MSU INNOVATION CENTER

2023 Annual Report

DEAR FRIENDS AND PARTNERS OF THE MSU INNOVATION CENTER,

Welcome to our Annual Report for the 2023 fiscal year. In preparing this letter, I was struck by the diversity of innovations you will find in its pages. This of course, reflects the diversity of research at Michigan State University (MSU) that covers every major area of inquiry in the 21st century, from the subatomic to the astrophysical, and from the study of the human condition in social sciences and liberal arts to the STEM sciences of medicine, biological & physical sciences, and engineering. At the Innovation Center, we engage with faculty from across this staggering array of research disciplines to help them translate their innovations into practice in a way that directly impacts the world; it is both a pleasure and a challenge.

In this annual report you will find stories ranging from corporate-engaged research into novel interventions in Parkinson's Disease, to middle school mathematics curriculum, to Brand and Experience design, to a company developing cures for Tuberculosis and other mycobacterial infections. At our 2023 Innovation Celebration, we honored faculty working in computer-aided biometrics for identity security; dairy nutrition and sustainable agriculture; advanced imaging to visualize living systems at near-atomic resolutions; and water treatment systems to remove PFAS from the environment. We also recognized startup companies coming from MSU at very different scales; a student startup developing an app that helps you hire help around your home; and a biomedical company that has raised over $50MM in funding and in the process of filing for its first-in-human trial.

We are particularly happy to share the news of national recognition for MSU faculty whose work was supported by the MSU Innovation Center.

Professor Andre S. Bachmann, MSU Professor of Pediatrics and Human Development, Dr. Caleb P. Bupp, and Dr. Surender Rajasekaran, MSU Clinical Professors and practicing physicians at Corewell Health, were recognized with the Inventor of the Year Award by the New York Intellectual Property Law Association (NYIPLA), recognizing them "for their methods and compositions to prevent and treat disorders associated with mutations in the ODC1 gene. U.S. Patent No. 11,273,137 B2". The award was certainly well-deserved, since the work behind this award included the definition of the molecular basis of a neurodevelopmental disorder, now referred to as Bachmann-Bupp Syndrome, and the first FDA-approved single-patient Investigational New Drug (IND) to treat the disorder in a pediatric patient, reporting a remarkable therapeutic response.

Muhammad Rabnawaz, Associate Professor in the School of Packaging, was inducted as a Senior Member in the National Academy of Inventors (NAI). From the NAI: "The NAI was founded to recognize and encourage inventors with U.S. patents, enhance the visibility of academic technology and innovation, encourage the disclosure of intellectual property, educate and mentor innovative students, and to create wider public understanding of how its members' inventions benefit society." Muhammad joins an elite club of 11 MSU faculty members who have been honored by the NAI as either Fellows or Senior Members. This honor was well-earned, with a long track record of innovation, patenting, engagement with corporations to translate his innovations to practice, and as a founder in a startup company (SCOPS Coating Technologies).

Lastly—just a moment to recognize and thank the more than 40 people who work across the Innovation Center ecosystem to make this all happen. It takes an energetic and flexible team of people to address the innovation needs of our wildly diverse MSU faculty. The Innovation Center team is outstanding, and up to the task. Thank you to both the team and the faculty we serve. Together we're improving the Michigan economy and having a global impact with our research and innovations in the marketplace.

CHARLES A. HASEMANN, PHD

Associate VP for Innovation & Economic Development

CLOSING IN ON A CURE

Unlocking New Avenues in Parkinson's Disease Treatment

MICHIGAN STATE UNIVERSITY AND TAKEDA'S RESEARCH PARTNERSHIP IS A PATH TO POSSIBLE NEW THERAPEUTICS FOR PARKINSON'S DISEASE

"One of the biggest risk factors is aging, and right now in the U.S. there are a lot of people born in the baby boom years of the 1940s-1960s who are reaching the age of 65. The occurrence of Parkinson's in that age group is expected to double over the next 15 to 20 years. We're at a critical point for finding new therapies."

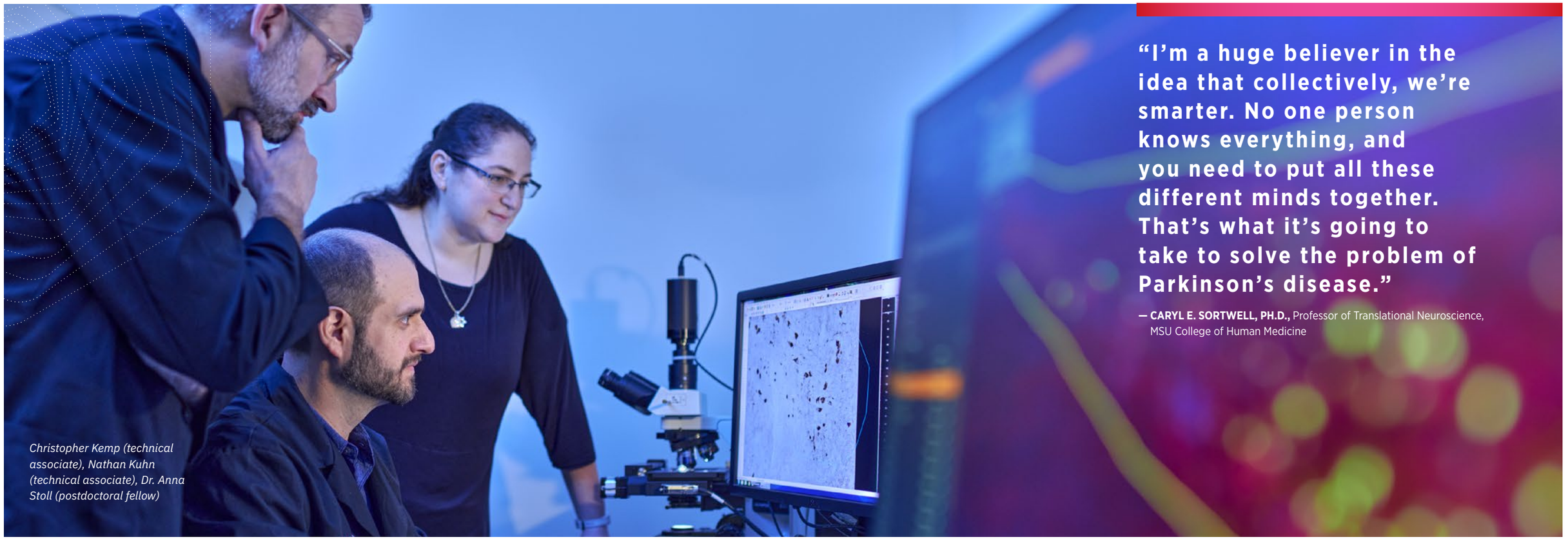
—**CARYL E. SORTWELL, PH.D.,** Professor of Translational Neuroscience, MSU College of Human Medicine

"As a Parkinson's disease neurobiologist, I am trying to uncover causes of Parkinson's as well as potential treatments to slow or halt the disease," says Caryl E. Sortwell, Ph.D., Professor of Translational Neuroscience, Department of Translational Neuroscience, in the Michigan State University (MSU) College of Human Medicine. She also studies ways to optimize the efficacy of therapies that that are currently available to treat the symptoms of the disease.

Dr. Sortwell and her team of MSU Translational Neuroscience investigators, Joseph Patterson, Matthew Benskey, Anna Stoll, Christopher Kemp, and Nathan Kuhn are doing this research under a collaborative sponsored research agreement between MSU and global industry partner Takeda Pharmaceuticals.

Dr. Caryl Sortwell (PI), Nathan Kuhn (technical associate), Christopher Kemp (technical associate), Dr. Anna Stoll (postdoctoral fellow), Dr. Matthew Benskey (co-investigator), Dr. Joseph Patterson (co-investigator).

Sortwell has studied Parkinson's disease (PD) since finishing her graduate studies in 1994. Her research had been in using a transplantation, or neural grafting, approach to treat major depressive disorders. At the time there also was interest in using transplantation for PD treatments, and she found herself migrating toward Parkinson's research. "I became very enmeshed in understanding that, even though it's terrible that Parkinson's is so complicated, it's also fascinating that it's so complicated. It stuck with me."



Christopher Kemp (technical associate), Nathan Kuhn (technical associate), Dr. Anna Stoll (postdoctoral fellow)

“I’m a huge believer in the idea that collectively, we’re smarter. No one person knows everything, and you need to put all these different minds together. That’s what it’s going to take to solve the problem of Parkinson’s disease.”

— CARYL E. SORTWELL, PH.D., Professor of Translational Neuroscience, MSU College of Human Medicine

According to the World Health Organization, in 2019 there were more than 8.5 million patients worldwide with Parkinson’s disease. The National Institutes of Health (NIH) estimate that Parkinson’s disease affects one to two per 1000 of the population at any time. The incidence of Parkinson’s increases with age; data show that it affects 1% of the population older than 60.

“It’s a worldwide disease,” says Sortwell. “One of the biggest risk factors is aging, and right now in the U.S. there are a lot of people born in the baby boom years of the 1940s-1960s who are reaching the age of 65. The occurrence of Parkinson’s in that age group is expected to double over the next 15 to 20 years. We’re at a critical point for finding new therapies. “

A partnership is formed

Sortwell’s research partner at Takeda Pharmaceuticals is Marianthi Papakosta, Ph.D., Associate Director in the Neurodegeneration unit within the Department of Neuroscience, with 20-plus years in the pharmaceutical industry working on targets for neurological diseases. In recent years, she has specialized in the areas of Parkinson’s disease, Alzheimer’s disease, and other neurodegenerative diseases that afflict people around the world. Papakosta is currently Global Project Leader pursuing a novel target for neurodegeneration at Takeda and also wished to acknowledge the work of Paul Rolzin, Nicola Broadbent, Ph.D., and Toni Wolinsky, Ph.D., fellow colleagues at Takeda in relation to this particular partnership with Sortwell’s group. While there already are a number of drugs on the market that are used for relieving symptoms for neurodegenerative diseases, pharmaceutical companies like Takeda are interested in disease-modifying therapies that go beyond symptomatic relief.

The partnership between the two women started in 2021 when through their mutual association with the Michael J. Fox Foundation for Parkinson’s Research, Sortwell and her work were recommended to Takeda. Sortwell is one of the Fox foundation’s advisors and has worked with them for a number of years. “I have a particular niche expertise, which is something that Takeda was looking for,” she says.

Papakosta expands on that: “Caryl is an expert in the preclinical models for Parkinson’s disease. She has a deep knowledge of that, and of course, of the disease. So, we were very happy to be connected with her.”

She continues: “When you are aiming at a particular disease, one of the critical tasks is to ascertain what preclinical animal models we can use to test our compounds to give us the greatest confidence that our efficacy will translate to the clinic. As part of this process, it is necessary to establish that the pathways that our compounds interact with are involved in the disease processes that are characteristic of the preclinical model.”

“As such the goal of this collaboration is to apply and use the very well characterized preclinical models that Caryl is working on in her lab to test our compounds.”

“From my point of view,” says Sortwell, “it’s exciting because we’ve spent many years trying to optimize these preclinical platforms to get them to a point where they could be leveraged to test novel drugs to see if they’re going to be beneficial for people with Parkinson’s.

“So, it was a really good timing that Takeda was looking for some of these preclinical platforms at a time when we were able to share a lot of information with them and they were able to help us optimize and design the experiments that they needed to test their drugs.”

“I’m a huge believer in the idea that collectively, we’re smarter. No one person knows everything, and you need to put all these different minds together. That’s what it’s going to take to solve the problem of Parkinson’s disease.”

Putting those minds together was the impetus for implementing a sponsored research agreement between Takeda and MSU.

Dr. Joseph Patterson (co-investigator).

Putting a research agreement in place

Jeff Myers is Director of Corporate Partnerships for MSU Business Connect, the arm of the MSU Innovation Center that handles negotiation and closing of the contractual agreements that underlie collaborations between the university and industry.

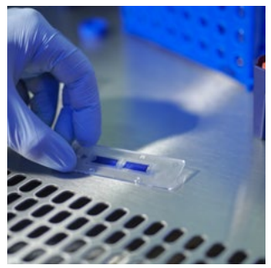
Myers facilitated the agreement inked between Takeda and MSU. “When a researcher has done all the early-stage work using initial funding sources, such as NIH grants, that’s when it is time to get industry involved,” he says. “Especially as a researcher moves closer to a potential treatment that industry might be interested in adopting, partnering with a pharmaceutical company for funding support has benefits for both parties.”

Business Connect is the conduit for such connections, according to Executive Director Nick Miller. “We engage faculty very early in the collaboration process, helping them seek and acquire funding from industrial partners. We act as a contractual business partner and facilitator of the collaboration for all faculty working on industry-sponsored research.”

Myers adds, “Dr. Sortwell has been well funded by the NIH and a few other sponsors and was in a position to do later stage research, which would be logically supported by a company in the industry, to attempt to get closer to something that could be a therapy.”

Myers notes that success is always a long shot in the pharmaceutical business. “Companies don’t allocate funds like this to projects that they don’t think are going to succeed,” he says.

Dr. Matthew Benskey (co-investigator)



A benefit for the corporate partner in a sponsored agreement can be exposure to diverse talent and expertise in the university system. “Any company who’s working with us in sponsored research or in any other capacity, ultimately benefits greatly from engaging with not only faculty, but with the graduate students, and sometimes even undergraduate students involved,” says Miller.

“One reason why we like industrially sponsored research, is that it contributes to the university having an impact,” he says. “It helps us support our overall research mission. And along with that, it supports graduate student training and education.”

Collaboration fuels reputation, excellence

“MSU has an excellent reputation,” says Myers. “We have an outstanding group of faculty members studying neurodegenerative diseases. Parkinson’s and Alzheimer’s are the primary targets of our research from that group. Dr. Sortwell has a terrific reputation for what her lab does. It’s a very active program.”

Papakosta agrees: “MSU has the capabilities, the principal investigator’s (PI) the appropriate labs, and the ability to help Takeda answer biological questions that we’re interested in. It’s of great benefit for us to collaborate with extremely smart and capable PIs to be able to test our hypotheses, to see if we can find the right compound that we can progress into the clinic.”

“For us, it’s extremely important to find the right partner, because it is one thing to have the scientific knowledge and the systems that MSU has, but we also need people that we can collaborate with. The advice and information that we get from such partnerships is priceless,” says Myers.

According to Myers, results from the collaboration have been promising and Takeda has already reached the decision to expand the work and provide additional funds.

Success is all about collaboration for Caryl Sortwell, too. “No one person can know or do everything,” she reiterates. “If we are successful, Marianthi’s team at Takeda will move this forward and hopefully it’ll get to the clinic and help patients. Our MSU team would be thrilled to be a part of the successful development of a therapy that can slow disease progression.”

“I like to use the analogy of a relay race. The team are trying to get to the end point as quickly as possible, but each leg of that race requires a particular skill or expertise, and people are passing the baton to the next expert. My academic research casts a wide net to explore potential therapies, but Takeda’s focus on specific molecular cascades and expertise in drug development has the potential to get us over the finish line as quickly as possible. This will allow us to cross that valley between research and the creation of an effective treatment for people with Parkinson’s or other neurological diseases.”

“For us, it’s extremely important to find the right partner, because it is one thing to have the scientific knowledge and the systems that MSU has, but we also need people that we can collaborate with. The advice and information that we get from such partnerships is priceless.”

—JEFF MYERS, Director of Corporate Partnerships for MSU Business Connect

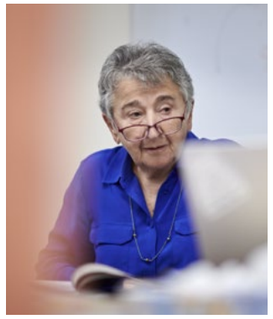
MAKING MATH MORE ACCESSIBLE

Connected Mathematics Finds Synergy in New Lab-Aids Partnership

MICHIGAN STATE UNIVERSITY AND LAB-AIDS REACH EXCLUSIVE DEAL TO PUBLISH FOURTH GENERATION OF THE CONNECTED MATH PROJECT

The Connected Mathematics Project (CMP) is set to begin an exciting new chapter in its transformative history, now that Michigan State University (MSU) and Lab-Aids have formed an exclusive partnership to publish the fourth edition of its curriculum, Connected Mathematics4 (CMP4), a complete middle school mathematics curriculum.

Developed at MSU with support from the National Science Foundation, the award-winning CMP curriculum is widely used in middle school classrooms across the United States and several different countries. Based in Ronkonkoma, New York, a suburb of New York City, Lab-Aids develops, manufactures, and publishes curriculum and supplementary programs that help students better understand science concepts through direct experience.



"A problem-centered curriculum not only helps students to make sense of the mathematics, it also helps them to process the mathematics in a retrievable way. Learning is enhanced if it is connected to prior knowledge and more likely to be retained and applied to future learning."

—**ELIZABETH DIFANIS PHILLIPS,** CMP author and Senior Academic Specialist in the Program in Mathematics Education

"We're opposed to the 'stand and deliver' method," said Jonathan Atkins, President of Lab-Aids. "We don't believe math or science, or quite frankly, many subjects, should be taught that way. When the teacher just dictates, and the students just take notes, and a student goes back and regurgitates it, there is no true learning or understanding. Students must have relevancy. They've got to see how math can be used in the real world to solve problems. This guiding principle is what can help motivate them to become effectual, productive citizens in whatever endeavors they pursue in the workplace."

"There's a reason there are science labs in schools," he added. "Science is hands-on. But to apply that philosophy to math and really create hands-on math instructional curriculum, guidelines, and ways to teach, is quite unique. So that's what was most appealing to us about CMP4."

The fundamental design principles of the CMP reflect the authors' core beliefs and research about effective teaching and learning of mathematics. Connected Mathematics is a contextualized, problem-based middle grades mathematics curriculum. As articulated by the authors, "Students can make more sense of

mathematics if the concepts and skills are embedded within a contextual problem. If time is spent exploring the challenge and the embedded mathematics in the problem, reflecting on solution strategies, examining why they work, comparing strategies, and relating them to those used in previous situations, then students are likely to build more robust understandings of mathematical concepts and related procedures."

Elizabeth Difanis Phillips, CMP author and Senior Academic Specialist in the Program in Mathematics Education and co-author Glenda Lappan, MSU Emerita University Distinguished Professor assert that "A problem-centered curriculum not only helps students to make sense of the mathematics, it also helps them to process the mathematics in a retrievable way. Learning is enhanced if it is connected to prior knowledge and more likely to be retained and applied to future learning."

"We think there's only a handful of big ideas in math that are important to learn in middle school," Difanis Phillips explained. "We identified these ideas. We unpacked the understanding and then repackaged these understandings as sequences or conjectural problems. CMP4 is not just about getting it right. It reflects the way you learn. You have a problem. You have to figure out how to solve that problem. Then you have to explain what you learned in the process. Students have to identify three things in their summary: What strategies did you use? What was the embedded mathematics you used today? How does that connect to what you learned yesterday?"

Difanis Phillips points out that CMP4 is the most researched mathematics curriculum in the history of mathematics education with over 500 research articles and 70 doctoral dissertations. She says CMP found a partner, not merely a publisher, with Lab-Aids, since their shared approach to problem-solving gives them the impetus to continually exchange ideas with each other.

What both sides bring to the negotiating table

According to Anne Di Sante, Executive Director of MSU Technologies (MSUT), what MSU brings to the table in reaching successful licensing agreements is the ability to act as a catalyst to successfully transfer technology from academia to the marketplace.

"We help catalyze and move these technologies out of the university into the hands of an entity that can invest resources and turn whatever we have into a product," said Di Sante. "Most of the technology that the university has is at an early stage. CMP4 is actually quite advanced compared to most of the technologies that we deal with. But even with CMP4, it requires an investment of resources to get it to be product-ready, and that's what these partners, our licensees, do."

CMP was originally marketed and published through Pearson Education, who handled earlier generations of the product until Pearson was acquired by another K-12 learning company. When the new company opted to move forward with an internal product offering, MSUT reached out to potential publishers who were either in the math or science space to see if there was any interest in incorporating CMP4 into their product line.

Mr. Atkins says Lab-Aids brings 60 years of experience in hands-on, evidence-based science programs to the partnership, as well as a customer base that stretches across the globe.

"We've seen tons of companies be absorbed who don't have the benefits of being the boutique size we are with our experience and customer base," Mr. Atkins said. "Tens of thousands of customers who know and trust us in science. And vice versa. There are many educators who know and trust CMP, and the fact they're working with us is probably going to make them take a closer look at our science products. We both come to the table with some unique synergy to help each other out, to be 'ying' to each other's 'yang', if you will."

"We help catalyze and move these technologies out of the university into the hands of an entity that can invest resources and turn whatever we have into a product."

— ANNE DI SANTE, Executive Director of MSU Technologies

The Lab-Aids publishing staff and Connected Mathematics Project staff partner at Wells Hall on the Campus of MSU to publish ConnectedMathematics4. ***Front row*** *(left to right): Elizabeth "Billie" Lozen, Lisa Kelp, Elizabeth "Betty" Difanis Phillips, and Sunyoung Park.* ***Back Row*** *(left to right): Kathy Dole, Ahmad Kohar, Taren Going, Denise Botelho (via Zoom), Yvonne Slanger-Grant, and Alden "A.J." Edson*

Brian Copple, MSUT Technology Manager for the CMP deal, agrees. He says the philosophical alignment between CMP and Lab-Aids proved to be key in bringing the two sides together.

"The best fit we found was with Lab-Aids, who was entrenched in curriculum for middle school science and was interested in expanding into the math space," he said. "With CMP4, we did a lot of work looking at a number of different pathways, including the traditional publishing route and also creating a startup company to commercialize it. Principal investigators (PI) typically are good at the research, publishing articles and optimizing the curriculum. But the business end of things is usually not their strength, which is understandable. So that's where we come in to fill the gap—to find the optimal commercial partner."

MSUT was also able to get trademark protections on some specific pedagogies associated with CMP. One is the "Arc of Learning" framework, which describes how learning develops over time through a unit when the mathematics are embedded in a problem.

From product development to product launch

Lab-Aids will publish both print and electronic versions of CMP4 in August of 2024. The company is ramping up product development, hiring and building teams to get the CMP4 platform up and running smoothly. Feedback about CMP4's many new features has been extremely positive from the more than 500 teachers involved in the three-year field test.

Mr. Atkins says he and the rest of the Lab-Aids team are excited to launch CMP4 and how much they appreciate the enthusiasm and engagement level of the CMP4 authors. While there can often be a dichotomy between academia and business in licensing negotiations, Mr. Atkins describes the experience of working with MSUT on the contract as "outstanding."

"We've been working with university systems as author groups for decades," Mr. Atkins said. "I have not had a university group so in tune with the business side of tech transfer. MSU Technologies just gets it. It was very refreshing to work with an organization that understood, from our perspective, the things we needed to get our part of the job done."

FROM LAB TO MARKETPLACE

MSU Startup Tarn Biosciences Takes Aim at TB

NEW THERAPEUTICS REPRESENT IMPORTANT NEW BREAKTHROUGH TO TREAT DRUG-SUSCEPTIBLE AND DRUG-RESISTANT STRAINS OF TB AND CHANGE PEOPLE'S LIVES.

"Dr. Abramovitch's passion is not only to do tuberculosis research, but to drive that forward, to be a cause of change in the world," says Frank Urban, Director of Venture Creation for Life Sciences at the Michigan State University (MSU) Research Foundation's venture studio, Spartan Innovations.

Urban is speaking of Dr. Rob Abramovitch, Associate Professor, MSU College of Veterinary Medicine, and researcher into new therapeutics for treating mycobacterial infections. Abramovitch's newly formed MSU startup, Tarn Biosciences, based in East Lansing, Mich., is developing therapies for tuberculosis (TB), nontuberculous mycobacterium (NTM) and other mycobacterial infections.

According to the Centers for Disease Control, TB is the greatest killer from infectious disease in the world, causing approximately 1.5 million deaths per year.

"Current antibiotic treatments work slowly, with treatment times lasting at least 6 months, with no guarantee of cure, and with harsh drug side effects," says Dr. Abramovitch. "If the TB is drug resistant, it can take more than two years to treat, with worse side effects. TB has a 40 percent mortality rate, even with treatment." Because of these long treatment timelines patient adherence to therapy is often quite low, contributing to the high mortality and morbidity of the disease.

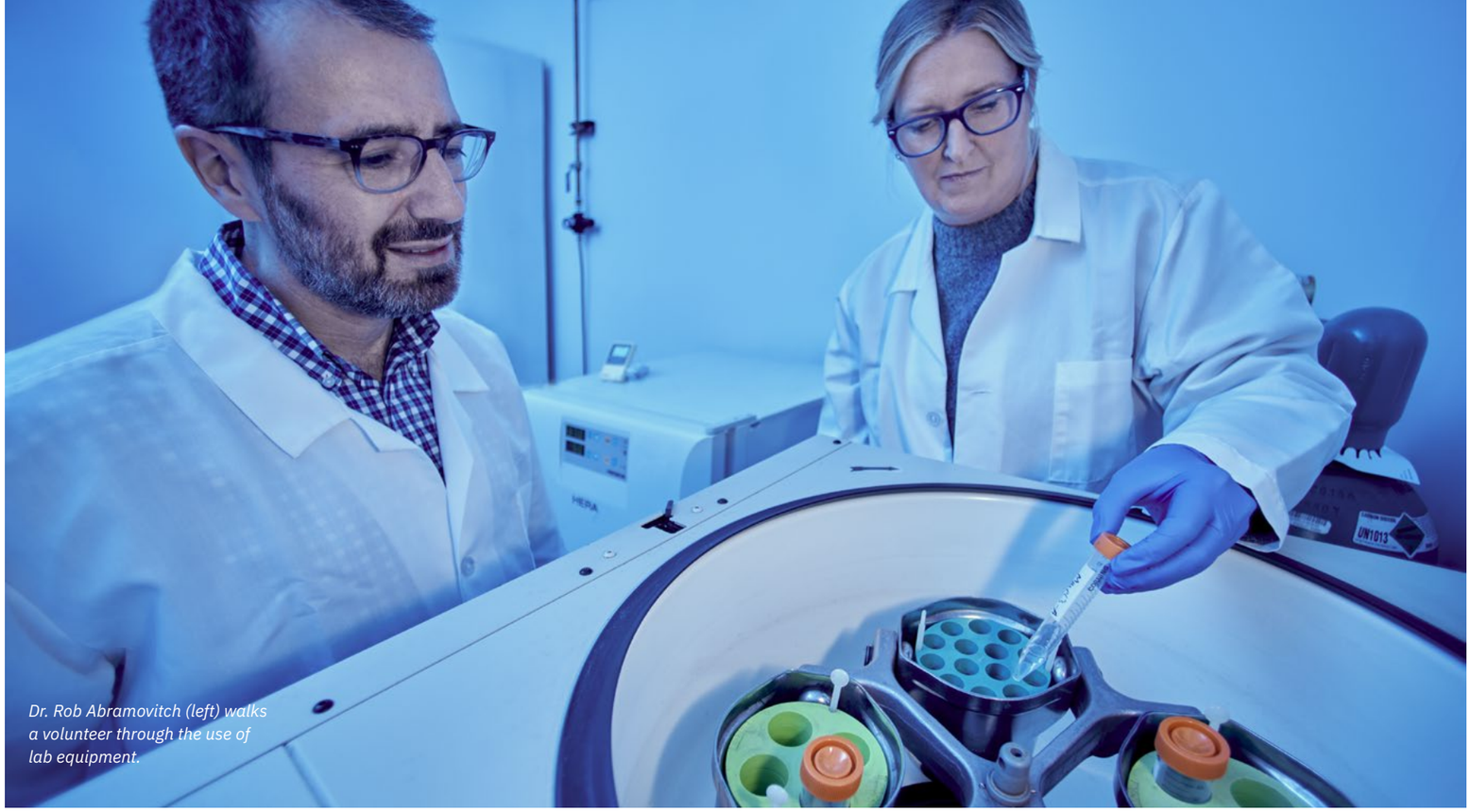
Transferring the technology

Abramovitch's research began more than ten years ago with attempts to identify therapeutic targets for intervention in TB. "We screened through about a million compounds for agents that modulate mycobacterium tuberculosis biology, and got some interesting lead compounds," he said.

MSU's goal is to move technologies from the lab to the marketplace. Anupam Jhingran, Technology Manager with MSU Technologies (MSUT), explains: "My role is to assist our faculty inventors in securing appropriate funds to develop the technology and to file patents to secure the intellectual property rights around the technology." In August of 2022, to bolster the commercial potential of the technology, the Abramovitch lab was awarded an ADVANCE grant which supported chemistry and in-vivo validation studies. "We are grateful to have access to programs such as ADVANCE which has supported several of our promising projects. ADVANCE is co-funded by the Michigan Strategic fund and administered by the Michigan Economic Development Corporation" says Jhingran. Jhingran also facilitated signing of the June 2023 option agreement between Tarn Biosciences and the University which grants Tarn Biosciences a limited license to MSU's intellectual property for further development, and the first right to negotiate an exclusive license for future commercialization.

Tarn was formed out of the collaboration between Abramovitch, MSUT and Spartan Innovations. In the spring of 2021, Spartan Innovations brought medicinal chemist, Dr. Edmund Ellsworth, and Entrepreneur-In-Residence Jim Vrbanac, Ph.D., to the project.

"The idea was to take the research and find a way to commercialize our discoveries," says Abramovitch. "To do that, we needed to do a lot more chemistry and commercial development. So, we brought Edmund on, who's been a core member of our team, who provides leadership and knowledge about medicinal chemistry, pharmacokinetics, and drug development." Vrbanac and Ellsworth became equity owners of Tarn with Abramovitch in September 2022. Vrbanac now fills the role of Tarn's CEO'.



Dr. Rob Abramovitch (left) walks a volunteer through the use of lab equipment.

"I really feel now that I'm at Tarn, we can make solutions; we can help solve this problem. That's what motivates me every day."

—DR. ROB ABRAMOVITCH,
Associate Professor,
MSU College of Veterinary Medicine

The journey through drug discovery

Dr. Edmund Ellsworth, Professor, MSU Department of Pharmacology and Toxicology has more than 30 years of experience as a synthetic, organometallic, and medicinal chemist supporting translation from early drug discovery to development. With many years of corporate experience behind him, he is a scientist and a recognized leader in the drug development process with a clear understanding of the steps and practices involved in transforming an early chemical lead into a viable drug candidate. "Drug discovery is a long journey that can take years," says Dr. Ellsworth. "It typically starts out in a lab, where molecular targets are identified then further explored as therapeutic targets for intervention in one disease or another. At Tarn, we have landed on two therapeutic focuses: one is TB, which has a global impact. The other is NTM, or non-tuberculous mycobacterium infection, which is an emerging disease in the U.S., Japan and parts of Europe."

Abramovitch explains: "NTM infections tend to appear in immunocompromised patients and the prevalence and incidence has consistently increased at approximately 8% a year in affected areas." In the U.S. prevalence of NTM infections is growing mostly in the south and along the coasts. Some strains, because of antibiotic resistance, are almost incurable. Based on this growth there is a serious need for new therapeutics.

The MSU scientists have worked on two targets that Tarn is moving towards investigational new drug studies (IND). For both, Tarn expects them to be effective for the treatment of TB and NTM infections alike.

"These drugs will represent important new therapies to treat drug-susceptible and drug-resistant strains of TB," says Abramovitch. "We expect a result to be shorter drug treatment regimens."

Funding enables more development

Tarn's initial funding came through the MSU Research Foundation's venture investment arm, Red Cedar Ventures. A total of $30,000 has been invested in the company to date.

In September of this year, Tarn was awarded a Small Business Technology Transfer (STTR) grant from the National Institutes of Health (NIH). The STTR, in addition to $25,000 from the Michigan Emerging Technologies Fund (ETF) position Tarn to further de-risk the technology with non-dilutive capital that could attract venture capital or strategic investors.

While the long development process continues, Dr. Vrbanac is overseeing the business aspects of the company. "Right now, I'm helping with managing the grant and setting up the company policies and procedures with respect to finance, investment, which include financial and employment," Vrbanac says. "I'll be responsible for getting the money from the government and moving it to contract labs, followed by reviewing data and writing Tarn's research reports for subsequent regulatory submissions. Presently, we have four different contract labs we're going to use, plus the contracted labs at MSU."

"Until this STTR came through, all of the financial support was coming through Red Cedar Ventures. Now we have independent support for the company through the NIH," he says.

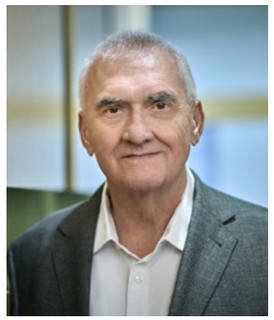
Phase two funding, which also will come through NIH, is expected to more than double the previous funding. Notes Urban: "Transition to that kind of funding will be the next level and put them in a really strong position to do an investment, probably near the end of a Phase II STTR."

"One of my most important jobs right now is investor relations," says Vrbanac. "I'll do a lot of presenting to potential investors now, so that down the road, when we have some really great data for one of our compounds, I'll already have a ready list of interested investors to go to for next-phase funding. Having more than one party interested in your Intellectual Property (IP) certainly does increase the value of the IP."

Building strong drug discovery facilities

According to Abramovitch, MSU has made a concerted effort over the past 10 years to build the capacity to do early drug discovery development.

"When I started here in 2013, MSU didn't have as robust a drug development capacity as we do now. Then they began an effort to build a drug discovery core. They built screening facilities; they hired an administrator to build and provide medicinal chemistry capabilities at MSU, and along with the Core In Vivo Facility, which does pharmacokinetics, they've built the capacity to do drug discovery and drug development in the academic environment," says Abramovitch, adding, "They've built an infrastructure to provide seed money to launch the research. That allows scientists with key early data and IP to seek other grants to drive the research forward, and then hopefully discover something that could move ahead to continued preclinical development."



"Until this STTR came through, all of the financial support was coming through Red Cedar Ventures. Now we have independent support for the company through the NIH."

—JIM VRBANAC, PH.D.,
CEO, Tarn Biosciences

"Molecular Discovery Grants (MDG) are a key early resource to support Drug Discovery at MSU" says Charles Hasemann, Associate VP for Innovation and Economic Development at MSU. "These grants are made possible by funds coming from the MSU Innovation Center and colleges whose faculty engage in drug discovery projects. These grants target the earliest stages of drug discovery projects at MSU, and get faculty engaged with the drug discovery support mechanisms that MSU has built in the past decade. MDG funding helped Abramovitch develop the earliest leads that eventually built confidence to launch Tarn."

From lab to startup

"Many of the faculty have gone through this process here at MSU and started their own companies. The faculty member becomes more of an expert with the know-how to advance therapeutics towards the clinic and hopefully the market," Ellsworth says.

The entire process enables much more than a lifetime of research. It allows faculty at MSU to be a part of bringing new technologies and therapeutics with the power to change peoples' lives into the global marketplace.

"I'm an academic researcher, right?" says Abramovitch. "When I started here, I didn't think I'd ever be starting a business."

"My Ph.D. was in plant diseases," he continues. "And when I was looking for what I was going to do for the rest of my career I felt a need to work on something that would impact global health. I saw that tuberculosis was this grand challenge in infectious disease and public health that needed more science to come to a solution."

"I thought I could dedicate my career to this, and I became a TB researcher. And since then, every day I'm motivated to get up and go to work because I realize that it's this huge problem that needs a solution."

"I really feel now that I'm at Tarn, we can make solutions; we can help solve this problem. That's what motivates me every day."

"At Tarn, we have landed on two therapeutic focuses: one is TB, which has a global impact. The other is NTM, or non-tuberculous mycobacterium infection, which is an emerging disease in the U.S., Japan and parts of Europe."

—DR. EDMUND ELLSWORTH,
Professor, MSU Department of Pharmacology and Toxicology

MSU INNOVATION CENTER

BY THE NUMBERS

CORPORATE SUPPORTED RESEARCH $25,235,343

141	60	44	48
Invention Disclosures	New Patent Applications	US Patents Issued	Executed License/Option Agreements

ROYALTIES RECEIVED $4,454,324

PRODUCT DEVELOPMENT GRANTS FOR MSU RESEARCHERS

8	11	8
ADVANCE	**MTRAC**	**TSGTD**
Advance Grant Program	Translational Research & Commercialization (MTRAC)	Targeted Support Grant for Technology Development (TSGTD)

CHRISTIAN NDERU IS NOT YOUR TYPICAL STUDENT ENTREPRENEUR.

As a senior majoring in Experience Architecture within MSU's College of Arts and Letters, he possesses a rare blend of artistic sensibility and entrepreneurial acumen. Awarded the prestigious 2023 Ian Gray Scholarship in Entrepreneurial Studies, Nderu's journey is a testament to the transformative power of creativity, community, and courage.

A Journey Between Continents

Born in Baltimore, Maryland, Christian moved to Mombasa, Kenya, at the tender age of 3 or 4. He spent the rest of his childhood oscillating between Nairobi, Kenya's bustling capital, and the serene coastal city of Mombasa. This transcontinental upbringing has afforded him a rich tapestry of experiences that fuels his unique perspective.

"It has given me opportunities to engage with different cultures," Nderu reflects. "My upbringing in Kenya made me aware of the challenges that many face globally, nurturing my open-mindedness and driving my curiosity to solve problems."

Fostering an Entrepreneurial Mindset

Christian's connection to entrepreneurship began in childhood, thanks to his grandparents who ran a family hotel. Immersed in this environment, he witnessed the multifaceted nature of running a business, from catering to guests to troubleshooting kitchen crises. This hands-on experience influenced his entrepreneurial aspirations, teaching him that entrepreneurship isn't just about making money but impacting lives.

"Ultimately, entrepreneurship is about solving problems and enhancing the quality of life," says Nderu. "The best entrepreneurs, like Brian Chesky and Sal Khan, are those who are motivated by impact rather than profit."

Creating Through Design

Although he doesn't see himself as an entrepreneur just yet, Nderu is a brand and experience designer with an entrepreneurial flair. His Experience Architecture major and participation in the Burgess Institute's programs, including the Minor in Entrepreneurship and Innovation, have shaped a problem-solving mindset that merges entrepreneurial strategies with design thinking.

"The entrepreneurial mindset is solutions-oriented, perfect for receiving feedback and problem-solving," he explains. "On the other hand, design thinking helps us to deconstruct problems from all angles. Both are invaluable skills in my career."

A Community of Innovators

Joining the Burgess Institute initially as an intern seeking graphic design opportunities, Christian soon discovered a like-minded community of aspiring entrepreneurs. The program aligned with his passion for design and provided him with resources to explore financial solutions through blockchain technology—a problem that once almost left him stranded during a winter break.

"The Burgess community is truly amazing," he remarks. "It's a support network of talented students and committed faculty who provide guidance, inspiration, and direction."

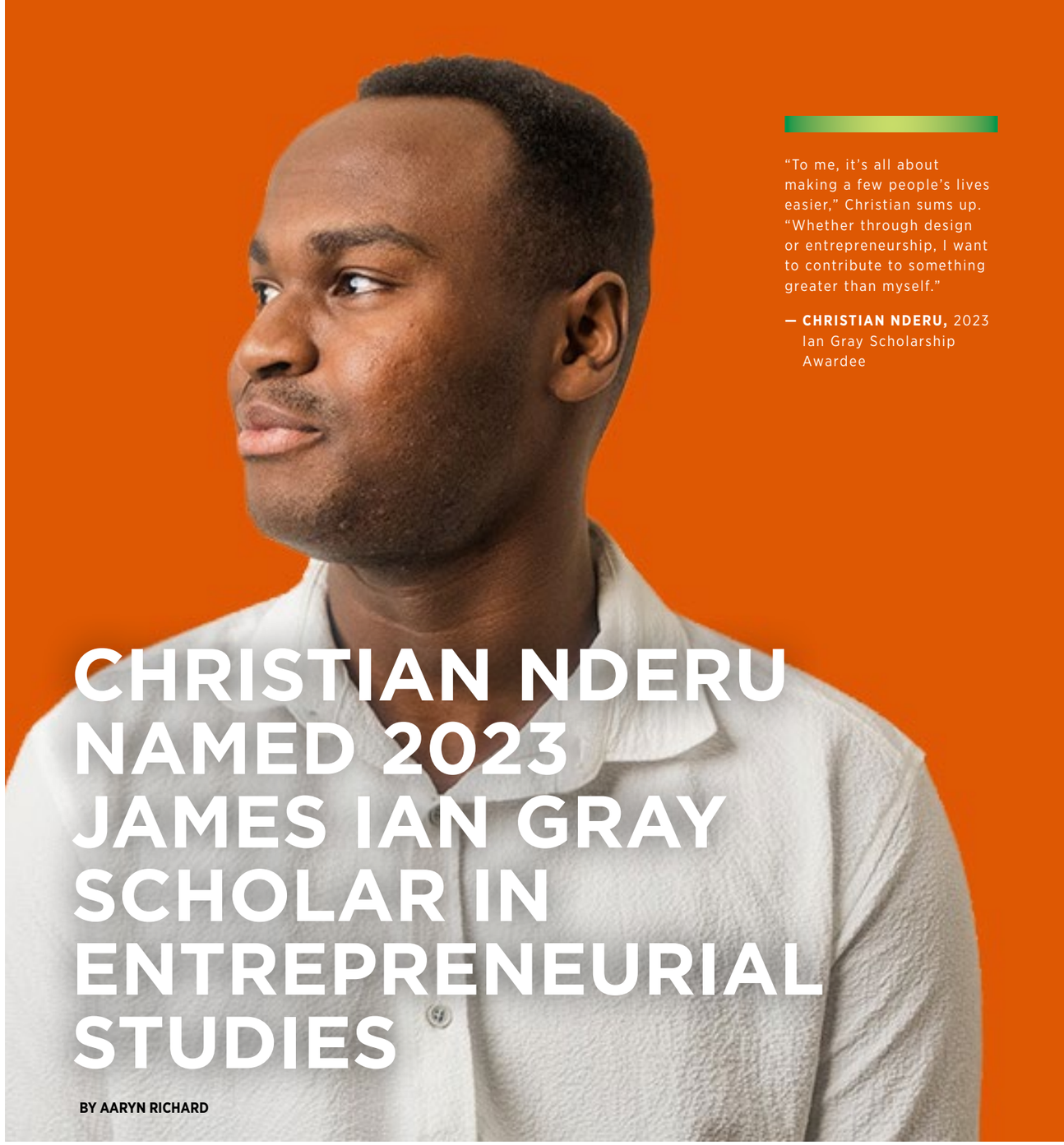
A Scholarship and a Commitment

For Nderu, the Ian Gray Scholarship is more than just financial aid; it is a nod of approval from a community that has become an integral part of his academic journey.

"I'm incredibly grateful to the Burgess Institute and the donors," he says. "This scholarship propels me to work even harder towards my goals."

Looking Forward

With a hopeful eye on the future, Christian plans to work as a Junior Designer in marketing or branding agencies post-graduation. Cities like Chicago, Denver, Detroit, or New York are on his radar. Through his work, he aims to continue impacting lives—whether that be through design or a return to entrepreneurship later in life.



CHRISTIAN NDERU NAMED 2023 JAMES IAN GRAY SCHOLAR IN ENTREPRENEURIAL STUDIES

BY AARYN RICHARD

"To me, it's all about making a few people's lives easier," Christian sums up. "Whether through design or entrepreneurship, I want to contribute to something greater than myself."

— **CHRISTIAN NDERU,** 2023 Ian Gray Scholarship Awardee

"To me, it's all about making a few people's lives easier," Christian sums up. "Whether through design or entrepreneurship, I want to contribute to something greater than myself."

Each year, the MSU Innovation Center awards the James Ian Gray Scholarship in Entrepreneurial Studies to an MSU student exhibiting exceptional qualities of an entrepreneur. Named after Dr. James Ian Gray, who spearheaded the creation of the Innovation Center and served as vice president for Research and Graduate Studies at MSU for nearly a decade, this scholarship honors Nderu's determination as a young, motivated creator. The recipient of the Ian Gray Scholarship receives $2,000 per semester to help cover tuition or student expenses.

TO LEARN MORE about Christian Nderu's journey, you can connect with him on his website and Instagram.

MSU INNOVATION CENTER
325 East Grand River Ave.
East Lansing, MI 48823

Phone: 517-355-2186
www.msuinnovationcenter.com