

Fiscal Year 2018

Capital Outlay Project Request

Institution Name:	University of Michigan – Flint
Project Title:	Murchie Science Building Addition
Project Focus:	STEM Academic, Research, and Administrative Support
Type of Project:	Addition
Approximate Square Footage:	65,000
Total Estimated Cost:	\$39 million
Estimated Start/Completion Date:	January 2017 (design start)/August 2020 (completion)
Is the Five Year Plan posted on UM-Flint’s website?	Yes
Is the requested project the top priority in the Five Year Capital Outlay Plan?	Yes
Is the requested project focused on a single, stand-alone facility?	Yes

PROJECT PURPOSE

The University of Michigan-Flint seeks \$29.25 million in state support to construct a 65,000-square-foot addition to the existing Murchie Science Building. The purpose of this addition is to address immediate space limitations, meet growing demand for instructional, research, and collaborative spaces for our science, technology, engineering, and math (STEM) disciplines, and create engineering-specific instructional and research laboratories that cannot exist within the Murchie Science Building due to original design limitations. As regional, state, and national labor markets call for greater numbers of qualified STEM graduates, the proposed Murchie Science Building Addition (MSB Addition) will enable UM-Flint to deliver the highest quality education to ever increasing numbers of students pursuing degrees in STEM disciplines. With the total cost of this addition estimated at \$39 million, the University and its donors lack the financial capacity to fund this project without this state appropriation.

Under the new leadership of Chancellor Susan Borrego and Provost Douglas Knerr, UM-Flint is engaged in strategic enrollment and academic planning initiatives to meet growing demand for 21st century STEM education. UM-Flint has assigned top priority to expansion of programs that train future scientists, engineers, science educators, and health professionals. The proposed MSB Addition represents the next essential phase in our strategic growth as a regional comprehensive university serving the needs of our region and state. It is Phase 3 of our “Campus Academic Buildings Expansion and Renovations” — an initiative that has been one of UM-Flint’s top

priorities since 2006. Thanks to the support of the State of Michigan through the capital outlay process, Phase 1, the French Hall Renovation, was completed in October 2010, and Phase 2, the Murchie Science Building Renovation was completed in November 2015 (with the exception of ‘added scope’ items approved by the State of Michigan during the course of construction). Phase 3, *the Murchie Science Building Addition*, is urgently needed to accommodate and sustain growing enrollment in STEM disciplines, address immediate space limitations, and respond to increasing demand for STEM graduates with the cross-disciplinary collaborative skills needed to drive innovation in our region, our state, and the nation.

Accommodate growing enrollment in STEM programs

The proposed project directly addresses our pressing need for additional space to accommodate growing enrollment in UM-Flint STEM programs, all of which are housed in the Murchie Science Building. Within the past 10 years, the number of UM-Flint students *majoring* in STEM disciplines increased by more than 680 students (an 84% increase). The number of students majoring in Biology, Biochemistry, Engineering, Physics, Computer Science, and Geography, Planning, and Environment more than doubled and the number majoring in Mathematics has increased more than 50%.

New and proposed degree programs are expected to accelerate enrollment in UM-Flint Engineering, Physics, and Geography, Planning, and Environment programs. After receiving ABET accreditation for its Mechanical Engineering program (2014), our Engineering department is now offering a B.S.E. in Mechanical Engineering as well as a B.S.E. in General Engineering. An M.S.E. in Mechanical Engineering will be offered beginning in 2017 and a proposal to offer a B.S.E. in Industrial Operations Engineering is pending approval. Our Geography, Planning, and Environment department now offers a B.S. in Environmental Science and Sustainability and Energy and in Urban and Regional Planning. Based on current growth in STEM programs and predicted increases in STEM enrollment, UM-Flint anticipates having more than 700 additional students majoring in STEM disciplines over the next 10 years (i.e., by 2025).

Accommodate growing enrollment in non-STEM programs with science and math prerequisites

The proposed MSB addition is also needed to accommodate the increasing numbers of *non-STEM majors* requiring courses in core STEM subject areas (i.e., math, biology, and chemistry). This is due to rapid growth in the Nursing and Physical Therapy programs offered by our School of Health Professions and Studies, as well as the recent accreditation of our Integrated Science Teacher Certification program (jointly offered by the College of Arts and Sciences and the School of Education and Human Services). Demand for integrated science teacher certification is directly related to the growing need for K-12 science teachers who can cultivate student interest in STEM disciplines at an early age.

Enrollment in UM-Flint’s nursing programs has nearly tripled over the past 10 years—from 581 students in Fall 2004 to 1,664 in Fall 2014. During this same period, enrollment in our physical therapy program increased 30%.

Finally, *every UM-Flint 4-year-degree candidate* is required to take at least one laboratory-based natural science course. This means non-STEM majors *in every discipline* are likely to utilize the laboratories and classrooms in Murchie Science Building at one time or another during their time on campus. Thus, increases in the University’s overall undergraduate enrollment contribute to overcrowding in the Murchie Science Building. Five times over the past decade, UM-Flint has claimed the “fastest growing” title among Michigan’s 15 public universities. From 2004 to 2014—a time when most universities in Michigan experienced little to zero growth, UM-Flint’s overall enrollment soared over 26%.

Address current space limitations

Despite renovations to optimize utilization of the existing space, issues associated with the original building’s design and current capacity remain. Original building spaces were intended to support basic science programs; they were not designed to meet the basic requirements of an engineering program (e.g., high ceilings to accommodate hoists and lifts, and loading docks with direct access to instructional and laboratory spaces). Moreover, the overall space available within the existing building cannot support enrollment growth.

High demand for classrooms and laboratories in the Murchie Science Building has resulted in academic bottlenecks for our students. Tight scheduling of these spaces limits our ability to offer course and lab sections at times convenient to students. Without adequate “wobble room,” if one program needs to change the time of a single section, times for many other course or lab sections are forced to change as well. The end result: students cannot always take a required course or lab when they need it.

With laboratories constantly scheduled for teaching, lab space is not always available for research by individual faculty or faculty/student research teams. Moreover, tight scheduling of biology and chemistry lab sections, in particular, has resulted in overcrowded and inadequate “lab preparation” spaces. As growing enrollment requires more lab sections to accommodate greater numbers of students — the finite space available for laboratory preparation is proving inadequate. Additional office, work, and storage spaces are needed to accommodate our growing laboratory preparation staff and to store larger amounts of laboratory supplies and equipment.

Address Michigan’s increased demand for STEM graduates

Increasing enrollment in UM-Flint’s Biology, Biochemistry, Engineering, Computer Science, Physics, Mathematics, and Geography, Planning and Environment programs is spurred by strong demand for STEM graduates in Michigan. Recent statistics indicate that demand for college graduates in STEM disciplines is high and predicted to continue to grow. *(Source: State of Michigan. Department of Technology, Management & Budget, Bureau of Labor Market Information and Strategic Initiatives. March 2015. A Look at Science, Technology, Engineering and Math (STEM) Talent in Michigan. Available at:*

http://milmi.org/admin/uploadedPublications/2317_A_Look_at_STEM_Talent_in_Michigan.pdf). To ensure we are meeting the evolving needs of industry, several UM-Flint STEM programs recruit representatives from major regional and national employers to serve on Advisory Boards that meet regularly to review and shape our STEM curricula. The proposed project will enable UM-Flint to respond to this industry demand as well as “enhance Michigan's job creation, talent enhancement and economic growth initiatives.” For additional, relevant statistics, please refer to our response to *Question 1* on pages 11 through 15.

SCOPE OF THE PROJECT

The proposed project includes the design and construction of a 65,000-square-foot addition to the Murchie Science Building. To ensure that we create a flexible learning platform that supports high impact pedagogical practices and interdisciplinary collaboration for all of our STEM disciplines, as well as to ensure optimal learning spaces for our rapidly growing engineering program, we engaged HED as the project architect for this addition. The innovative learning spaces within the MSB Addition together with the conventional spaces in the original Murchie Science Building – will allow the two structures to function synergistically – with each enhancing the unique strengths of the other. The MSB Addition will feature flexible spaces specifically designed to support interactive learning, facilitate interdisciplinary collaboration, and meet evolving needs. Use of these flexible spaces will complement use of the original building’s traditional spaces, relieve overscheduling in traditional classrooms and laboratories, and free up needed space to support laboratory preparation staff and supplies.

Design objectives for the proposed MSB addition

- Showcase STEM education
- Accommodate evolving research and instructional needs with flexible labs and classrooms that fully support the needs of both science and engineering programs
- Foster innovation and cross-disciplinary teamwork with spaces that encourage collaboration
- Attract students with technology-rich, interactive spaces
- Support industry partnerships in research and development
- Attract faculty with state-of-the-art education and research facilities
- Demonstrate green technology through LEED sustainable features, materials and energy conserving building systems
- Ensure safe, secure and accessible spaces for all occupants

ORIGINAL MURCHIE SCIENCE BUILDING and PROPOSED MSB ADDITION

Type of Space		Number of Spaces		
		Original MSB	Proposed MSB Addition	Combined MSB/ Addition
LABORATORY	Instructional Class Laboratories	---	11	11
	Traditional Laboratories	12	---	12
	Research Laboratories	27	15	42
CLASSROOM	Interactive Teaching Classrooms	1	6	7
	Traditional Classrooms	15	--	15
LECTURE HALL	Large Lectures Halls	2	--	2
OFFICE	Faculty Offices	74	19	93
COLLABORATION	Dedicated Student Collaboration Spaces	--	7	7
OTHER SHARED SPACE	STEM Tutoring and Skill Development Center	--	1	1
	General Science Lab for Genesee Early College	--	1	1

Spaces within the new addition will feature the types of state-of-the-art, technology-enhanced, interactive facilities required to produce industry-ready STEM graduates for our region and state. Specifically, classrooms and laboratories will be designed to support high-impact pedagogies, foster interdisciplinary collaboration, and offer the flexibility needed to meet evolving needs.

Designed for engineering—Fostering cross-disciplinary collaboration

When it opened in 1988, the Murchie Science Building provided excellent space for the university's laboratory science programs—with nearly half of the 192,000-square-foot building consisting of wet labs. Unfortunately, the building was designed for an older generation of equipment and for programs much smaller and different than the programs we offer today. Teaching laboratories are 33% smaller than current standards. Neither these laboratories nor the classrooms were intended to support teamwork and multidisciplinary collaboration—two skills essential in the 21st century workplace. Most important, none of the building spaces meet the unique requirements of an Engineering program (e.g., high ceilings that can accommodate hoists and lifts, and loading docks with direct access to instructional and laboratory spaces).

The proposed MSB Addition addresses all of these deficiencies with innovative learning spaces designed to accommodate evolving STEM programming as well as to foster student interaction and cross-disciplinary collaboration.

- **Instructional Class Laboratories.** These interactive laboratories are designed with the flexibility to adapt to project teams and equipment of various sizes.

Focused on Engineering

- **Automotive / Combustion Lab.** This wet lab will focus on all aspects of automotive engineering including drive train, suspension, combustion, and safety. Activities will include the development and implementation of combustion measurement techniques for various combustion systems.
- **Dynamics / Vibration Lab.** This engineering lab will focus on the characterization of dynamic behaviors of structures and structural materials, and the investigation of vibrations.
- **Fluids Lab.** This interdisciplinary science/engineering wet lab will be designed for experimentation and computational work. Floor-mounted and benchtop equipment will be used to study the principals of flow measurement (e.g., multiphase flow and wind tunnel studies).
- **Robotics / Mechatronics Lab.** This interdisciplinary engineering laboratory will be used to study applications of modern systems and control methods with a focus on robotics within mechatronic systems.
- **Senior Design Studio / Freshman Design Lab.** This engineering lab will be used by senior students to design and construct unique capstone projects that focus on concepts acquired in previous engineering courses. It will also be used by freshman students to learn about the various engineering disciplines.
- **Solid Mechanics and Materials Lab.** This lab will focus on the characterization of materials and evaluation of their response to applied stresses. It will include floor-mounted and benchtop testing equipment as well as computers for computational work.
- **Thermal Systems Lab.** This interdisciplinary science/engineering lab will be used to teach instrumentation and measurement techniques in thermal systems, and perform active testing of components of thermal systems.

Focused on Sustainability and Urban Design

- **Sustainability Lab.** This interdisciplinary science/engineering lab will enable students and faculty to test prototypes of energy- and water-efficient devices, and develop software for optimizing energy and water efficiency in residential and commercial structures. This lab will be used to evaluate the performance of “green features” of the *MSB Addition* as well as to support existing activities at UM-Flint’s *Urban Alternatives House*, a demonstration project for residential energy and water

efficiency that was awarded the highest LEED certification (Platinum) when it began operations in 2014.

- **Urban Design Studio.** This interdisciplinary science/engineering space will enable students and faculty to develop site plans, conduct design charrettes, and model prototypes of energy- and water-efficient devices in built structures.

Focused on General Science

- **Astronomy and Astrophysics Dome and Telescope.** With computers linked to rooftop equipment this facility will enrich existing instruction and facilitate faculty and student research in Astronomy and Astrophysics.
- **General Science Lab for high school students enrolled in *Genesee Early College*.** This general science wet lab will be dedicated to the Biology, Chemistry, Physics, and Anatomy and Physiology courses that are part of the *Genesee Early College* (GEC) curriculum. Currently, early college science courses are held in laboratories already over-utilized by various UM-Flint academic departments. This dedicated lab will allow greater flexibility in GEC course scheduling, and provide work areas and storage to support the GEC's existing FIRST Robotics Team.
- **Interactive Teaching Classrooms.** Presently, most science lectures meet in one of two large lecture halls that are constrained by high utilization and traditional lecture-style fixed seating. To support effective pedagogical approaches, the MSB Addition will include three new interactive classrooms with built-in flexibility to allow group work of various sizes as well as traditional lectures. Moveable seating will enable 50 students to engage in group activities. One of these classrooms will be dedicated to basic and advanced physics instruction—completing the pair of “flipped classrooms” previously funded through a generous private donation. (The first “flipped classroom” was created during renovation of the original Murchie Science Building.)
- **Student Collaborative Areas.** Each floor of the MSB Addition will include collaborative areas designed to facilitate peer mentoring and create a sense of belonging for students who remain largely commuters to our campus. To encourage both impromptu collaboration and scheduled activities, these spaces will feature small group study rooms as well as flexible spaces with moveable walls and comfortable lounge seating. Dedicated meeting areas and storage units will be provided to support STEM-related student organizations.
- **STEM Tutoring and Skill Development Center.** This center will house tutorial staff and dedicated supplemental instruction space to support STEM coursework. When students need

practice in specific laboratory skills (e.g., pipetting, building molecules, or identifying anatomical structures), basic lab equipment and models will be readily accessible at all times.

- **Flexible Faculty Offices and Research Laboratories.** The MSB addition will include ~~19~~ faculty offices and ~~15~~ research laboratories to support anticipated growth in STEM enrollment and research.

Supporting STEM development in K-12 education

The proposed MSB Addition supports UM-Flint's wider K-12 STEM initiatives by providing a dedicated general science lab for high school students attending the Genesee Early College (GEC). An early college allows high school students dual enrollment in both high school and college courses, while experiencing the college culture on UM-Flint's campus.

- **Genesee Early College (GEC).** A STEM-focused, five-year early college program designed to prepare high school students for careers and advanced study in medical science and STEM professions. It is open to students from the 21 local districts in Genesee County, as well as districts adjacent to Genesee County, and housed at UM-Flint. This early college is a partnership between UM-Flint and Genesee Intermediate School District.

UM-Flint's commitment to K-12 STEM education is exemplified by our leadership in additional early colleges and STEM-focused dual enrollment educational partnership (DEEP) programs.

- **Carman-Ainsworth STEM Early College**—launched in - Fall 2016, this STEM focused three-year early college ~~that~~ brings Carman-Ainsworth High School students to UM-Flint's campus for their final year (courses ~~will~~ take place in the Murchie Science Building)
- **Grand Blanc Early College.** A three-year early college that serves 150 Grand Blanc High School students, bringing them to campus and to the MSB building during their final year.
- **DEEP Programs in Pre-Engineering and Medical Science** for 11th and 12th grade students in ~~Davison Community Schools,~~ Lapeer Community Schools, Livingston County Schools, ~~Utica Community Schools,~~ and the Western Genesee Consortium (Carman-Ainsworth, Flushing, and Swartz Creek Schools)

Finally, UM-Flint is expanding our offering of K-12 science and math outreach. In addition to hosting a high school robotics team, we currently offer residential and non-residential summer

camps in engineering; Math Field Day, a day-long competition of area high school math teams; Family Math Night, an opportunity for parents and children of all ages to explore mathematics through games and puzzles; Curiosity Academy, an after-school STEM programs for middle school girls; and Super Science Friday, an interactive, multidisciplinary science event that brings more than 700 7th and 8th graders from across Genesee County to UM-Flint’s campus for a day of science exploration and learning.

In terms of K-12 outreach, UM-Flint’s proposed MSB Addition will play a central role in showcasing the innovation, teamwork, and multidisciplinary nature of emerging STEM fields. The new labs and instructional classrooms will make possible additional outreach events. UM-Flint is committed to working with K-12 students and educators throughout our region to further support Michigan’s goal of increasing the supply of citizens who are qualified to meet the demands for STEM jobs in the state.

Demonstrate green and sustainable commercial building concepts

The proposed MSB Addition will be designed as a state-of-the-art, environmentally “green” science building—a “living laboratory” for our students and the wider community. Green buildings use resources (energy, water, and materials) more efficiently than conventional buildings. Given population growth, climate change, and finite natural resources, nearly every industry is incorporating sustainability into both products and practices. For UM-Flint students in programs within the Murchie Science Building (e.g., Sustainability and the Environment, Industrial Operations Engineering, Mechanical Engineering, and Chemistry)—the new addition will serve as a demonstration project that exemplifies key concepts in their studies. For UM-Flint students in programs across campus, the new addition will serve as an introduction to the latest sustainable products, systems, and practices being adopted around the world. For members of the local community, the MSB Addition will serve as a showcase and an inspiration—an example of how resilience and sustainability can be integrated into the rebuilding of Flint.

The overall building design will incorporate natural daylight, renewable energy, and green building materials, as well as low-VOC paints, glues, and carpets. Where possible, materials will be repurposed from local renovation projects or purchased from Michigan-based manufacturers. The following "green" design features are proposed to reduce energy and overall potable water usage:

➤ *Minimize Energy Consumption*

Building orientation and design that optimize daylight ♦ Passive solar design with automated interior sun shades ♦ Solar panel windows to generate renewable energy onsite ♦ Energy-efficient fixtures and appliances, including LED lighting ♦ Motion-detectors or similar "smart" power strips ♦ Energy efficient HVAC unit with energy recovery ventilator ♦ Additional insulation ♦ “Living” green roof system

- Minimize Water Consumption
Low-flow sinks ♦ Dual-flush toilets ♦ Low-flow urinals ♦ Graywater system
- Manage and Utilize Stormwater
“Living” green roof system ♦ Stormwater cisterns ♦ Functional landscaping ♦ Porous pavements

The MSB Addition is committed to meeting criteria for LEED Silver certification as defined by the US Green Buildings Council Leadership in Energy and Environmental Design (LEED) Green Building Rating System. The building design will strive to meet LEED Gold certification.

1. How does the project enhance Michigan's job creation, talent enhancement and economic growth initiatives on a local, regional and/or statewide basis?

Science, technology, engineering, and mathematics are vital to Michigan's economy, for the state must transform from a historically unskilled labor force to one comprised of skilled workers, specifically in the areas of science and technology.

Source: <http://www.nextgenscience.org/michigan>

The STEM programs housed within UM-Flint's Murchie Science Building are critical to the continued economic growth of Michigan and successful revitalization of Flint and Genesee County and will meet the State's first metric impacting job creation. Our region is continuing to adapt to the job loss, population loss, and environmental consequences stemming from over-reliance on a single industry—automobile manufacturing. UM-Flint's STEM and STEM-related programs are uniquely positioned to support economic diversification and help prevent future large-scale job loss within the city of Flint, its region, and the state of Michigan. The proposed MSB Addition will enable us to support growing enrollment in our STEM programs and produce the types of graduates needed to help Michigan's economy grow.

Based on current growth in UM-Flint STEM programs, predicted increases in STEM enrollment—and the expanded capacity offered by the proposed MSB Addition—we anticipate more than doubling our current number of STEM graduates over the next 10 years (i.e., by 2025). This represents 470 highly qualified STEM graduates annually—the majority of whom will remain in Michigan and support the State's most promising industries.

Talent enhancement

STEM occupations are important drivers of the Michigan economy, contributing innovation, technological advancement, and valuable skills to our workforce.

Source: *A Look at Science, Technology, Engineering, and Math (STEM) Talent in Michigan*. March 2015. Michigan DTMB. Bureau of Labor Market Information & Strategic Initiatives.

The MSB Addition will enable UM-Flint to supply the types of talent needed for Michigan’s growing and emerging industries. More than 77% of UM-Flint graduates stay in Michigan to pursue their careers — ensuring that Michigan retains valuable talent. Of those graduates remaining in Michigan, 58% stay in our surrounding region—with the highest concentration in Genesee County.

The 65,000-square-foot MSB Addition will provide the space necessary to accommodate continually increasing enrollment in our STEM and STEM-related programs. Moreover, the MSB Addition will be specifically designed to facilitate and encourage cross-disciplinary collaboration—ensuring that our students develop the communication and teamwork skills required in 21st-century work environments. These transferable soft skills—grounded in liberal arts and combined with STEM knowledge—help drive the innovation that keeps Michigan’s economic growth at the top in the Midwest and sixth in the nation.

According to Michigan’s Bureau of Labor Market Information & Strategic Initiatives, even in occupations where science or engineering is the main function, communication and teamwork are top priorities.

Communication, a key soft skill, is listed as a requirement in 54% of all advertisements for STEM jobs. This is often listed as both internal communication (with one's team and other units within the business) and external communication (with customers). . . . Working in teams, another often-cited soft skill, appeared in nearly 6 in every 10 job ads.

Source: A Look at Science, Technology, Engineering, and Math (STEM) Talent in Michigan. March 2015.

Job creation

Improving UM-Flint’s capacity to produce more STEM-focused, college graduates will enhance Michigan’s ability to compete for jobs in the future. First, demand for college graduates in STEM disciplines is high and predicted to continue. Second, increasing the number of 4-year college graduates in these disciplines will increase Michigan’s per capita GDP.

As educational inputs increase, economic output per capita rises more than proportionately . . . for each additional year of post-secondary schooling a region’s workforce obtains, real GDP per capita and real wages per worker jump by more than 17 percent.

Source: A Matter of Degrees: The Effect of Educational Attainment on Regional Prosperity, <http://www.milkeninstitute.org/publications/view/564>

High demand for college graduates in STEM disciplines is predicted to continue. According to the State of Michigan’s long-term forecasts, (Source: Box 1, page 1, State of Michigan. DTMB. March 2015. A Look at Science, Technology, Engineering, and Math (STEM) Talent in Michigan) (growth in STEM-related job opportunities is expected to outpace job growth among all other occupations. The path to graduation for all of

these high-demand careers requires the basic science programs housed in the Murchie Science Building. In addition to preparing students for careers as scientists, engineers, nurses, and physical therapists, UM-Flint has a long history of successfully preparing students for admission to medical schools, dental schools, and pharmacy programs—with nearly 100% of our graduates admitted from the following UM-Flint science programs: Molecular Biology and Biotechnology, Chemistry, Biochemistry, and the Honors Scholar Program.

Genesee County and beyond. Three years ago the University supported the creation of a new Next Michigan Development Corporation called the I-69 International Trade Corridor. The Trace Corridor links economic development of four mid-Michigan counties: Genesee, Shiawassee, Lapeer and St. Clair. In just two of the counties, Genesee and Shiawassee, looking ahead to the year 2020, the job outlook for the I-69 Trace Corridor is predicted to be especially strong for students graduating from the science and engineering programs housed within the Murchie Science Building (or from the health professional programs, which require the basic science and math courses offered in the Murchie Science Building:

Ambulatory Health Care Services	24% growth
Physical Therapists	22.5% growth
Registered Nurses	15.8% growth
Professional, Scientific, & Technical Services	11.6% growth
Industrial Engineers	7.2% growth
Mechanical Engineers	6.1% growth

Source: State of Michigan, DTMB, Labor Market Information, Occupational Projections: Long-Term 2010 to 2020.

<http://milmi.org/cgi/dataanalysis>

Michigan. *At the state level, there is a similar story—although broader STEM job growth is predicted.* Between 2012 and 2022, Michigan will have 371,000 job openings. Of those that are STEM-related, an estimated 92% will require a post-secondary education—with 85% requiring a minimum of a bachelor's degree.

Occupations predicted to have the highest percentage job growth, in Michigan, are listed below.

Science, Technology, Engineering, and Math

<i>Civil Engineers</i>	18.2%	<i>Biochemists</i>	22.5%	<i>Urban Planners</i>	
<i>Industrial Engineers</i>	14.9%	<i>Chemists</i>	7.7%		8.5%
<i>Mechanical Engineers</i>	12.5%	<i>Environmental Scientists</i>	9.6%	<i>Actuaries</i>	28.3%
		<i>Geoscientists</i>	14.7%		

Health and Medicine

<i>Registered nurses</i>	20.2%	<i>Physical therapists</i>	23.2%	<i>Physicians</i>	11.3%
<i>Nurse practitioners</i>	19.6%	<i>Pharmacists</i>	24.0%	<i>Dentists</i>	10.3%

Source: State of Michigan, Bureau of Labor Market Information & Strategic Initiatives; www.michigan.gov/lmi

The top companies in Michigan currently recruiting and hiring UM-Flint STEM graduates include: Auto-Owners Insurance (Lansing, MI), B&P Process Equipment (Saginaw, MI), Compuware (Detroit, MI), Dynatrace (Detroit, MI), General Motors Corporation (Flint, MI), and Thomson Reuters (Ann Arbor, MI). Regional employers attending UM-Flint's career fairs and posting job openings include: major insurance corporations, computer companies, pharmaceutical companies, health care organizations, energy corporations, and automotive suppliers.

At the national level, similarly high STEM job growth is predicted—with the following careers showing *exceptionally* high growth potential from 2012 to 2022:

Physical therapists	<u>36.0%</u>	Geographers	<u>29.0%</u>
Nurse Practitioners	<u>33.7%</u>	Mathematicians	<u>23.0%</u>

Source: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Outlook Handbook

Economic growth

Reflecting Governor Snyder's economic growth initiatives, UM-Flint's undergraduate- and graduate-level STEM programs are "*partnering with industry*" to ensure that we consistently support Michigan's economic growth by producing STEM graduates with the specific knowledge and skills requested by Michigan's industries. UM-Flint's close collaboration with major Michigan employers enabled us to offer more than 642 internships and 3,191 jobs to our STEM students and alumni in the 2014-2015 academic year. Both our Chemistry and

Engineering programs have established Advisory Boards, consisting of industry representatives who meet on a regular basis to review our STEM programs and ensure they are consistently meeting the changing needs of Michigan’s employers. These advisors, as well as other industry insiders—have stressed their desire for STEM graduates with excellent soft skills in communication and teamwork. The proposed MSB Addition will allow us to construct the flexible instructional and interdisciplinary spaces needed to cultivate the teamwork and communication skills needed in Michigan’s industries.

COMPANIES REPRESENTED ON UM- FLINT CURRICULUM ADVISORY BOARDS

Chemistry Department

- BASF (Warren, MI)
- Bausch and Lomb (New York)
- Dow AgroScience (Indiana)
- Michigan Molecular Institute (Midland, MI)
- Dow Chemical (Midland, MI)
- Springhill Chemical (Almont, MI)

Engineering Department

- CPI Fluid Engineering (Midland, MI)
- DASI Solutions (Canton, MI)
- Faurecia (Auburn Hills, MI)
- Ford Motor Company (Detroit, MI)
- GM Powertrain (Pontiac, MI)
- Lear Corporation (Southfield, MI)
- Magna Seating (Highland Park, MI)
- North American Lighting (Farmington Hills, MI)
- Peter Basso Associates (Troy, MI)
- SanLuis Rassini Brakers (Plymouth, MI)
- TMI Climate Solutions (Holly, MI)
- TRW Automotive Electronics (Livonia, MI)
- Yazaki (Canton, MI)

2. How does the project enhance the core academic and/or research mission of the institution?

The proposed MSB Addition is integral to the core academic mission of UM-Flint — meeting and exceeding the State’s second metric in several ways. As a regional comprehensive campus of the University of Michigan, our focus is on academic excellence and community engagement. The proposed MSB Addition enhances our capability in both of these areas.

Academic Excellence

While the expanded space provided by the MSB Addition will accommodate growing student enrollment, the state-of-the-art design of this addition will enable us to employ highly effective

pedagogical approaches. The collaborative design of the new classrooms, laboratories, and open spaces supports “high-impact educational practices” (HIPS) — interactive practices proven to increase student engagement and retention. The proposed spaces will enhance academic excellence by facilitating HIPS —including interactive teaching methods, and student-faculty and student-student learning and research collaborations. These high-impact practices will increase the intellectual and practical competencies of our students and produce graduates with the knowledge and skills needed to succeed in the 21st-century workplace.

The proposed MSB Addition will support the following HIPS, which are advocated by the Association of American Colleges and Universities:

Source: Association of American Colleges and Universities. 2008. High Impact Educational Practices: A Brief Overview

- **HIP: Cross-disciplinary learning communities.** This HIP integrates learning across disciplines by involving students with “big questions” that matter beyond the classroom. Students work closely with one another and with their professors to explore common topics. Current challenges related to “environmental sustainability” require the combined efforts of various disciplines, including math, engineering, physics, biology, chemistry, and earth and resource science. The proposed MSB Addition includes eleven *instructional class laboratories* dedicated to cross-disciplinary research in sustainable systems, urban design, engineering design, robotics, fluid dynamics, and material properties. Moreover, the addition includes *student collaborative areas* designed to support cooperative student projects, study groups, and organizations.
- **HIP: Collaborative assignments and projects.** This HIP involves two key goals: “learning to work and solve problems in the company of others, and sharpening one’s own understanding by listening seriously to the insights of others, especially those with different backgrounds.” Approaches range from course-related study groups, to team-based assignments and writing, to cooperative projects and research. The proposed MSB Addition includes six *interactive teaching classrooms* with flexible seating to facilitate team-based student assignments. Moreover, the new addition includes several *student collaborative areas* designed to support cooperative student projects, study groups, and student organizations.
- **HIP: Undergraduate research.** The new *research laboratories* within the MSB Addition will support individual undergraduate research efforts, as well as “free up” smaller research labs for individual research projects within original Murchie Science Building.
- **HIP: Capstone projects.** This HIP helps students integrate and apply what they have learned in their undergraduate courses. The MSB Addition includes a variety of spaces designed to support individual and group applied research projects—including cross-disciplinary *instructional research laboratories* (e.g., Urban Design Studio; Senior Design Studio / Freshman Design Lab).

Community Engagement

As a Carnegie-classified Community Engaged campus, UM-Flint’s core mission involves the application of knowledge to the real world. The proposed project will undoubtedly help the campus to more fully realize our community engagement goals. With flexible *interactive classrooms, instructional class laboratories and research spaces* available for community outreach and programming, the MSB Addition will strengthen the STEM pipeline from K-12 into college. The *General Science Lab* for the Genesee Early College can be used to facilitate after-school programming, summer camps, and special events with our community at large. Dedicated spaces in which to foster a “green” demonstration building, the MSB Addition will offer the community a working model of sustainable and resilient commercial building practices. Finally, the MSB Addition will increase the space available for faculty and student research that addresses real issues in our community—from fresh food access to toxic chemical storage to aging water infrastructure. UM-Flint researchers are currently working on a \$1 million federally-funded study that employs cutting-edge criminological methods and spatial mapping to develop and test sustainable crime prevention strategies along Flint’s University Avenue corridor—an area that is home to many of the city’s largest employers but also plagued by poverty, blight, and high crime.

3. How does the project support investment in or adaptive re-purposing of existing facilities and infrastructure?

As outlined above, the proposed MSB Addition will complement and increase the functionality of the original Murchie Science Building as it features additional classroom and instructional lab spaces specifically designed to support innovative pedagogy and interdisciplinary collaboration—as outlined in the State’s third metric. The additional space afforded by the new addition will eliminate current “academic bottlenecks” caused by overscheduling of both classrooms and labs within the original Murchie Science Building. Thus, courses and labs can be offered at times convenient to students. New teaching laboratories within the MSB Addition will free up lab space in the original building—offering greater opportunities for research by individual faculty or faculty/student research teams. Additional “freed up” space will be used to improve the amount of office, work, and storage space supporting “lab preparation” efforts.

4. Does the project address or mitigate any current health / safety deficiencies relative to existing facilities? If yes, please explain.

The recent renovations included many life safety and operational upgrades to bring the existing building up to current codes including: new audible fire alarm system, the addition of a significant number of emergency eye wash/shower/drench hose stations, confirmation that exit access travel distance, egress capacities, exits per floor, dead end travel distances, emergency egress routes and exit door arrangements were all code compliant, upgrades to emergency

lighting and exit signs, verification to lighting levels, receptacle panel boards located inside Chemistry labs and hazard areas were removed and new provided outside of the area, a new generator and automatic transfer switch was provided for all life-safety loads, improved exhaust system performance at animal rooms and anatomy lab, the addition of modern fume hoods for the safety and well-being of the student and staff, along with various modifications to achieve barrier free compliance such as toilet room renovations, door hardware, upgrades, etc.

The new Addition to MSB will improve access to the building for people with physical disabilities through the specific location siting and orientation, as the build-out will reduce the travel distance between the building and nearby parking facilities.

5. How does the institution measure utilization of existing facilities, and how does it compare relative to established benchmarks for educational facilities? How does the project help improve the utilization of existing space and infrastructure, or conversely, how does current utilization support the need for additional space and infrastructure?

Laboratory utilization is measured by the departments hosting the twelve instructional labs in the Murchie Science Building. Utilization factors include: class time, prep and clean-up time, open lab for tutoring, and research by students and faculty. Using a 40-hour scheduling week, instructional lab time utilization was 70% (with lab station utilization at 78%) during Fall 2014. These utilization figures either meet or exceed the national benchmarks set by the Council of Educational Facility Planners, international and the State of North Carolina (see below):

- Instructional Lab time utilization – 50%
- Instructional Lab station utilization – 75% to 80% (of available seats)

Source: Council of Educational Facility Planners, Int'l. 1985. Space Planning Guidelines. Columbus, OH; and The University of North Carolina, Chapel Hill. 2009. Facilities Inventory and Utilization Manual for the State of North Carolina. Sixth ed. Page 233

With existing labs optimally utilized, additional lab space is required to sustain UM-Flint's growing enrollment in STEM disciplines and meet Michigan's growing demand for STEM graduates. The innovative design of these additional instructional spaces will enable UM-Flint to produce the types of STEM graduates needed to spur and support economic growth in Flint, Genesee County, and the State of Michigan.

6. How does the institution intend to integrate sustainable design principles to enhance the efficiency and operations of the facility?

The University of Michigan-Flint is committed to environmental stewardship in its approach to all building projects. All new construction projects, including both new construction and major renovations, are required to meet the American Association of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 90.1-2007. In addition, projects that have a construction budget of \$10 million or more are required to target improved performance exceeding the base ASHRAE requirements by 30%.

The proposed MSB Addition meets and exceeds the State's sixth metric (sustainable design) as it will be designed to achieve the highest possible level of sustainability and energy efficiency. The project is committed to meeting the Leadership in Energy and Environmental Design (LEED) Silver criteria, and will strive to meet the Gold or LEED criteria. As such, the building design will incorporate natural daylight, renewable energy, and green building materials, as well as low-VOC paints, glues, and carpets. Wherever possible, materials will be repurposed from local renovation projects or purchased from Michigan-based manufacturers. (A list of the proposed green building features is provided on page 10.)

7. Are match resources currently available for the project? If yes, what is the source of the match resources? If no, identify the intended source and the estimated timeline for securing said resources?

The University has identified matching resources that will be available for the project. The financing will come from a combination of internal capital renewal funds and base resources to address the growing need for major renovations to aging General Fund buildings.

8. If authorized for construction, the state typically provides a maximum of 75% of the total cost for university projects and 50% of the total cost for community college projects. Does the institution intend to commit additional resources that would reduce the state share from the amounts indicated? If so, by what amount?

Although the current state authorization anticipates a maximum state contribution of 75% toward the total cost of a project (with the institution funding at least 25%), we are very open to funding more than 25%, if required.

9. Will the completed project increase operating costs to the institution? If yes, please provide an estimated cost (annually and over a five year period) and indicate whether the institution has identified available funds to support the additional cost.

Building operating costs are expected to be offset with energy efficiency improvements. Operational costs will increase with the additional square footage that is added by approximately \$560K/year or about \$2.8 M over five (5) years. Figures for any additional reoccurring annual operating funds will be available upon completion of the proposed project. The table below compares current operating costs (based on the existing 192,900 gross square feet) against projected future operating costs (based on 272,900 gross square feet; the existing gross square feet plus the 80,000-square-foot MSB Addition). The University believes that not only will increased enrollment in STEM related fields and the cost savings from energy and water efficient features will both to help to offset the expected increase in overhead.

	\$/gsf	Current	Future
Custodial Building Cleaning	1.48	\$285,492	\$403,892
Outside Grounds	0.12	\$23,148	\$32,748
Plant Maintenance	1.66	\$320,214	\$453,014
Purchase Utilities	1.83	\$353,007	\$499,407
Security	1.12	\$216,048	\$305,648
Communications	0.34	\$65,586	\$92,786
Insurance	0.13	\$25,077	\$35,477
Service Contracts	0.32	\$61,728	\$87,328
		\$1,350,300	\$1,910,300

Please note: Future utility costs per square foot anticipate cost savings due to energy- and water-efficient features that will be integral to the design of the MSB Addition. Although the estimated operating budget figures do not reflect these further cost savings, LEED-certified buildings have been proven to use as much as 25% less energy and realize up to a 19% reduction in aggregate operational costs in comparison to non-certified buildings.

Source: GSA. August 2011. Green building performance A Post occupancy evaluation of 22 GSA buildings. Available at: http://www.gsa.gov/graphics/pbs/Green_Building_Performance.pdf

10. What impact, if any, will the project have on tuition costs?

There will be no impact on tuition costs as a result of this project.

11. If this project is not authorized, what are the impacts to the institution and its students?

Currently, there are no other funding approaches that are feasible if this proposed project is not funded through State of Michigan Capital Outlay process. Without the additional space provided by the proposed MSB Addition, UM-Flint cannot sustain continued growth in STEM enrollments. The University will be forced to turn away prospective students, resulting in fewer qualified graduates to meet growing demand for science, engineering, and health professionals in Michigan. Without the innovative instructional laboratories proposed for the MSB Addition, the quality of the student educational experience will be compromised. These multidisciplinary interactive spaces will complement the existing traditional labs and allow faculty to implement the high impact pedagogies that have been proven to foster multidisciplinary teamwork and problem-solving skills—the types of skills now required in business, industry, and health professions.

12. What alternatives to this project were considered? Why is the requested project preferable to those alternatives?

Alternatives to the proposed MSB Addition were deemed both counterproductive and more costly. The only feasible alternative to a building expansion would be to create additional interactive lab and classroom spaces within the existing Murchie Science Building. This type of effort would displace current functions and require costly renovation of existing space. The infrastructure requirements for science labs are intensive; thus, lab redesign/renovation can cost nearly as much as, if not more than, new construction. Prior renovations to the original Murchie Science Building focused on optimizing current resources, extending the useful life of the existing asset and upgrading to existing lab spaces. Any further efforts to increase the quality and quantity of instructional lab space will require a building expansion, as outlined in this request.