

Marburger STEM Center

Year 1 Report

Lawrence Technological University is delighted to celebrate the one-year anniversary of the Marburger STEM Center's Founding Executive Director, **Dr. Sibrina Collins**. When Dr. Collins joined the university, elements of the STEM Center existed, but we needed a visionary leader to combine and enhance them into a cohesive whole. With a clear vision to become a global leader in STEM pedagogy from Kindergarten through graduate school, Dr. Collins is elevating the profile of the Center as the university engages learners in ever-evolving ways.



With Dr. Collins's leadership, Lawrence Technological University has a vision to become the international leader in innovative ways for teaching and engaging students in STEM subjects. Today, Lawrence Tech is serving as a "living laboratory" for new approaches in STEM pedagogy. As we continually innovate and test these approaches, LTU faculty are engaged in meaningful dialogues with teachers, parents and young learners in a wide variety of communities. Lawrence Tech is grateful for supporters who make it possible for risks to be taken in pursuit of dramatic gains in STEM educational achievements, particularly in underserved communities like Detroit.

The Space

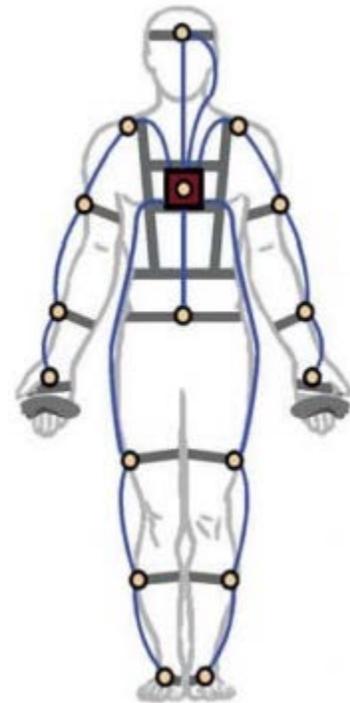
In September, we celebrated the opening of the A. Alfred Taubman Engineering, Architecture and Life Sciences Complex, home of the Marburger STEM Center. The building does not have a single traditional classroom. Instead, all of the learning spaces are labs, where students learn by doing.

The Taubman Complex incorporates a number of sustainable features. The building's heating, ventilation, air conditioning, and energy control systems include a "heat wheel" on the first floor that recovers and reuses 30 - 40 percent of the heat expended in the building. The building also employs occupancy sensors that turn off not only the lights but also half of the electrical outlets if a room is vacant. (These interruptible outlets are color coded so that students and faculty don't plug equipment running a lab experiment into them.) The building is designed to capture all rainwater falling on its roof and feed it into an underground storage tank, where it is used for lawn watering.



The unique spaces in the building includes multiple robotics engineering laboratories. One space is used primarily by robotics engineering students as a 24/7 “tinker lab” that contains modular equipment and components needed to build and test a variety of robotic systems. Workstations are outfitted with power sources, signal generators, oscilloscopes, soldering equipment and data acquisition systems. A separate area houses CNC machines, 3D printers, and tabletop robot arms. A nearby computer science robotics laboratory is used for the development of autonomous robots and accommodates workshops, camps, and Robofest competitions, so that students of all ages have access to and inspiration from this continually emerging field.

Surrounding the Marburger STEM Center are also labs related to biomedical engineering. One lab is dedicated to active learning about biorobotics/haptics. This space provides practical, hands-on experience to students in sensing, perception, control, and feedback in next generation robotics. Students in the biomedical engineering labs also have the opportunity to explore “Quantified Self” – the popular social movement using technology to record data on all aspects of people’s health and wellness such as diet, stress, sleep, activity, and many biomechanics-related variables. Entrepreneurial students are working on projects to enable improved health for future generations. Traditional employers value the practical experience that students in these labs receive in better understanding the key elements of human interface with products.



The Mission

The mission of the Marburger STEM Center is to meet the educational and professional development needs of a diverse community of STEM learners with cutting-edge and engaging experiences in flexible learning spaces through pioneering programming from LTU's four Colleges. The mission is achieved by:

- Enhancing the skill set of LTU students, which prepare them for well-paying careers in STEM-based industries through curricular and extra-curricular learning opportunities.
- Engaging historically underrepresented groups in STEM through progressive programming.
- Extending STEM to a broader population of students by including the disciplines of information technology, architecture, digital humanities, robotics, engineering and computer, management sciences and health care.
- Providing leading-edge K-12 outreach programming to the diverse community of STEM learners.
- Engaging K-12 teachers with innovative professional development workshops focused on active-collaborative learning, problem-based learning and course-based research experiences.



From Kindergarten through PhD programs, the means of teaching STEM topics have not changed in decades. Reading from a book, completing worksheets, listening to lectures or performing pre-determined experiments in a laboratory have been the mainstays of STEM educational approaches. As the volume of available information increases exponentially and traditional institutions are being questioned, reformed or dissolved at every turn, it is incumbent on educators to rethink their traditional approaches to molding young minds.

Students from disadvantaged backgrounds most frequently have unstructured home lives, but these environments foster self-reliance, problem-solving and teamwork. With scarce resources also comes an innate understanding of the need for collaboration, making group initiatives intuitive and impactful for these students. Students from middle class or more traditionally-structured backgrounds need to increase their own skills in problem-solving and collaboration in order to be successful in the modern workplace as well. A child can be given a worksheet with a list of math problems (e.g.: 12×7) and they will painstakingly learn it. But if teachers instead provide room dimensions to a group of students and ask them to figure out how much

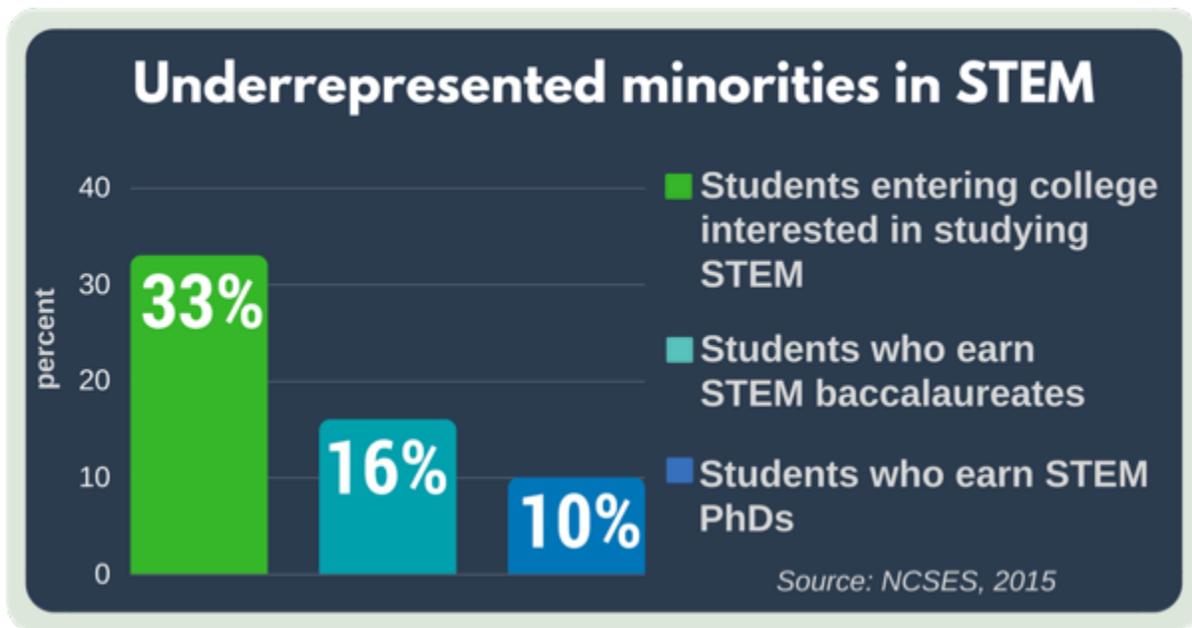
furniture can fit inside, they will have to learn to multiply at an even higher level, but the uses for the mathematical skills suddenly become real. The students are more engaged with the material and are learning skills far beyond what a rote worksheet provides. Career-oriented thinking opens up, without an instructor having to give a lecture on “what is interior architecture” or “what does an industrial designer do?” With its institutional mission based around Theory and Practice, Lawrence Tech is uniquely well-suited to pioneering new approaches in education through problem-solving and research-based activities, performed both individually as well as in groups.



Lawrence Tech Students

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As shown in the following graph, students who enter college intending to participate in STEM majors frequently lose interest:



Thanks to a comprehensive plan put forth by a cross-section of faculty, Lawrence Tech is one of only 24 schools nationwide to be selected for a new program to boost minority participation in STEM study and careers.

The \$1 million grant was awarded to Lawrence Tech under the Inclusive Excellence Initiative of the Howard Hughes Medical Institute, the largest private, nonprofit supporter of science education in the United States. More than 500 colleges and universities nationwide applied for grants under the initiative. Lawrence Tech was the only institution in Michigan to be selected.

The objective of the initiative is to help colleges and universities encourage participation and cultivate the talent of more students in the natural sciences. HHMI challenged schools to identify the reasons students are excluded from science and find new ways to include students in opportunities to achieve science excellence. In particular, the HHMI initiative focuses on those undergraduates who come to college from diverse backgrounds and pathways. These “new majority” students include under-represented ethnic minorities, first-generation college students, and working adults with families.

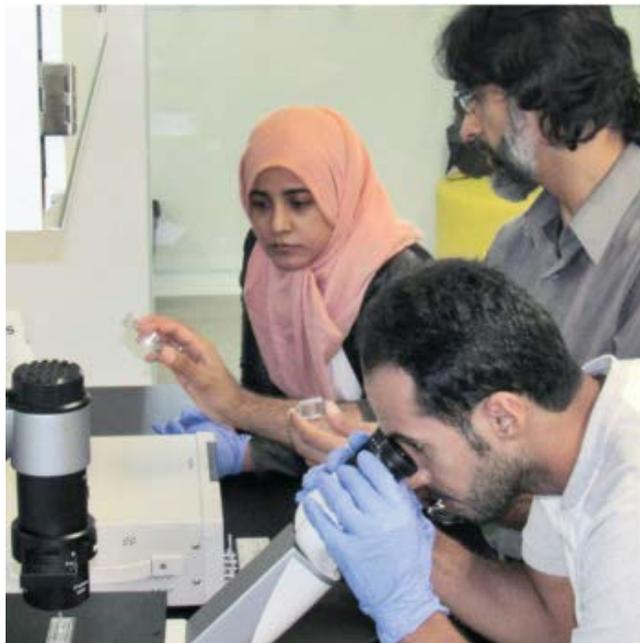
In Lawrence Tech’s case, the goal of the project is to revolutionize teaching, basing education on classroom-based research experience. Courses in multiple disciplines will be modified into CRE courses, providing research experiences to all students as part of the curriculum. These experiences will be designed in a culturally responsive fashion, allowing students to express their culture and identity through research. Participating in research as an undergraduate student has been proven to increase student retention and graduation rates, as well as boosting GPA and the likelihood of moving on to graduate school.

For decades, educational grants – including some awarded by HHMI – have focused on interventions aimed at students, such as summer research apprenticeships, tutoring, advising,

and summer bridge programs designed to ease the transition from high school to college. While these interventions can help the students involved, they do not generally address long-term issues that, if changed, could have a more sustained impact. HHMI's new goal is to catalyze changes that last well beyond the lifetime of the five-year grants.

In addition to the new funding from HHMI, Lawrence Tech is proud to continue our partnership with the State of Michigan's King Chavez Parks (KCP) Initiative to expand support for students who are financially or academically at risk, non-traditional or first-generation, or from traditionally underserved populations. The grant introduces several new programs:

- Operation: MACRO (Math Achievement: A Culture of Relevance & Ownership), which combines drilled-based learning and discipline with creativity and practical applications. Students will learn how to take charge of their own math education.
- Operation: Science, which is designed to support students in gateway science courses utilizing the peer-driven supplemental instruction model developed at the University of Missouri-Kansas City.
- Operation: CultureShock!, which introduces at-risk students to the active-collaborative and problem-based learning models necessary for success in STEM courses.
- Operation: Internship, which connects at-risk students with internship opportunities early in their college careers and promotes the "soft skills" needed to flourish in the workplace.
- Operation: FLEX (Financial Literacy Education Exchange), which provides personal finance literacy education and mentoring.
- Operation: Enhanced Clinical Counseling, which helps students work with learning and emotional disabilities.



Entrepreneurship

Lawrence Tech has created a Studio for Entrepreneurial Engineering Design (SEED) thanks to funding from the Kern Family Foundation. SEED is the home of curricular and extracurricular activities all aimed at the development of an entrepreneurial mindset that our students can combine with their developing engineering skillset. Last fall, sophomore engineering students worked with a nonprofit agency, Dearborn-based Services to Enhance Potential, and StoneCrest Behavioral Health Center in Detroit, to develop products to help with disability-related needs in the workplace.

STEP works with people with disabilities to train and place them in meaningful employment, and StoneCrest provides employment opportunities to STEP clients. Through the partnership, students met with STEP clients and learned about disability employment, designing specific products to meet client needs. Not only did students receive practical experience related to their future careers, they also were provided an opportunity to give back to those who had different kinds of hurdles to overcome. The practical engineering experience was noteworthy, but it was the experience in using engineering to improve lives of the less fortunate that was truly priceless.

Courses like SEED make a tremendous difference in ensuring continued interest in STEM disciplines in a way that traditional book-and-lecture methods cannot.

Collaborations



Dr. Richard Marburger, known for his unique approach to partnerships with other institutions, has inspired STEM-related partnerships at other universities:

- GEAR-UP/College Day Program with Oakland University and the University of Michigan-Dearborn, which helps middle school and high school students prepare for college.
- Future Faculty Fellows Program with Wayne State University, which provides support to graduate students who will teach STEM topics to at-risk students in the future.

Because, as Dr. Marburger says, “Lawrence Tech is the home of great ideas. But we are not the *only* place where great ideas can flourish.” Increasing the pre-eminence of Lawrence Tech’s STEM educational approaches requires participation and adoption by others as well. These unique multi-institution partnerships enable all institutions to reach larger numbers of students in more efficient ways.

Connecting with Industry

To provide current students with insight and contacts in STEM-related industries, the Marburger STEM Center introduced the inaugural Science & Technology Showcase. More than 40 employers came to see the research students are doing in disciplines ranging from biomedical engineering to computer science. A sophomore computer science major showcased his project analyzing the lyrics of Beatles songs written by Paul McCartney and John Lennon, to see if the words both men favored could determine which of them really wrote a particular song. A molecular and cell biology senior showed off her project to analyze two genes to identify differences in individual tolerances of the painkiller codeine and the blood thinner Warfarin. A third student showed off her development of a device to tell EMTs or others performing CPR how much pressure to put on a person's chest – not too little, which won't get oxygen into the lungs, and not too much, which can break a rib. Projects like these provide insights for employers into just what Lawrence Tech students are innovating in today's labs, and gives students a chance to stretch their communications muscles while demonstrating their deep knowledge of a particular STEM area.

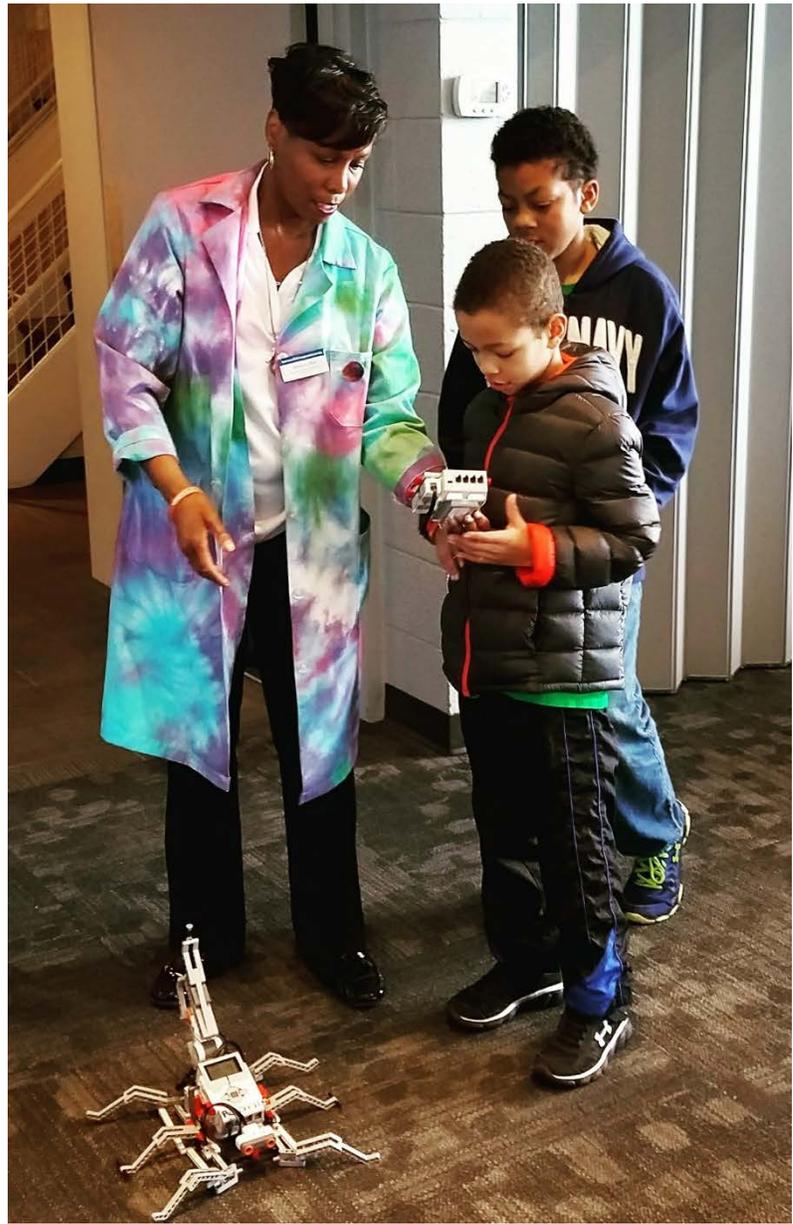


K-12 Outreach

From Kindergarten through PhD programs, the means of teaching STEM topics have not changed in decades. Reading from a book, completing worksheets, listening to lectures or performing pre-determined experiments in a laboratory have been the mainstays of STEM educational approaches. As the volume of available information increases exponentially and traditional institutions are being questioned, reformed or dissolved at every turn, it is incumbent on educators to rethink their traditional approaches to molding young minds.

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Through workshops, camps, courses and competitions, the Marburger STEM Center works with K-12 students to excite interest in STEM areas and bring Lawrence Tech’s newest techniques in pedagogy to a broader audience.

- **Basic Urban Design Workshop** is focused on exposing high school students to the process of community design through an interactive activity. The students are given the opportunity to solve global issues through a small-scale design project utilizing critical thinking, the design process, urban design methods, and resource management.
- **Robofest** is a festival of competitions and events with autonomous robots that encourages students to have fun while learning principles of Science, Technology, Engineering, and Math (STEM) and Computer Science. Students design, construct, and program the robots. Any robotics kits are allowed in the construction of robots. Robots can be programmed with any programming language. Since 2000, over 20,000 students have competed in Robofest, including teams from 14 North America, South America, Asia, Europe and Africa.
- More than 50 parents and students attended **Sampson Webber Leadership Academy’s STEMstation Night**, a parent engagement event, held May 18 at SWLA, a K-8 academy within the Detroit Public Schools Community District. STEMstation Night was filled with several hands-on interactive activities through six STEAM Stations – each with a different focus. The stations included robotics, design, engineering, mathematics, science, and 21st century literacy. LTU students, representatives from the Detroit nonprofit EcoWorks, and Sampson Webber students and teachers led the stations.



- LTU's **Blue Devil Scholars Program** is an innovative partnership with the Detroit Public Schools Community District that provides students pathways to successful STEM careers. The goal of the Blue Devil Scholars program is to spark students' interest in the exploration of STEM subjects, nurture a college-bound mindset, prepare them for admission to Lawrence Tech, ease their transition to higher learning, and inspire them to consider STEM-based careers. Through this partnership with DPS, LTU is providing an academic intervention at Sampson-Webber Leadership Academy (SWLA) a K-8th grade school. Ultimately, we expect to enroll 300 students through 12th grade. Moreover, the goal is that as success is demonstrated, the program can be duplicated by additional partnering institutions. Participating students are provided age-appropriate activities and courses designed to strengthen their learning in STEM subjects, and helping them complete high school with some college credits. Next, the students will be admitted to Lawrence Tech and receive scholarships supporting their completion of a degree.



- The **STEM + Design Program** - Lawrence Technological University's College of Architecture and Design + Marburger STEM Center have partnered with Detroit Community Public Schools to engage students in a critically driven studio focused on the idea of community. The students utilize the design process – selecting a community issue, conducting research, critically analyze data and their own experiences, schematic sketching, design development and documentation - to create architectural interventions addressing community issues that are not only relevant to Detroit but globally.

Parents and teachers are key secondary audiences for the Outreach programming of the Marburger STEM Center. Lawrence Tech hosted a computer coding workshop focused on the C computer programming language for middle school parents of Detroit Public Schools. The primary focus of the computer coding workshop was to expose and engage parents in technology related fields. The workshop was provided free of charge, with additional resources provided for the parents to continue learning to code on their own. To introduce the workshop, Collins talked about the importance of coding, relating it to apps on your cellphone such as Facebook and Twitter.



Collins led the parents through the workshop, teaching them how to write computer code to create and successfully run a program using the C programming language. The parents cheered when she announced, "You have now just written your very first program!"

Several professional development workshops were offered to K-12 educators during the academic year. **CSI:Lawrence Tech**, designed for educators, helped teachers develop coursework, engage students, and teach forensic science using an integrated science approach. They worked alongside police officers and experts trained in forensic science.



The Hands on Science workshop for DPS science is an innovative approach of conveying science concepts to K-12 teachers by doing hands on science activities. Teachers explored inquiry based science activities that focused on the matter and DNA. Teachers explored traits, adaptations, and the structure and properties of the DNA molecule. During the workshop, participants were introduced to Active and

Collaborative Learning (ACL) and Problem-based Learning (PBL) techniques which are proven as highly effective pedagogies to develop both content and process skills for students at any age-level.



Lawrence Tech also provides on-going research-based resources, electronically as well as in person and in print, for K-12 teachers to enhance their ability to particularly focus on enhancing diversity in STEM. Resources include features on the contributions of women and scientists of color.

As Lawrence Tech continues to pursue its vision of creating viable STEM career pathways, particularly for students of underrepresented populations, we are ever grateful for the support of generous philanthropists making our efforts possible. We continue to develop the STEM workforce, ensuring that the City of Detroit and its citizens have exposure, access and educational inspiration for generations to come. While our faculty pioneer innovative approaches to education, our students will continue noteworthy research efforts, and our STEM alumni will establish leading-edge businesses having a lasting impact in the community. The STEM economy is powerful, and Lawrence Tech is proud to be leading the way.