@ Michigan events page.

COLLABORATIONS AND EVENTS

The BSI has also established or developed several additional in-person events and collaborative online spaces, including:

- Michigan Research Cores Website and iLabs software
- Annual Biosciences Celebration
  - 2018: Featured presentations from 5 main SRI grantees (90 attendees)
  - 2019: Featured presentations from 4 main SRI grantees from this year, 4 latest cores awardees, and Vice President for Research Rebecca Cunningham (120 attendees)
  - 2020: Cancelled due to the COVID-19 pandemic
  - 2021: Scheduled for fall 2021
- Program to improve S10 success
  - Webinar, 2019
  - Webinar, 2020
- Coordinating faculty recruitment in the biosciences
- Privileged site for all faculty searches in the biosciences; participation required for BSSP eligibility

FINANCIAL MANAGEMENT AND METRICS

ADMINISTRATIVE SUMMARY

The programmatic and organizational activities of the Biosciences Initiative are led by Jennifer Ohren, project lead, in conjunction with the BSI Director, Roger Cone. Ohren has played a significant role in the success of the Biosciences by shepherding all administrative and strategic activities, including serving as the budget administrator of the $150M investment. Maya Pickard serves as the program's administrative coordinator, and Cathy Andrews provides partial effort as a scientific cores consultant.

Jennifer Ohren
BSI Project Lead

Maya Pickard
BSI Administrative Coordinator

CONSULTANT:

Cathy Andrews,
Director of Operations, LSI

The BSI administrative team supports our awardees, the distribution of funding, budgetary activities, grant milestones, and all aspects of research grant administration. Our team works on coordination, communication, and strategic planning to provide tools and resources that allow our principal investigators and grant administrators to focus on making their research programs as successful as possible.

The administrative group manages the annual review and flow of funds for all biosciences programs. Each funded BSI program completes a formal annual review and presents in person to the Biosciences Initiative Coordinating Committee. The following year's budget proposal is then reviewed by the BICC as well, as each program's advancement is based on successful completion of annual milestones.

The oversight of the Initiative's $150 million intramural fund involves transparency and coordination with the University Finance Office and with central offices such as the Office of the Vice President of Research and Procurement Services.

Our group also relies on successful collaboration and enriching relationships with our community partners: schools, colleges, deans, chairs, and institute directors. These partnerships are critical to the mission and aims of the BSI, particularly as we continue to serve an expanded biosciences enterprise.

Moving forward, the administrative group will be responsible for collecting metrics on each BSI-funded activity, to determine which activities are successfully executing their research plans. Many of these metrics are already built in to annual reports collected by the BSI. For example, we are currently measuring how quickly our funded core labs are adding their core information to the Michigan Research Cores, installing and operationalizing new technologies, implementing recharge schemes for the use of their equipment, and engaging new faculty in the use of their resources. In funding activities at the cutting edge of science, we fully expect some failures. Collection of data on BSI activities will allow us to both assist investigators in reaching their goals and, if needed, sunset the funding of programs that may not be working as envisioned.

FORMER BSI STAFF: **Annie Kadeli**, Marketing and Communications Specialist; **Donna Ray**, PM Intermediate/Cores Coordinator

BIOSCIENCES INITIATIVE BUDGET NARRATIVE

As a result of the Final Report of the President's Advisory Panel on the Biosciences, the BICC was charged with implementing aims from the report in order to achieve the goal of the University of Michigan becoming a biosciences powerhouse. Consistent with the U-M's status as a world-class institution, the focus became to foster an intellectually rich and diverse scientific environment in which bioscientists and other scholars could more easily and effectively collaborate, and to be a magnet for the very best faculty, postdocs and researchers in the world.

The decision was made to focus on rewarding U-M's rising stars, breaking down barriers to interdisciplinary integration, and increasing access to campus-wide resources. To achieve these goals, the BICC decided upon high-level programmatic categories to maximize impact across the university.

Scientific Research Initiative competitions, investment in Precision Health and the Biological Sciences Scholarship Program, Core Resources, and Educational Programs were defined and started to roll out in 2018 to begin allocation of the Initiative's one-time investment of $150 million.

In early 2018, the BICC created funding competitions that sought to find forward-looking, high-impact scientific research projects in the biosciences and convergent disciplines that would result in globally leading programs, focused on solving critical problems. A key element in the request for applications (RFA) was the beginning of the plan to hire up to 30 tenure-track, provost-funded faculty lines.

As proposals are submitted to the BICC for review, the most important elements for consideration are innovation, impact, viability, interdisciplinarity, convergence, and leadership. In the case of the large Scientific Research Initiatives, proposals are independently scored by the BICC, two to three external reviewers and an external advisory council. Taking the entirety of proposal reviews, the BICC then provides recommendations to the president and the provost for consideration of funding.

The BSI award terms are from one to five years and typically operate on an expense reimbursement basis (the exception being where programs are so diverse and collaborative that funding must be pre-loaded in order for projects to be implemented).

Under the award terms, there is an agreement that principal investigators and any executors of the awards will complete an annual accounting and end-of-year report for BICC review. Committee assessment of project metrics, analysis of financial justification, and overall budget evaluation determine continuation of subsequent work and funding.

As more experience was gained around this collaborative type of intramural funding, we determined that creating opportunities for our mid-career (MBioFAR) and junior faculty (Ideas Lab) would allow us to foster growth in areas that were not already targeted in our existing programs.

Finally, as our reputation grew across campus as a convening and collaborative body, we found that we could leverage our expertise and have a greater impact by partnering in the reimagining of the Michigan Neuroscience Institute and two provost-level DEI Initiatives.

As of this writing, the Biosciences funding is approximately 90% allocated, with plans to finish awarding projects over the next two years to creative faculty who are working to solve our world's most complex biological problems (see the allocation model in the appendix).

The Biosciences funding is approximately 90% allocated, with plans to finish awarding projects over the next two years to creative faculty who are working to solve our world's most complex biological problems.

CONCLUSIONS AND FUTURE DIRECTIONS

“The world is full of magic things, patiently waiting for our senses to grow sharper.”

— W.B. Yeats

After reading this progress report, my hope is that you will get a sense of how the Biosciences Initiative is working to create the foundation for great future discoveries in the life sciences at the University of Michigan. In addition to funding emerging areas of science, the Scientific Research Initiatives, Ideas Labs, Biological Sciences Scholars Program and Michigan LIfe Sciences Fellows program all create novel structures to enhance the culture of transdisciplinarity at U-M. I am excited to think about long-term opportunities and discoveries, for example, that arise from creating contacts and collaborations among highly diverse young faculty through the Ideas Labs.

The engagement of the Biosciences Initiative Coordinating Committee in the approval of faculty hiring has thus far resulted in a uniformly high quality of recruitment. Further, the creation of programs in emerging areas of science, such as the Institute for Global Change Biology, is attracting nationally leading scientists to U-M. The search for a director of this program led to serious interest from two members of the National Academy of Sciences and serves as an indicator of the value of the BSI in elevating science at U-M. The BSI has also focused intentionality on improving diversity in STEM, and this has already yielded a successful recruitment of a brilliant biomedical engineer committed to improving diversity in her field.

In the sciences, our senses grow sharper not only by virtue of our interactions and collaborations with diverse scientists in diverse disciplines, but also by virtue of the quality of the discovery tools at our disposal. The BSI has invested in Precision Health and has already brought many new discovery tools to U-M faculty, such as light sheet microscopy, high-throughput mass spectrometry, and cryo-electron tomography, to name a few. Furthermore, through the creation of a simple comprehensive Michigan Research Cores website, the BSI has significantly improved access to these tools.

In addition to the initial high-level recruitments through the BSI, we are also starting to see indications of novel types of returns on the investment that bode well for the goals of the initiative. Directly related to BSI investments, we have already seen a contract from the Sun Pharma Advanced Research Company (SPARC) with the Natural Products Discovery Core, multiple grants from the Chan Zuckerberg Initiative to the RNA Biomedicine program, a grant from the NIH for cryo-EM education, a grant from the Open Philanthropy Foundation for production of SARS-CoV-2 spike protein, a grant from the NIH making U-M one of four national sites studying SARS-CoV-2 infection in health care workers, and a philanthropic donation to the Concussion program for student scholarships.

Despite early indications of progress, however, important work remains to be done. The vast majority of BSI funds, although allocated, have not yet been put to work—and the new BICC members will play an important role in ensuring that quality investments continue to be made. Furthermore, careful identification and monitoring of metrics of BSI programs can help to create guidelines for future university initiatives. Finally, a significant amount of funds remain to be allocated, and programs like the Ideas Labs and the MBioFAR are just beginning. We look forward to your input as we continue to guide this initiative into the future.

Roger D. Cone, Ph.D.
Chair, Biosciences Initiative Coordinating Committee

APPENDIX

- New BICC Members
- BSI Allocation Model
- BSI Budget Allocation Graph
- Cores Data

NEW BICC MEMBERS

The Biosciences Initiative Coordinating Committee's (BICC) mission is to strengthen research and education in the biosciences across the university through strategic leadership, coordination and alignment across the campus. Sponsored by the president and provost, the committee makes recommendations to the president and the provost for strategic alignment of practices, policies and investments in the biosciences. The BICC, chaired by Dr. Roger Cone, will welcome many new members beginning July 2021.

LIZ BARRY
Liaison to the President; Special Counsel to the President

SALLY CAMPER
Professor of Human Genetics and Internal Medicine, Medical School

ARUL CHINNAIYAN
Professor of Pathology Urology, Medical School

AIMEE CLASSEN
Professor of Ecology and Evolutionary Biology and Director, Biological Station, College of Literature, Science, and the Arts

ROGER CONE
Chair; Vice Provost and Director of the Biosciences Initiative; Asa Gray Collegiate Professor of the Life Sciences; Mary Sue Coleman Director of the Life Sciences Institute; Research Professor, Life Sciences Institute; Professor of Molecular and Integrative Physiology, Medical School

LOLA ENIOLA-ADEFESO
Professor and Vice Chair for Graduate Studies in Chemical Engineering; Professor of Biomedical Engineering; Professor of Macromolecular Science and Engineering; Director of the Cell Adhesion and Drug Delivery Lab; Associate Director for the NIH Cellular Biotechnology Training Grant; Senior Fellow, Society of Fellows, College of Engineering

DANIEL FORGER
Professor of Mathematics, College of Literature, Science, and the Arts; Research Professor, Computational Medicine and Bioinformatics, Medical School

BETSY FOXMAN
Professor of Epidemiology, School of Public Health

TRACHETTE JACKSON
Professor of Mathematics, College of Literature, Science, and the Arts

STEVE KUNKEL
Acting Chief Scientific Officer, Michigan Medicine; Senior Associate Dean for Research, Endowed Professor of Pathology Research, Department of Pathology, Medical School

YUJI MISHINA
Professor of Dentistry, School of Dentistry

JAMES MOON
Associate Professor of Pharmaceutical Sciences, College of Pharmacy; Associate Professor of Biomedical Engineering, College of Engineering

PAVAN REDDY
Professor of Hematology/Oncology, Pediatrics and Internal Medicine, Medical School

SRIJAN SEN
Frances and Kenneth Eisenberg Professor of Depression and Neurosciences, Associate Professor of Psychiatry, Research Associate Professor, Molecular and Behavioral Neuroscience Institute; Associate Vice President for Research in Health Sciences, Medical School

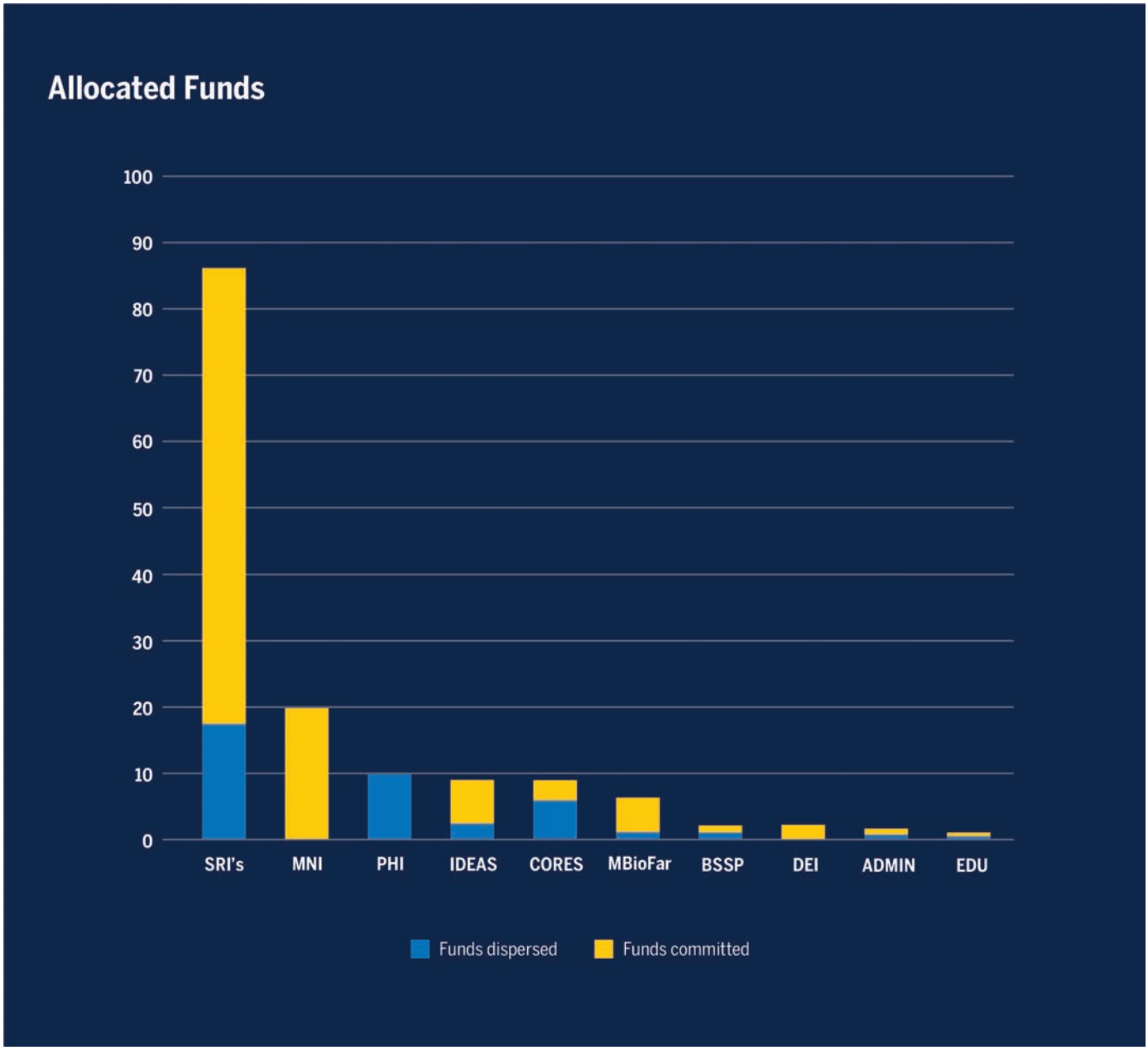
JANET SMITH
Associate Director, Professor and Center for Structural Biology Director, Life Sciences Institute; Margaret J Hunter Collegiate Professor in the Life Sciences; Professor of Biological Chemistry, Medical School; Professor of Biophysics, College of Literature, Science, and the Arts

CRISTEN WILLER
Professor of Cardiovascular Medicine, Internal Medicine, Human Genetics, and Computational Medicine and Bioinformatics, Medical School

BSI ALLOCATION MODEL

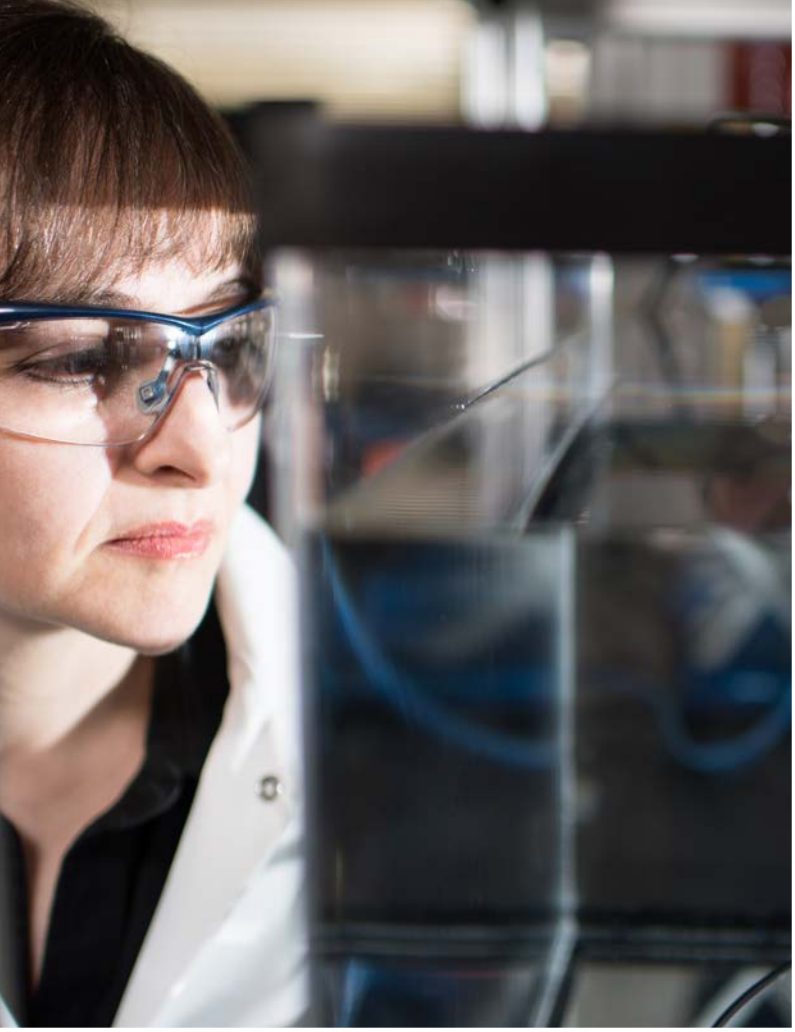
Category	Category Budgets	Allocated	Remaining
Administration	**1,885,359**	**1,885,359**	**0**
Scientific Initiatives	**85,711,609**	**85,711,609**	**0**
Michigan Concussion Center		5,163,408	
Center for RNA Biomedicine		10,200,000	
Natural Products Discovery Core		7,549,402	
Cryo-Electron Microscopy		16,054,179	
Institute for Global Change Biology		9,200,000	
BioInnovations in Brain Cancer		9,915,533	
Cell Programmable Biomaterials		7,576,170	
Spatial Cell Analysis		7,052,917	
Michigan Center for Infectious Diseases		13,000,000	
Precision Health	**10,000,000**	**10,000,000**	**0**
Biological Sciences Scholars Program	**3,000,000**	**1,325,011**	**1,674,989**
Scientific Core Resources	**9,000,000**	**5,690,524**	**3,309,476**
Educational Programs	**1,003,500**	**535,502**	**467,998**
Michigan Biological Faculty Awards Recognition	**7,399,532**	**1,500,000**	**5,899,532**
Ideas Lab	**9,000,000**	**3,045,385**	**5,954,615**
Michigan Neuroscience Institute	**20,000,000**	**20,000,000**	**0**
Diversity Equity and Inclusion Initiative	**3,000,000**	**3,000,000**	**0**
TOTALS	**150,000,000**	**132,693,390**	**17,306,610**

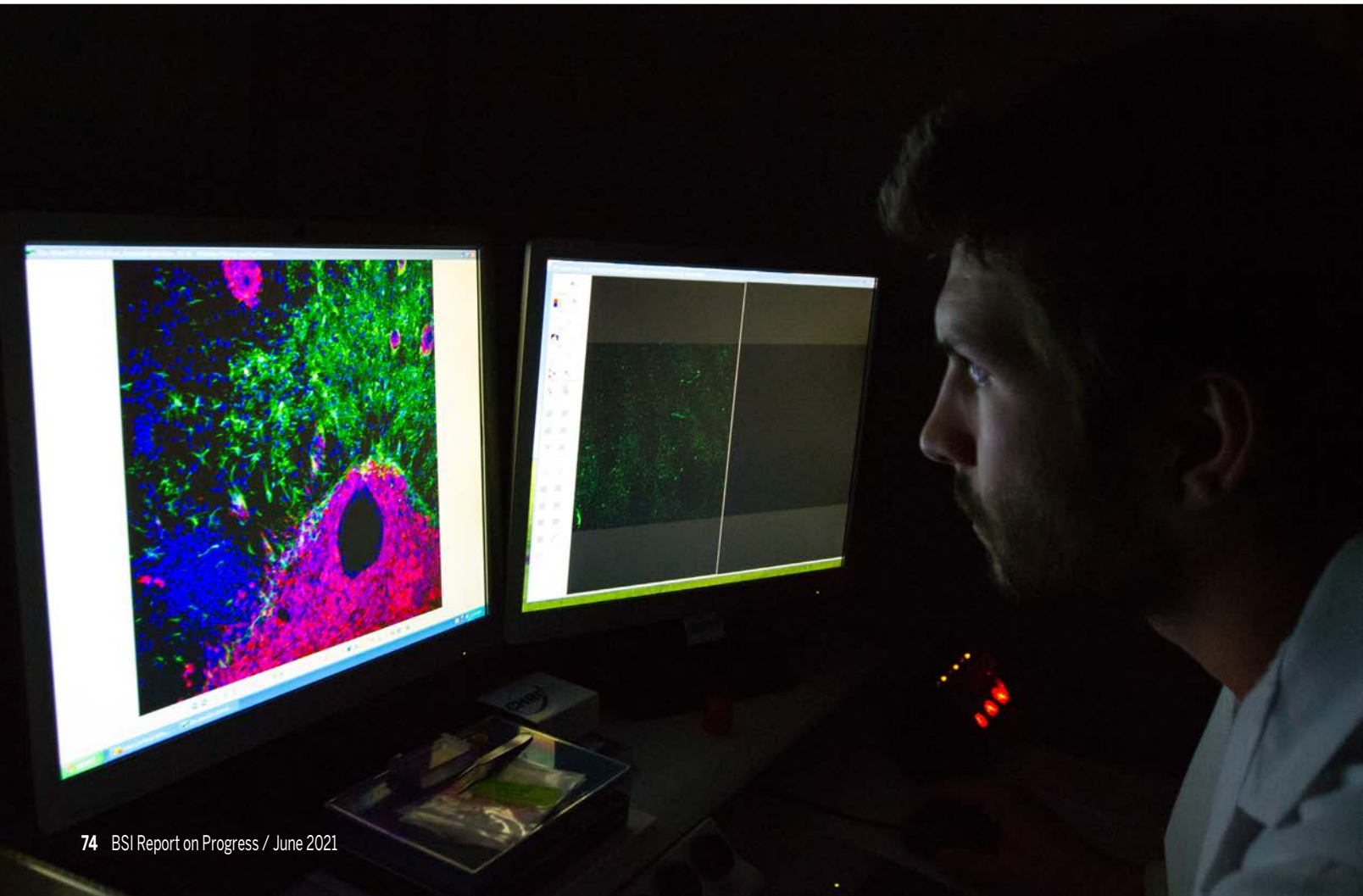
BSI BUDGET ALLOCATION GRAPH

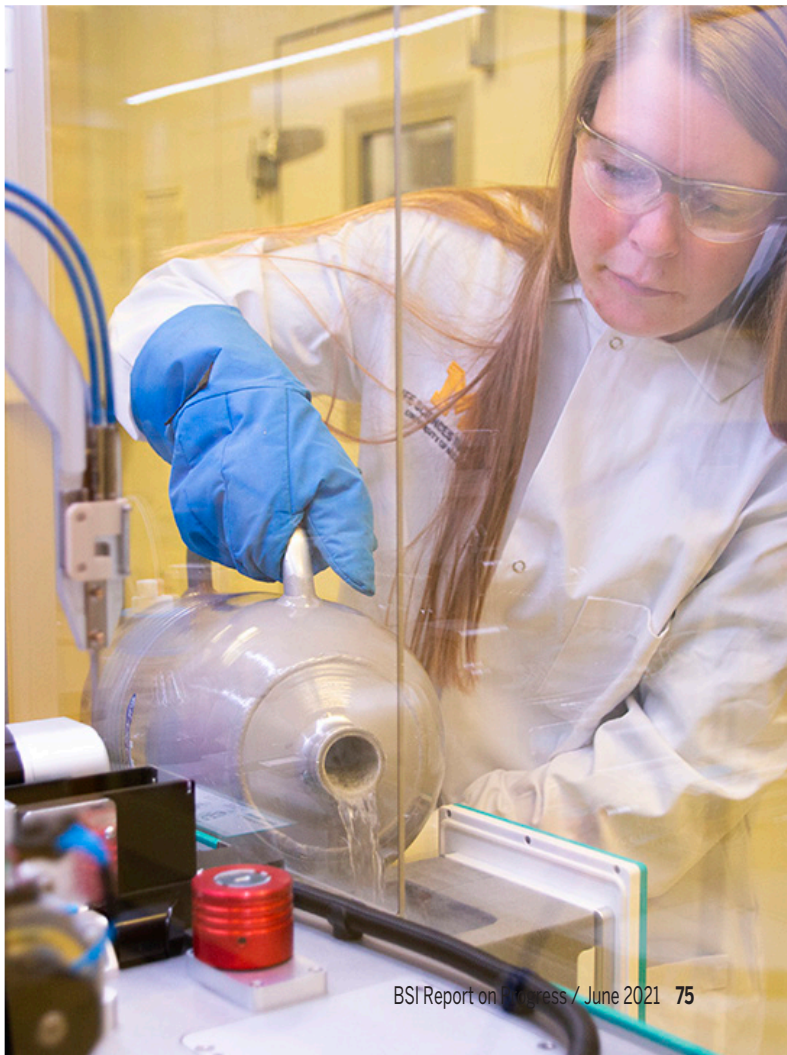


CORES DATA

Core Name	New Instrument Installation	Use of Michigan Cores Research Website	Use of MiCores	Recharge Rate Status	Advisory Committee Operational	Comments
Mass Spec	Pending	No	No	No	No	Fall 2021
BioNMR	Complete	Yes	Yes	Approved	Yes	
Cryo-EM	Complete	Yes	Yes	Approved	Yes	
CCG	Complete	Yes	Yes	Approved	Yes	
NPDC	Complete	Yes	Yes	Approved	Yes	
SMART	N/A	Yes	Pending June 2021	Approved	Yes	
Bru-Seq	Complete	Yes	Pending June 2021	Approved	No	
Light Sheet	Complete	Yes	Yes	Approved	Yes	







University of Michigan
Biosciences Initiative
Mary Sue Coleman Hall
210 Washtenaw Avenue
Ann Arbor, MI 48109-2216

BIOSCIENCES
UNIVERSITY OF MICHIGAN