FINAL REPORT
from
UNIVERSITY of MICHIGAN - FLINT
STEM INITIATIVE TASK FORCE

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Executive Summary

The Science, Technology, Engineering, and Mathematics (STEM) Task Force was appointed by Provost Voland in September 2012. The charge to the task force included examining the current campus program offerings (academic and non-academic) and areas of potential growth; and identifying resources as well as refinements to organizational structures within academic affairs to significantly expand/enhance STEM fields. Provost Voland attended the first meeting of the task force to distribute the charge to the task force. He also emphasized that the task force’s recommendations should not be limited to constraints such as resources, space, etc. The task force should figure what is needed to significantly strengthen the STEM fields and not limit its thinking, including concerns about the presence of possible competition.

The task force consisted of eight faculty members, a faculty administrator and one staff member. It was co-chaired by Senior Vice Provost for Academic Affairs and a senior faculty member. Administrative support was provided by the Office of Graduate Programs and the Directors of Research and Institutional Analysis provided research support. The task force met throughout the academic year (2012-2013), and issued its final report in June 2013.

The task force conducted an extensive review of numerous internal and external reports, surveyed the UM-Flint STEM faculty, interviewed four deans at other universities, conducted two open forums, and examined STEM programs at selected other universities (via their Web sites). It also formed seven sub-groups to research and to make recommendations pertaining to specific aspects of STEM education such as academic program offerings, recruitment and retention, K-12 and industry partnerships, financial resources, and organizational structure.

The task force identified a number of issues pertaining to STEM education at UM-Flint. Some of the more significant ones are as follows. While the overall enrollment in UM-Flint STEM fields has experienced growth over the years, it still lags behind the national average. This is partly caused by lack of sufficient academic program offerings as well as not having focused recruiting. Faculty hiring in STEM fields has not kept up with the growth in enrollment. Retention rates remain significantly challenged and below the general university retention rates. These challenges are not totally unique and parallel those of the national scene. Examination of the UM-Flint K-12 partnerships revealed that the university has recently increased its efforts in this regard and now offers several dual-enrollment programs and outreach events. However, there are significant science and math deficiencies among Michigan students and elsewhere, particularly among African American students. The university has sought and obtained external grants in STEM fields over the years with the most recent funding levels being between $150K
and $300K per year. However, this level of grant funding is not nearly commensurate with the size and composition of the campus. Additional external grants would benefit the campus in many ways such as more indirect cost recovery, needed research equipment, travel support, graduate student assistantship and many others. The challenges in this area include lack of a distinct STEM unit and absence of any incentive for faculty to engage in grant writing activities. The survey of STEM faculty revealed a number of concerns including lack of adequate STEM faculty to cover one’s programs and/or develop new programs, student retention, faculty development, compensation, ability to attract and retain quality faculty, and funding for STEM disciplines. The task force also examined various organizational structures that could support addressing some of the issues it had identified.

The recommendations section of this report is divided into separate sections, organized by each specific aspect of STEM education. A list of more significant recommendations is as follows:

- **New academic programs** – explore development of a number of new discipline-specific and interdisciplinary programs at both graduate and undergraduate levels.
- **Student Recruiting** – regain prominence of science in curriculum; create effective bridge programs; diversify the recruiting efforts; and develop more effective recruitment strategies.
- **K-12 Partnerships** – focus on elementary teachers; expand existing programs; familiarize high school students with STEM careers; and hire a STEM K-12 coordinator.
- **Retention** – expose students to at least one high impact practice, implement peer mentoring; utilize proven active learning techniques; strengthen students’ math preparation; and increase student success by using a robust set of metrics.
- **Sponsored Research and Industry Connection** – review tenure/promotion standards and faculty annual review process and reward attainment of significant grants; review faculty workload and explore offering reassigned time for grant writing and administering; create a STEM industrial advisory board; collaborate with industry to create current and popular academic programs; and hire a fulltime STEM internship coordinator.
- **Faculty Development** – develop a five-year plan to increase the number of STEM faculty proportional to the enrollment levels; conduct a market analysis of STEM faculty and undertake equity adjustment as needed; and increase funding support for STEM fields.
- **Organizational Structure** – explore creation of a new STEM structure with priority given to a new college, followed by a division within CAS, an institute or a center.
I. Introduction

In his 2013 State of the Union address, President Obama recognized the importance of expanding science, technology, engineering, and mathematics (collectively known as STEM fields) in the United States (U.S.). He stated [1],

“Tonight, I’m announcing a new challenge to redesign America’s high schools so they better equip graduates for the demands of a high-tech economy. We’ll reward schools that develop new partnerships with colleges and employers, and create classes that focus on science, technology, engineering, and math – the skills today’s employers are looking for to fill jobs right now and in the future.”

A number of extant studies have shown the need to increase the number of post-secondary graduates in STEM fields. For instance, a 2012 report by the President’s Council of Advisors on Science and Technology identified the critical importance of creating more STEM graduates. It stated, “Economic projections point to a need for approximately one million more STEM professionals than the U.S. will produce at the current rate over the next decade if the country is to retain its historical preeminence in science and technology [2].” The report also points to retention and graduation as major issues in need of greater attention and suggests a more holistic approach to STEM education.

The U.S. Congress has also been highly supportive of expanding STEM fields for many years. Its most recent comprehensive official act was undertaken on February 11, 2011 when Congress established the Committee on Science, Technology, Engineering, and Math (STEM) Education (also referred to as CoSTEM) by action of the National Science and Technology Council (NSTC) [3]. The creation of CoSTEM was a follow up to Section 101 of the America COMPETES Reauthorization Act of 2010. The explicit purpose of CoSTEM is to coordinate Federal programs and activities in support of STEM education.

Michigan government officials have recognized the importance of expanding the STEM fields as well. In February 2012, Governor Snyder made the following remarks at an “Expanding Opportunities for Job Creation” hearing before the U.S. House Committee on Education and Workforce [4]:

“I am committed to partnering with Michigan’s public colleges and universities to provide a postsecondary education that is marketable and transferable. A recent report by the Center for Michigan concluded that Michigan graduated 20% too few computer and math professionals, 14% too few healthcare professionals, and 3% too few engineers in 2009 - 2010. Among our shortage, there is a common message. Addressing these deficits will require Michigan to invest
in the development of science, technology, engineering, and math (STEM) as well as health industry talent. Otherwise, these shortfalls hold the potential to stunt Michigan’s projected economic growth.”

a. Planning Efforts at UM-Flint

The University of Michigan-Flint has had a long history of involvement with STEM fields, including academic program offerings, scholarly research, grants and sponsored research activities, outreach efforts, and more recently dual-enrollment programs.

Expansion and enhancement of the STEM fields has been identified as one of the top priorities of the University of Michigan-Flint for several years. The 2007 Blue Ribbon Commission Report (i.e., the 2007 academic plan) contained 11 recommendations. Its third recommendation states [5],

Seek external funding to create a STEM (Science, Technology, Engineering and Math) Center. The proposed Center would be charged to develop and offer (in conjunction with academic units) new multidisciplinary STEM undergraduate and graduate programs and degrees, which build on our existing strengths.

Further, the 2011-2016 Strategic Plan Priority #1 is to “Enhance the quality and breadth of academic programs, and be a school of first choice” [6]. This Priority contained two sets of initiatives: Enhanced Academic Quality and Targeted Program Growth. The sixth recommendation in the latter states,

Target program growth in science, technology, engineering, math (STEM) areas on the basis of demonstrated student interest and available funding.

b. Formation of the Task Force and Charge

In response to the above recommendations, in fall 2012 Provost Gerard Voland appointed a task force with the charge of finding ways to expand/enhance STEM fields. The STEM Task Force consisted of the following UM-Flint faculty and staff members1:

- R. Ganguly - Physics
- S. Gano-Phillips - Psychology
- M. Kaufman – Earth Resource Science
- V. Lotfi (co-chair) – Provost Office
- Q. Mazumder - Engineering
- A Moss – Division of Student Affairs
- M. Simkani - Mathematics
- J. Sucic - Biology

1 One faculty member and one staff member joined the task force after it was originally conceived.
Ms. Mary Deibis from the Office of Graduate Programs provided administrative assistance. Dr. Terry Van Allen, Director of the Office of Research and Ms. Fawn Skarsten, Director of the Office of Institutional Analysis provided research support.

The specific charge to the task force included:

*Given the established campus priority on the need to expand STEM fields, what changes/refinements need to occur in academic affairs to achieve this? Proposed areas to examine include, but are not limited to:*

- **Current UM-Flint STEM program offerings and areas of potential growth;**
- **STEM fields that we do not currently offer but should be offering within the next five years, ten years;**
- **Resources (e.g. financial, space, services, etc.) required for expanding/enhancing STEM fields;** and
- **Structures (e.g., center, institute, school, etc.) that promote expansion/enhancement of STEM fields.**

In meeting with the Task Force to assign the above charge, the Provost emphasized that our recommendations should not be limited to constraints such resources, space, etc. The Task Force should figure what is needed to significantly strengthen the STEM fields and not limit its thinking, including concerns about the presence of possible competition. The Task Force was instructed to submit its final report by the end of the winter semester 2013.²

**c. Definition of STEM**

The Task Force began its work in earnest in October 2012. Its first task was to establish a definition of STEM. Establishing a tight definition of STEM fields was deemed important because it would determine which fields of study as well as academic departments to focus upon during the course of the work of the task force.

We checked the National Science Foundation, pertinent U.S. Government sources and other sources to establish a firm understanding of what is meant by “STEM”. While we did not find an “official” definition of STEM, we found a rather common practice of what is included in STEM fields. The following definition was extracted from NCES [7]:

*STEM fields, as defined here, include mathematics; natural sciences (including physical sciences and biological/agricultural sciences); engineering/engineering technologies; and computer/information sciences.*

² In a subsequent conversation with the Provost, it was agreed to submit our report which included the Task Force recommendations before the end of June 2013.
It should be noted that while there is no official definition of STEM fields, the U.S. government uses the stated fields regarding access to work visas for immigrants who are skilled in these fields. Other entities such as the National Science Foundation use the same definition for sponsored research opportunities.

d. An Overview of the Approach

The Task Force formed a project plan which included the following major components:

1. Background research including the following components:
   - Review of selected reports pertaining to STEM fields
   - Review of current UM-Flint academic program offerings
   - Review of admission, retention, graduation reports
   - Examination of STEM faculty hiring and advancements
   - Review of select other institutions with STEM programs
   - Interviewing deans of universities with STEM schools
2. Survey of the STEM faculty at UM-Flint
3. Hold open forums for UM-Flint faculty, staff and students
4. Issuance of the final report

The Task Force agreed to hold weekly meetings, secure assistance from the Office of Research and the Office of Institutional Analysis to undertake the faculty survey as well as obtain the necessary reports. In addition, the Task Force divided into seven sub-groups, each charged with investigating and reporting a specific aspect of STEM such as recruitment, K-12 partnerships, new academic programs, industry connections, student support and retention, financial resources, and organizational structure.

II. Background Research and Issues

We referred to two national reports in the Introduction section. Another comprehensive report was written by Gonzalez and Kuenzi [6] with the Congressional Research Service in August 2012. In their report, Gonzalez and Kuenzi (G & K) examined a number of different aspects of STEM education including federal funding, condition of STEM education in U.S., and policy issues such as elementary and secondary schooling, teacher quality, post-secondary education, and governance concerns.

G & K concluded that the U.S. policy makers have had an “active and enduring interest” in STEM education for a long time. This was reflected by more than 200 bills containing the term “science education” that were introduced between 100th and 110th congresses. Further, despite the common belief that U.S. performs poorly in STEM education, certain aspects of STEM education in U.S. are quite strong. They point to an overall enrollment increase of 35% in science and engineering at the graduate level over the last decade as well as double digit enrollment increases of several underrepresented and minority student groups. However, they discovered serious concerns pertaining to a persistent academic achievement gaps between various demographic groups, STEM teacher
quality, rankings of U.S. students on international STEM assessments, and the ability of the U.S. education system to meet domestic demand for STEM workforce.

a. Current UM-Flint Academic Programs and Enrollment

The University of Michigan-Flint currently offers 16 undergraduate and five graduate programs in STEM fields (Please see Appendix A.) These programs are offered primarily through five departments within the College of Arts and Sciences (CAS). The five departments consist of Biology; Chemistry and Biochemistry; Computer Science, Engineering, and Physics; Earth Resource Science; and Mathematics.

Overall enrollment in the stated programs has experienced a steady growth over the years. Figure 1 presents the student enrollment in STEM fields in undergraduate and graduate levels for the period 2003 through 2012. The fall 2012 total enrollment (i.e., undergraduate and graduate) was over 1,350 students. This enrollment level clearly delineates a strong demand for STEM fields at UM-Flint. When compared with the 2003 enrollment levels, there has been a 55% increase in undergraduate enrollment and close to 1,200% increase in graduate enrollment. While the UM-Flint enrollment growth in STEM fields has been relatively strong, it is still significantly below the national average as a percentage of the total university enrollment. The fall 2012 enrollment level constituted roughly 15.6% of the total UM-Flint enrollment. By comparison, at the national level this figure is over 27% just for undergraduate students.

A number of factors contribute to the relatively lower percentage of STEM students at UM-Flint. Some of the most significant issues are as follows. The University lacks a diverse set of academic degree programs in STEM fields. The programs that are currently offered by the UM-Flint are traditional STEM programs. There is a need for programs that are more aligned with today’s industrial and societal needs, reflecting the recent advancements in the STEM fields. There are at least a dozen academic programs with rather high potential (see Appendix B) that the University could offer if it had adequate human and financial resources. Further, due to lack of sufficient resources, almost all of the undergraduate recruiting efforts are currently directed to general recruiting (rather than program specific and more focused recruiting) and to a rather limited geographic region. Some professional schools undertake additional student recruiting for their own students, but to our knowledge (with the exception of engineering) none explicitly for the STEM fields.
**STEM Faculty Growth versus Enrollment**

Although UM-Flint has experienced a healthy enrollment growth in STEM fields over the past decade, the number of STEM faculty has not increased proportionally. Figure 2 presents the enrollment in the number of undergraduate STEM fields versus non-STEM fields within CAS between 2003 and 2012.
As stated earlier, undergraduate enrollment in STEM programs increased from 802 students in 2003 to 1,246 in 2012, (a 55% increase) whereas undergraduate enrollment in non-STEM fields increased from 1,413 to 1,721(a 22% increase) during the same period. However, when we examine the number of STEM and non-STEM faculty during the same period, the change is not proportional. That is, the total number of STEM faculty (fulltime and part-time) increased from 75 to 99 (a 28% increase) whereas the number of non-STEM faculty increased from 155 to 190 (a 23% increase.) This implies that the number of non-STEM faculty has increased proportional to the non-STEM enrollment increase, but not in STEM fields.

It should be noted that due to significant enrollment declines in CAS in 2011-2012 and 2012-2013 there were fewer faculty hires. If one examines the period between 2003 and 2011, prior to the CAS financial challenges, the increase in STEM faculty was 27% whereas the increase for non-STEM faculty was 27%.

The lack of sufficient STEM faculty, particularly commensurate with the enrollment growth in STEM fields is a significant source of dissatisfaction among the STEM faculty. This issue will be discussed in more details below in the section covering the STEM faculty survey. The discrepancy between the STEM faculty growth as compared to the STEM student enrollment growth not only contributes to morale problems among the STEM faculty, it also hinders the ability of the affected departments to offer current programming as well as the ability to offer new and demanding programs, thereby increasing the College’s overall enrollment. The number of STEM faculty should be proportional to the number of students they enroll, especially since certain science disciplines are much harder to teach, require significantly more preparation time (e.g., labs), and face accreditation standards.

International Student Market

As presented in the K-12 Partnerships section below, the pool of potential U.S. students who are interested in the STEM fields and are adequately prepared (i.e., proficient in math and science) is rather limited and efforts are needed to create ‘pipeline programs’ via K-12 partnerships. On the other hand, an examination of the international student market reveals presence of strong demand for STEM fields. Figure 3 presents the number of international students studying in the United States (U.S.), majoring in STEM fields during academic year 2011-2012. The figure (278,700 students) constitutes approximately 37% of the total number of international students (over 750,000 students) studying in U.S. for the same period. This is compared to only 16% of the students at UM-Flint.

We need to create STEM pipeline programs through outreach efforts and K-12 partnerships. We also need to significantly increase our domestic and international recruiting in the STEM fields. Although
the international students’ market in STEM fields is quite strong, recruiting international students should be done with care and we must ensure such students have adequate language proficiencies.

Figure 3 - International Students Studying STEM in U.S. Universities in Academic Year 2011-2012

b. Retention

Attracting, retaining, and graduating students in STEM disciplines is not only a challenge at UM-Flint, but is also a challenge at colleges and universities across the nation. In the February 2012 report from the President’s Council of Advisors on Science and Technology “Report to the President” [2], the Advisors cite a national retention rate of students in STEM disciplines at roughly 40%. A careful review of retention data at UM-Flint crossing six years shows a first-year comprehensive STEM discipline retention rate of 59.9% and a two-year STEM discipline retention rate of 36.8%. Additionally, a comparison of ACT math sub scores puts our most recent admitted class as scoring at 37% in the ACT College Readiness Benchmark in math. The national percentage of students entering college math ready is 43%. These scores underline the need for K-12 pipeline programs that address math readiness.

Retaining students to succeed and attain their goals in college is widely understood to be a rather challenging task. This task becomes overwhelmingly more complex when a relatively large percentage of students such as ours must have outside employment to pay for their college education.
To make matters worse, a sizeable number of our students who enter the STEM fields are not academically prepared as evidenced by our retention and graduation rates.

Figure 4 presents the results of a retention analysis for selected STEM majors, covering entering freshmen cohorts between 2005 and 2010. The figures are the average (over 6 years) percentage of students who remained within their majors and those who left the major, but stayed at UM-Flint. As seen from Figure 4, in a number of STEM disciplines, especially those with relatively larger number of students, the first year retention rate is around or below 50%. The weighted-average first year retention percentage in one’s major (for those programs displayed in the chart, 905 students) is actually 49.7%. That is, of every two students who began his/her first year at UM-Flint in a field such as biology, one student left the major after one year. While it is true that such students remain at UM-Flint and one can argue that first year students have difficult time deciding what they want to study, if we examine fields such as physics, environmental science, actuarial science, we do not observe the same phenomenon.

![Figure 4](image-url)  

**Figure 4** - First-Year Retention in Major versus University  
(numbers in parentheses represent the number of students in the cohort)

From an administrative and budgetary point of view, retaining students to succeed and graduate is by far more economical than recruiting new ones. *Hence, increasing our retention and graduation rates is not only a moral imperative, it makes economic sense. There is a need to introduce strategies to strengthen our retention and graduation rates.*
c. Outreach and K-12 Partnerships

The UM-Flint is currently engaged in several K-12 partnership programs, ranging from hosting a fully operational five-year early college (i.e., Genesee Early College) to offering dual-enrollment credits onsite at local/regional school districts. Some programs have been in place for as long as six years and some were launched a year ago. These programs are currently supported by one staff member at 30% effort, housed in the Office of Graduate Programs, who spends his time helping to coordinate partnerships with high schools and special events. A second full-time staff position (100% effort), housed in the Provost’s office has been created recently and a search is under way to fill it. This person will become the primary “point person” for these outreach programs. The STEM-focused dual enrollment school program is entitled, Dual Enrollment Education Program (DEEP). The program provides high school students with college-level classes, for college credit, taught by university faculty. The program was first offered at Lapeer in 2007 and is currently being implemented in Utica and Hartland.

For special events, there is only one college/university-level effort, the Super Science Friday (SSF). SSF targets 7th and 8th grade students. All other special events that target both the community as well as select groups are organized, promoted, and funded at the department level and are not coordinated. Some of these events include Math Night, AstroNite, and the Teachers’ Demo Academy. Individual efforts by faculty and students include visiting area schools, judging science fairs, participating in admission events, and assisting with Science Olympiad events at Mott and workshops at Sloan/Longway.

To examine the need for K-12 partnerships in STEM areas, we looked at data from both the Michigan Education Assessment Program (MEAP) and the National Science Foundation [9]. We summarize our findings here, and report our recommendations based on this data in the next section. MEAP scores indicated general underperformance by students in Genesee County schools compared to the state averages, with the largest gap occurring in mathematics. Moreover, the Education Trust-Midwest reported that, statewide, “not a single grade could be considered proficient in math” [10]. In addition, they report, proficiency in science statewide has dropped to below 16%. Review of the NSF data clearly delineates that by 12th grade, there is no racial/ethnic group that is proficient (nationally) in either science or math. Among White/non-Hispanic students, proficiencies are just below 30%, whereas among Black/non-Hispanic students, less than 10% of students are proficient. What is more striking is that this is a seemingly monotonic downtrend that starts before 4th grade. In 4th grade, less than 50% of White/non-Hispanic (and about 8-13% of Black/non-Hispanic) students are proficient in math and science. The proficiency drops to just below 40% (10%) by the 8th grade. There is a clear
need to assist K-12 institutions and their teachers in order to enhance potentially longer term recruitment issues.

The lack of adequate K-12 students’ preparation in math and science impacts UM-Flint in two fundamental ways: 1) we have already lost many potential STEM majors long before they ever reach high-school; and 2) many of our students start UM-Flint with significant deficiencies in their science and math knowledge. We as educators know that a large part of effective teaching and learning is interest and excitement for the subject. If K-12 partnerships can ignite the spark of wonder and excitement for science in our community’s children, we all will benefit. Not only does UM-Flint benefit, but STEM professions benefit simply by showing children what real scientists, engineers, and mathematicians do for living. If we can impart even a small part of the passion we have for our subjects to K-12 students, we have helped our community make informed choices as students, employees, consumers, patients, voters, and citizens.

d. Sponsored Research and Connecting with Industry

At present, there is a sizeable level of federal funding in support of STEM education. It is estimated that at least 13 federal agencies fund 105 to 252 STEM education programs or activities. Annual federal appropriations for STEM education are in the range of $2.8 billion to $3.4 billion [8]. Published reports identify the Department of Education, National Science Foundation (NSF), and the Department of Health and Human Services (HHS) as the key providers of funding.

The University of Michigan-Flint has been actively seeking external funds in support of its STEM programs for several years. Figure 5 represents the total annual amounts of external grants awarded to the University since 2009. The sources of funding for these grants range from federal, to state and local foundations. The grants support such topics as study of quasars and black holes, food science, creation of a solar photovoltaic for the Urban Alternatives House, study of the multiphase high velocity clouds in the Milky Way Halo, evaluation of the adult sea lamprey behavior and many others.
The above grants have been extremely beneficial in supporting STEM programs at UM-Flint, especially providing experiential learning opportunities for our students. However, the University is not currently receiving the level of external funding that is commensurate with its size and composition. There are grant opportunities that the University could easily apply for. However, lack of a distinct STEM unit appears to hinder such efforts. For instance, at Ann Arbor, the College of Engineering alone generated over $178 million of external grant in FY11 whereas the LSA brought in $138 million. In Dearborn, during FY12, the College of Engineering secured $5.2 million in external grants while the College of Arts, Sciences and Letters was awarded approximately $326,000. The total amount of external grants at Dearborn for FY12 was $6.2 million. Another example is Wayne State University in FY11 the College of Engineering was awarded approximately $20 million with close to 100 fulltime faculty whereas College of Liberal Arts and Science brought in the same amount with 437 fulltime faculty. In addition, because the University does not have a distinct STEM unit, it might receive relatively low priority when competing with other institutions with the said structure. Other factors that limit our ability to seek greater external funding include faculty workload and insufficient reassigned time for grant writing (lack of incentives), research space, and limited number of STEM graduate programs and graduate research assistants.

Establishment of enduring relationships with industry partners would benefit all of our stakeholders, including students, faculty, local community, industry partners, and the entire campus.

Benefit of stronger industry partnerships to our students include:

- Successful programs that create bridges from high schools and 2-year colleges to UM-Flint.
- Enrollment in cutting edge programs jointly developed with private companies.
• Hands-on research opportunities and work experiences through internship and learn-and-earn programs as well as class projects.
• Gaining insight into careers and opportunities for STEM practitioners.
• The opportunity to have industry figures as mentors.

Our faculty would benefit by having the opportunity to collaborate with the industry partners on research and development. Science-based industries invest heavily in R&D and are very likely to collaborate intensively with universities. Further, this might enhance our opportunity to receive grants from the industry partners.

The local community would benefit from the academic knowledge spillover, which helps promote innovations and economic growth. The industry partners would benefit by having access to a more knowledgeable and skillful workforce as well as access to the University research facilities. The business employees with STEM background who are considering a career change to become STEM high school or college teachers would benefit from the programs and resources provided by the University and its business partners.

The University would benefit by increasing student retention, partly by engaging the first- and second-year students in applied research. Assigning authentic hands-on research projects to the first- and second-year students is a proven practice to increase retention (e.g. the Freshman Research Initiative at the University of Texas, Austin). Research experience clarifies students’ interests and increases their confidence. We would also benefit by obtaining the external funds that promote university-industry collaboration in favor of the growth in STEM disciplines and opening new pathways for unlikely-to-consider-STEM groups to succeed in STEM fields.

Similar to the challenges facing our ability to generate sponsored research, currently there are no incentives for faculty to seek partnerships with industry. Current promotion and tenure policies do not emphasize external grants, or pursuing and creating industry partnerships. The University has only one fulltime staff member who is in charge of corporate and foundation relations.

e. Deans’ Interviews

As a part of our research, we conducted live video and phone interviews with STEM deans and one non-STEM dean at two other universities. These universities are somewhat similar to our campus in terms of their size. They had recently established their STEM school or college (hereafter referred to as school).

Interviews with the STEM Deans

The primary motivation/rationale for creation of a separate STEM school had been to have a more focused and cohesive academic unit. For some, the apparent unmanageability of a relatively large college of arts and sciences had been a motivator. The initiatives had also stemmed from planning
processes including strategic planning. The newly established schools had formed by housing the traditional sciences, technology, engineering and mathematics departments.

The financial resources needed to create/reorganize STEM schools had ranged from none in one case to new funding to create a dean’s office in another. The sources of funding were internal funds from the university administration as well as external grants. One university had been building a new science building before the reorganization began.

Space allocation/reallocation did not appear to have been a significant issue. One dean commented that space is always challenging and that everyone needs more. One dean reported some minor issues pertaining to space. On the other hand, another dean stated, “there is more flexibility now in moving space between departments”.

When asked about benefits gained as a result of the creation of the new STEM schools, the deans highlighted: greater collaboration among faculty; increased external funding; enrollment growth; more efficient administration and administrative processes; better student recruitment by admissions office due to having a distinct identity; increased research productivity; and greater efficiencies. As for the challenges, having different faculty cultures was stated by all of the deans. In one case, having different department configurations (i.e., some small departments and some relatively large departments) has been an issue.

Interview with the Non-STEM Dean

We also contacted the Dean of College of Arts, Humanities and Social Sciences (CAHSS) at one of stated universities that had created a separate STEM college. We asked the dean a similar set of questions that were based on the questions that we had asked the STEM deans. This dean had joined the CAHSS after separation from the STEM College. The Dean reaffirmed the motivation behind the separation. When asked if the move had “hurt” the remaining CAHSS, it was stated that there was nothing that really hurt the existing college. However, some of the impacts were that the remaining faculty was left with general education and not grant-producing disciplines. The Dean further stated that if the two colleges were to be combined the resulting unit would be enormous and rather difficult to manage by one dean. She identified certain benefits of the current organizational structure and indicated that “small colleges allow in one sense greater productivity.” As an example, it was cited that CAHSS faculty is starting to engage in more research activities where before their focus was teaching.

In regards to enrollment changes after the split, The Dean did not believe there was any negative impact to CAHSS. The new majors that are being developed are starting to grow. The Dean mentioned the presence of certain space and equipment issues and stated that they should be addressed in advance. Also, there were concerns about certain types of resources that had been shared before such as a computer lab. Overall she viewed the split as positive decision, particularly for the university.
f. STEM Faculty Survey

As a part of our research and data collection, we decided to survey our STEM faculty and seek their input on a number of different aspects of STEM education at UM-Flint. The goal of our survey was not to accomplish a differential analysis; rather, we sought to obtain a snapshot of STEM faculty opinions and attitudes about various issues facing them. Accordingly, with assistance from the Office of Research during late fall 2012 and winter 2013 semesters, we surveyed faculty members from the departments of Biology, Chemistry/Biochemistry, Computer Science, Earth and Resource Science, Engineering, Mathematics, and Physics/Astronomy. We received a total of 55 responses out of 55 survey requests or a 100% response rate. The survey contained three types of questions: gap-analysis questions where we compared importance of an issue versus the respondent’s satisfaction with it; those that were just evaluative and sought the respondents’ views or assessment of an issue; and open ended questions, allowing a written response to the question. Below is a summary of the results, and Appendix E provides the details of the survey results.

The gap-analysis questions covered a number of categories including physical infrastructure, organizational support for STEM initiatives, external funding opportunities, student retention, student support, and STEM promotion and advertising. The five issues of highest importance to the respondents were: implementing measures to improve student retention; funding for STEM disciplines; adequate support for faculty development; competitive faculty salaries; and growth in fulltime faculty (proportional to enrollment levels). Some issues that received the lowest satisfaction among the faculty were those that were of highest importance such as competitive salaries, adequate number of fulltime faculty, and funding for STEM disciplines. Other items with low satisfaction revolved around support for scholarly research, equipment for research, release time for developing grant proposals and conducting research, and lab space. Items that had the largest gaps (satisfaction versus importance) were: number of fulltime STEM faculty; competitive salaries, startup funding, and funding for STEM disciplines.

The questions that were designed to assess the respondents’ view of the issue (non-gap type questions) focused on: ability to attract, hire, and retain quality faculty; maintaining accreditation; faculty teaching load; sufficiency of faculty to cover one’s discipline; and organizational structure. A relatively large percentage of respondents (78%) stated that their department did not have sufficient faculty to adequately offer their programs. Additionally, 79% of the respondents indicated that their teaching load and course preparation interfered with their ability to conduct the scholarly research expected of them for tenure/promotion. Twenty five respondents observed that they had lost potential new hires primarily due to non-competitive salaries, inadequate startup funding, inadequate facilities, lack of instrumentation/equipment, and space for research.

A number of open-ended questions were also included. They covered areas such as: things that the university is doing well; areas in need of improvement; how to promote STEM fields; and how to make STEM fields more attractive. Responses to these questions were quite varied and will not be summarized here. We did incorporate many of the suggestions throughout our report and within the
recommendation sections. The reader can refer to the full survey results available in the Office of Graduate Programs.

We also asked the respondents to identify which of several organizational structures (e.g., a center, an institute, a division, a new college, etc.) they preferred, including maintaining the status quo. An overwhelming majority (89%) felt that some new structure was necessary. Preference for a center or an institute was 13% with 17% favoring a new STEM division within CAS. The percentage of respondents favoring the creation of a new school or college was 59%. Lastly, 11% of the respondents selected “none of the above.” These responses aligned with the question of what would be needed to promote STEM research and education.

g. Open Forums

We held two open forums (dated 2/28/2013 and 3/18/2013) to solicit feedback from the campus. Appendix G presents the full text of the notes taken during both forums. The format of the forums consisted of a PowerPoint presentation by a member of the task force followed by a question and answer session. The PowerPoint presentation contained our charge, members of the task force, definition of STEM and our progress as of the date of the presentation. The first forum had many more staff members present than faculty. However the second forum was relatively well attended and included mostly CAS faculty colleagues.

During each forum, the audience was asked to comment on: academic program offerings, student recruitment/retention, student support, faculty support, and structure. Some attendees chose to ask questions or comment on other areas not included in our list. For instance, a couple of people asked why the faculty survey was administered to only the STEM faculty. We observed that the survey contained numerous questions pertaining to the STEM disciplines only and that our charge was to recommend ways to significantly expand the STEM fields. Another colleague observed that if/when STEM fields grow they will have an impact on other disciplines.

We did not observe a strong overarching theme emerging from the two forums. Generally there were positive comments such as having a STEM focus would help us apply for federal grants, there are existing interdisciplinary research/collaboration between CAS and SHPS that are working well, and high praise of the College of Engineering and Applied Science at Western Michigan University with strong ties to industry. There were also cautionary observations such as potential impacts of growth in STEM fields on other disciplines, the need to keep general education in CAS if there were to be a new STEM college, the need to assess the costs associated with creating a new school/college, and possible fragmentation of the faculty.

h. Organizational Structure

We examined a number of different organizational structures that would support the planned expansion of the STEM fields. These included creating: a STEM center; a STEM institute; a STEM division within CAS; a STEM division within Academic Affairs; a STEM college; or maintaining the existing
structure. In this section, we present a brief overview of each option and provide an assessment of each option and our recommendation in the recommendation section.

It should be noted that our evaluation of the stated options was done independently and not in conjunction with any other possible University efforts. For instance, it is conceivable that one may create an institute within Academic Affairs (outside any school or the college) and then have a series of initiatives launched by the schools and the college at the same time. Incorporating such an approach in our analyses would make it near impossible to determine the absolute strength of each of the options we considered since one would have to have an idea of the depth and breadth of such local initiatives.

Maintaining the Existing Structure

One obvious course of action would be to maintain the current organizational structure at UM-Flint and continue with changes to procedures within CAS. This option, while worth a consideration, was not as aligned with our charge as the provost wanted a specific set of recommendations including “structural” that would result in significant expansion of the STEM fields across the campus.

STEM Center

A center within the University of Michigan system is a budget unit with a specific focus, either academic or service-oriented. Examples on the Flint campus include Thomson Center for Teaching and Learning (TCLT), Center or Environmental Research (CARE), the Women’s Educational Center (WEC) and the International Center (I/C). Centers are normally intended to promote a specific concept such as teaching and learning by TCLT and environmental issues by CARE. They may have faculty affiliates and offer educational programs in the form of workshops or even professional development/continuing education. A center can be housed inside or outside of a school or college.

STEM Institute

An institute is similar to a center in many respects, but perhaps at a much larger scale. An institute is also a budget unit with a specific focus that could be broader than that of a center. In fact, an institute may contain one or more centers. An example within the University of Michigan is the Institute for Social Research (ISR), perhaps the world’s largest academic social science survey and research organization. ISR is composed of five research centers and an administrative support unit, the Center for Institute Services. As with centers, institutes may have faculty affiliates and offer educational programs in the form of workshops or even professional development/continuing education; they do not offer for-credit academic degrees or programs; and institutes are expected to be self-funded (or require minimal general funds).

STEM Division

A division within (or outside) a school/college might be viewed as a consortium of two or more departments of homogeneous academic disciplines. To our knowledge, there is no universal definition of a “division” – rather, its scope/authority will depend upon the specific implementation. For
instance, a division might have total budgetary autonomy, very minimal autonomy, or none. Similarly, a division might have near complete autonomy over its tenure/promotion standards, policies, and practices or be bound by those of the larger unit. An example of a divisional organization is the College of Arts and Sciences at the University of North Carolina at Chapel Hill. In this case, the College is divided into four divisions: the Division of Fine Arts; the Division of the Humanities; the Division of Natural Sciences and Mathematics; and the Division of Social Sciences.

STEM College

A STEM college would be similar to one of the existing professional schools at the University of Michigan-Flint. It would be comprised of two or more academic departments within the fields of science, technology, engineering, and mathematics. It would function as an autonomous academic unit with its own budget, faculty, departments, policies/procedures, codes, governing bodies (e.g., executive committee, etc.) curricula and other pertinent components.

Establishment of a STEM college would require negotiations with would be affected parties as well as approval by the Regents. A college would require a dean and possibly some additional administrative support personnel such as an associate dean, a budget person, administrative assistant, etc., as well as some administrative offices.

III. Recommendations

We have examined a number of different aspects of STEM fields at UM-Flint such as program offerings, recruitment and retention, faculty concerns, partnerships, and funding including sponsored research and others. We have also identified various issues facing the STEM fields at UM-Flint. Below, we present our recommendations, organized by each aspect of STEM education separately.

a. New Academic Programs

There are a number of potential new innovative programs that could be developed at both the undergraduate and graduate levels. Many of these could be interdisciplinary. Additionally, many are “state of the art” programs that have the potential to draw large numbers of students. Several of these including the MS in Mechanical Engineering, the BSE in Industrial and Operations Engineering, and the BSE in Electrical and Computer Engineering are in the planning stage, while others are purely hypothetical at this point. Below is a summary of the potential new programs. Appendix B presents details of each proposed program.

- Potential Interdisciplinary Graduate Programs
  - MS in Bioinformatics (Biology and CSEP)
  - “Biotechnology-based” MBA
  - “Science Education” Master’s degree

- Potential Graduate Programs Housed Within One Department
o MS in Mechanical Engineering
o MS in Cell/Molecular Biology
o MS degree in ERS
o MS degree in Psychology

- Potential Interdisciplinary Undergraduate Programs
  o Neuroscience (Biology and Psychology)
  o Bioinformatics (Biology and CSEP)
  o Biophysics (Biology and CSEP)
  o Landscape Ecology (Biology and ERS)
  o Forensic Science (Biology/Chemistry/Anthropology)

- Potential Undergraduate Programs Housed Within One Department
  o BSE in Industrial and Operations Engineering; BSE in Electrical and Computer Engineering; BSE in Automotive Engineering
  o “Green Chemistry” tract or degree
  o Material Science (Chemistry, or perhaps Chemistry/CSEP)
  o Astronomy

In addition to the potential programs listed above, there are numerous programs that could be offered in fields related to Informatics, over and above the identified program in Bioinformatics. These include programs in Business Informatics; Cheminformatics; Community Informatics; Computational Informatics; Development Informatics; Ecoinformatics; Education Informatics; Engineering Informatics; Environmental Informatics; Health Informatics; Music Informatics; and Social Informatics. This is not a complete list, rather it is representative of a set of cross-disciplinary programs that could take advantage of expertise from programs already offered on this campus. Using similar reasoning, there is the potential for programs in various computational fields: Computational Biology, Computational Chemistry, Computational Linguistics, Computational Mathematics, Computational Physics, etc.

b. Student Recruiting

Our proposed recruitment strategies are intended to address the current UM-Flint recruitment issues and expand them to include certain other subsets of potential student populations. They are built upon four objectives, each with a certain set of strategies. Below is a summary of our recommended recruitment strategies. Appendix C presents details of each strategy.

- Regain the prominence of science in the curriculum
  o Build a unique STEM identity through outreach, marketing and branding effort
  o Expand curricular efforts such as UNV100

- Institute effective bridge programs, summer camps, peer-mentoring
  o Provide hands-on science education to elementary and middle school students
  o Expose students to real-life scientists and engineers
• Ensure science teachers are well-trained

• Develop a broadly-based and efficient STEM recruiting strategy
  o Recruit from within
  o Target STEM-centered educational outlets
  o Work with high school counselors
  o Recruit outside of the box
  o Create post-doctoral residency opportunities

• Diversify recruitment efforts
  o Increase the percentages of women and minorities enrolling in the STEM disciplines
  o Perceived similarity to the organization matters
  o Recycle—link science and teaching
  o Heavily expand recruitment of international students
  o Expand geographical area of STEM recruiting efforts

We believe the above recruitment strategies will significantly enhance and expand our abilities to recruit STEM students.

c. K-12 Partnerships

The goals of K-12 partnerships at UM-Flint should be: 1. Encourage student interest in STEM for the sake of our disciplines and a well-educated society; and 2. Connect students to UM-Flint as a place where engaging STEM programs exist. To attain these goals, we recommend the following strategies. (Details of these strategies are presented in Appendix D.)

• Focus on Elementary Teachers
  o Create series of workshops in each of the sub-STEM disciplines that teach teachers how to incorporate hands-on experiences in the classroom.
  o Incentivize participation in the workshops by providing the necessary materials, financial support for substitute teachers, and offering continuing education credits to the teachers.
  o Incentivize participation of the UM-Flint faculty and staff by for participating in these programs by rewarding them during annual reviews and promotion and tenure process.

• Expand Existing Programs
  o Expand the existing Super Science Friday to include a series of programs that lead to more in-depth exploration of a subject for interested students (i.e. “Awesome Science Saturday”).
  o Explore the development of a STEM focused middle college (similar to Genesee Early College).

• Educate High School Students on STEM careers
  o Work with Admissions and University Relations to hold specific STEM events that connect prospective students to STEM faculty and alumni.

• Hire a specific STEM K-12 Coordinator
  o Hire dedicated staff member to coordinate the STEM K-12 programs, and to seek specific STEM funding for these outreach programs.
d. Retention

The retention recommendations that are presented here are aimed at implementing student success strategies that are proven effective, but are also unique to the distinct nature of our campus. Several themes and highlighted programs that appear in the “Report to the President” serve as the foundation for the recommendations that are enumerated below.

- Within the first two years of a student’s enrollment at UM-Flint, they should be exposed to:
  - At least one high impact practice such as research-based opportunities, collaborative learning projects, or internships
  - Peer mentoring program in a learning-community environment
  - Proactive outreach from academic advisors that address the creation of academic plans, student financial realities, and co-curricular plans
- To the extent possible, proven active learning techniques should be a primary pedagogical approach of courses taught in the first two years of the sequential STEM curriculum
- Student math preparation should be addressed by
  - Using a summer bridge program when presenting scores warrant it
  - Giving special attention to Intermediate Algebra, College Algebra and Pre-Calculus courses, with proven teaching/learning strategies
  - Implementing a creative supplemental instruction model that works for our students. Such a model could deviate from the current process and include a teaching assistant structure
- Establish a robust set of metrics on student success and excellence and use the outcomes for continuous program improvement

We believe that the above recommendations, in conjunction with the other recommendations in this report, will give immediate attention to the success of our students and will uplift their total student experience and student life cycle.

e. Sponsored Research and Connecting with Industry

To significantly increase our future sponsored research activities and our ability to seek and obtain external grants, we recommend the following:

- Review tenure/promotion standards and when appropriate and reward attainment of significant external grants.
- Review faculty annual performance criteria and incentivize awards of external grants.
- Review faculty workload and develop reassigned time for grant writing efforts as well as those with external grants.
- Develop new STEM programs at the graduate level and support additional graduate student research assistants.
- Create a formal framework for the exchange of research ideas and funding opportunities.

To expand our partnerships with industry, we recommend the following:
• Create the leadership for joining networks of universities designed to connect corporations to universities. The State of Michigan supports networks that promote innovations and economic growth.
• Create a STEM Industrial Advisory Board.
• Look for creative solutions to open new pathways into the STEM fields:
  o Collaborate with the industry, high schools and 2-year colleges to develop bridge programs for smooth transitions into University’s STEM programs.
• Work with the industry to create special STEM programs for unlikely potential students of the traditional programs.
• Partner with businesses to provide academic programs and resources to help their employees with STEM background to change careers such as becoming STEM teachers.
• Increase the number of programs that include applied projects with the cooperation of the industry.
• Work closely with the industry on curriculum development and maintenance. Ensure that academic programs incorporate learning standards and content consistent with industry-recognized skills.
• Hire a full-time STEM Internship Coordinator to identify funding sources and to significantly increase internship opportunities and learn-and-earn programs.
• Create the leadership for improving the R&D collaboration with the industry significantly.

f. Faculty Development

Recommendations in this section originate from the findings in II.a - Current UM-Flint Academic Programs and Enrollment as well as section II.f – STEM Faculty Survey. It is critically important to recognize that availability of adequate number of qualified STEM faculty will impact all of the different aspects of the STEM education that we have discussed in this report. Faculty can grow existing programs, develop and offer new programs, play a significant role in strengthening retention and assist with recruiting, bring in external grants thereby support graduate students and increase our indirect cost recovery, expand our outreach efforts and offer pipeline programs such as dual-enrollment and early college, and contribute in many other ways.

• Review historic and current enrollment levels in STEM fields and develop a five year plan to increase the number of STEM faculty to be commensurate with the enrollment levels.
• Conduct a market analysis of STEM faculty salaries and undertake equity adjustment as appropriate for those below the market.
• Implement parts of the newly released “Reassigned Time” report commissioned by the Provost and provide release time to faculty for writing significant grant proposals as well as working on such grants.
• Review funding levels in STEM departments and ensure STEM disciplines are funded appropriately.
• Increase the startup funds for new hires and standardize reduced teaching load during the first one or two years for new faculty hires similar to those in some UM-Flint professional schools.

• Increase the travel funds for conference attendance and other professional development opportunities and guarantee coverage of minimum of one conference per year.

• Create an annual equipment/instrumentation fund.

We believe the above recommendations when implemented should address several faculty concerns and contribute to the successful attainment of our other goals in this report.

**g. Organizational Structure**

As stated earlier, we examined a number of different organizational structures, including maintaining the current structure and not adding any new one. We recognize that many aspects of each of the structures we examined in our work, including the status quo, shall depend upon the specifics of the implementation and may vary widely. In addition, implementation of many of the options we examined will require additional resources, some significantly more than others. While we did consider such a criterion, we were also operating under instructions from the Provost not to limit our recommendations to such constraints and to focus on the long term.

We also recognize that our recommendations for the organizational structure will be perhaps the most sensitive part of our report and one that will require future analysis and discussions. Hence, irrespective of which option is implemented, *we encourage the administration to take a considered and methodical approach and to consult with all of the pertinent parties.*

We do not believe the option of “doing nothing” is best, especially since close to 90% of our faculty respondents in the survey believed otherwise. One might argue that, the College of Arts and Sciences could undertake a set of initiatives to promote the STEM fields rather than proposing a brand new structure. This of course would mean that something is being done, albeit within the College and on a smaller scale. While this approach would be easiest to implement, we believe the approach would not address a number of issues raised in this report such as the desire for a distinct identity.

A STEM center was deemed to be relatively easy to create as it does not require Regents approval. It would primarily require adequate personnel and some space, as well as faculty affiliates and/or an advisory board. A center could assist with recruiting and outreach efforts as well as promoting connection with K-12 and industry. A drawback of a STEM center is its inability to offer for-credit and/or degree programs. It can, however, assist with undertaking market studies, identifying potential new academic programs. A center would be able to facilitate applying for external grants and or other types of external funding. It is not clear that a center would be in a position to address some of the STEM faculty concerns such as workload, release time for research, curriculum matters, and the need for additional faculty. Our task force viewed creating a center as the fourth preferred option.

Creating a STEM institute would be somewhat more complex, requiring Regental approval. All of the stated advantages of a center would apply to an institute with perhaps the possibility of the added
prestige in undertaking sponsored research and applying for external grants. Long term, an institute could become organizationally more complex and even contain one or more centers. The same limitations of a STEM center also apply to an institute, particularly in its ability to address faculty concerns. Financial requirements for creating an institute would depend upon its complexity. Our task force assessed the creation of an institute as the third preferred option.

Creating a STEM Division within CAS would require approval by the CAS Governing Faculty as well as the Departments to be placed within such a division. It would also require a division head and possibly some additional support personnel and possibly some administrative offices. The complexity of creating a division would depend upon its scope and authority. In addition to the advantages associated with a center or an institute, a division will have the ability to offer academic degrees and for-credit programs because it consists of existing academic departments. Some potential shortcomings of a division might be the lack of complete autonomy in curricular matters; personnel policies such as promotion and tenure and compensation; lack of a clear and universally understood identity; and having to compete for resources with numerous other departments/divisions within the college. Some of the above potential shortcomings of a division can be avoided by having clear policies and procedures, agreed upon by the entire college faculty and administration.

Financial requirements for creating a division would depend upon its complexity and structure. A division’s ability to address all of the issues identified in this report is much greater than that of an institute but still face certain limitations. A division outside of a college (i.e., at the provostial level) would be similar to a center/institute if it would not be allowed to offer academic degrees. It would function similar to a school/college if it could offer degree programs. Creating a STEM division within CAS was the second preferred choice of the STEM faculty who completed survey (9 out of 54 respondents or 17%). Our task force considered creation of division within CAS as the second preferred option.

Establishment of a STEM college would require extensive negotiations with would be affected parties, relatively much higher initial financial resources, as well as approval by the Regents. Similar to other professional schools at UM-Flint, a college would require a dean, administrative personnel and space. Advantages of a STEM college include all of those associated with a center, institute as well as its ability to offer academic degrees and for-credit programs. A college will have a distinct identity and may be able to more effectively apply for sponsored research and external grants. It will have complete autonomy over its programs, faculty, students and staff. A college would have the potential for responding to its faculty needs somewhat more expeditiously, not have to compete for resources with many other departments within a school or a college. It will have access to the senior university leadership (i.e., provost). The departments within a STEM college would also benefit from having deans and committee members from disciplines that are more comparable to their own. This option was by far the most preferred choice of the STEM faculty who completed survey (32 out of 54 respondents or 59%). It was deemed by the majority of the task force members (six out of ten) as the most preferred choice. However, this was also the least favorite choice of two members.
It should be emphasized, however, that if this option were to be pursued, each of the pertinent STEM departments within CAS should be given the right to join the new college or remain within the remaining part of CAS. Further, and more importantly, implementation of this option should be done with utmost care and in-depth analyses to ensure that both the STEM College and the remaining part of CAS would be able to support themselves financially.
Appendix A - STEM Programs & Enrollment Trends at UM-Flint

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STEM Graduate Summary

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Appendix B - Potential New Programs

Potential Interdisciplinary Graduate Programs

1. MS in Bioinformatics (Biology and CSEP)
   Bioinformatics has become a popular major at many institutions around the country, with graduates in demand at a variety of academic institutions, government laboratories, and private enterprises. An M.S. program might prove to be extremely popular, as it could provide graduate training in an extremely current field with available employment opportunities.

2. “Biotechnology-based” MBA
   Biotechnology and pharmaceutical companies are often interested in hiring individuals for marketing and sales positions that have expertise/background in both science and business, making this program a possibility for students interested in pursuing these kinds of options.

3. “Science Education” master’s degree
   A number of institutions currently offer masters level programs where students take a mix of education and science courses (with the latter either concentrated in one discipline or spread over several disciplines). Offering such a program here could potentially spur enrollment from area teachers.

Potential Graduate Programs Housed Within One Department

1. MS in Mechanical Engineering
   This program is currently in development and will allow CSEP to fill a key curricular niche and offer a highly technical and specialized program to qualified graduate students.

2. MS in Cell/Molecular Biology
   One of the most frequently asked questions that prospective M.S. in Biology students ask is whether specialized graduate degrees in biological fields will ever be offered; the most popular of these specialized degrees—especially among international students—is an M.S. in Cell/Molecular Biology.

3. MS degree in ERS

4. MS degree in Psychology

Potential Interdisciplinary Undergraduate Programs

1. Neuroscience (Biology and Psychology)
   Neuroscience is one of the “hottest” fields of research today. While both the Biology and Psychology departments provide some instruction in neuroscience, having a formal degree tract could draw more students and better prepare them for careers in this field.

2. Bioinformatics (Biology and CSEP)
   Bioinformatics has become a popular major at many institutions around the country, with graduates in demand at a variety of academic institutions, government laboratories, and private enterprises. An undergraduate program might prove to be extremely popular, as it
could provide training in an extremely current field that would allow students to pursue entry-level employment positions.

3. Biophysics (Biology and CSEP)
   While a Biophysics program is a possible new degree option, with faculty already in place who are capable of teaching the coursework, this would almost certainly be attractive to only a very small number of students.

4. Landscape Ecology (Biology and ERS)
   Landscape ecology is a natural fit for the Biology and ERS departments and could prove to be a popular major. Students completing a Landscape Ecology degree would have a number of employment or graduate education opportunities.

5. Forensic Science (Biology/Chemistry/Anthropology)
   Forensic science continues to be a field that offers a number of employment prospects for skilled individuals. A Forensic Science degree tract could be extremely interdisciplinary, with major contributions to the curriculum provided by the Biology, Chemistry, Anthropology, and perhaps other (i.e., Criminal Justice) departments.

Potential Undergraduate Programs Housed Within One Department

1. BSE in Industrial and Operations Engineering; BSE in Electrical and Computer Engineering; and BSE in Automotive Engineering
   These programs are currently in development and will allow CSEP to attract students interested in these disciplines, who otherwise would not have considered attending UM—Flint.

2. “Green Chemistry” tract or degree
   Green chemistry is another extremely “hot” field right now, and a degree tract in this area will likely provide students with many career and employment opportunities. Furthermore, this would be a degree tract that might lead to a variety of industry collaborations.

3. Material Science (Chemistry, or perhaps Chemistry/CSEP)
   Like green chemistry, material science is a potentially in-demand degree option that would likely open up possibilities for industry collaborations.

4. Astronomy
   Astronomy is a popular field that can potentially attract many students. Currently, UM-Flint is the only campus in the University of Michigan system (and possibly the only state university) that does not offer a degree, or even a minor, in astronomy. Astronomy is a very versatile field, and students trained in astronomy have many marketable skills that are sought after in industry, teaching, business, and economics.
Appendix C - STEM Student Recruitment

1. Regain the prominence of science in the curriculum

- **Build a unique STEM identity through outreach, marketing and branding efforts.** For example, establish a multi-disciplinary Institute/Center for STEM Public Policy and Leadership to address the national-scale erosion of scientific literacy. This institute would build support for educating a competitive workforce for a global, technologically complex economy. Create a public forum for the exchange of ideas between education researchers and education practitioners.

- **Expand curricular efforts such as UNV 100.** Offer introductory courses to first-year students that provide exposure to science from different perspectives. For example, courses such as the “History of Ideas” or “Advancements in Science and Technology” can fulfill this objective.

2. Institute effective bridge programs, summer camps, peer-mentoring

- **Provide hands-on science education to elementary and middle school students.** Through the Integrated Science TCP program and applied research of the faculty, develop curriculum that engages students early on and keeps them interested as they move from elementary to middle school. This allows students to learn science the way scientists do – by doing it.

- **Expose students to real-life scientists and engineers.** Few students understand the full range of STEM careers available to them. This is why it is so important to expose them to actual scientists and engineers as early as grade school. This will demystify STEM and make pursuing studies and careers something real--something they can touch and feel. For computer science this is particularly important because computing is such an integral part of our lives, yet few K-12 science teachers have degrees in the field.

- **Ensure science teachers are well-trained.** How can we expect our students to excel in science if their teachers aren’t properly prepared to teach it? Studies show that science is often the subject that elementary school teachers feel least prepared to teach. Provide ongoing professional development (e.g., a Masters in Integrated Science) that hones teachers’ instructional abilities and knowledge of science content. These efforts have been shown to have a positive impact on student performance and achievement.

3. Develop a broadly-based and efficient STEM recruiting strategy

- **Recruit from within.** Research by Penn State and other institutions has shown that up to 80 percent of students entering college are not certain what they want to major in, even if they have initially declared a major. In addition, up to 50 percent of college students change their majors at least once before graduation, and some change several times.

- **Target STEM-centered educational outlets.** Specifically, the National Consortium for Specialized Secondary Schools of Mathematics Science and Technology (NCSSSMST); 6 of these schools exist in Michigan. In addition, the Michigan Math and Science Centers Network is a collaboration of 33 regional centers throughout the state created by the Michigan Legislature to elevate mathematics and science education for all students in
Michigan. This network supports the delivery of high quality mathematics and science education for the students of Michigan.

- **Work with school counselors.** Identify all talented science and math performers at all schools within the “inner radius” of UM-Flint; that is, within commuting distance. Each of these students should be visited by representatives from our school (via school presentations) and also be invited to visit UM-Flint by the 11th grade.

- **Recruit outside of the box.** Develop programs that allow high-school seniors to take specific courses for college credit at UM-F. The high school teacher must be qualified to teach the college course, and they use the UM-F syllabus. Increase out-of-state recruiting, especially in high diversity areas, and create substantial financial assistance packages for high-ability out-of-state students.

- **Create post-doctoral residency opportunities.** Adding post-doctoral students can help departments expand their research and provide an opportunity to evaluate potential future faculty.

4. **Diversify Recruitment Efforts**

  - **Increase the percentages of women and minorities enrolling in the STEM disciplines.** Mimic other successful pre-college recruitment programs for women and minorities, such as the Pre-collegiate initiative for minorities in engineering (PRIME), the summer undergraduate program in engineering research at Berkeley (SUPERB); Mathematics, Engineering, and Science Achievement (MESA), and the Sisters in Science at Temple University. In addition, programs such as the Ohio House of Science and Engineering coordinate resources across colleges and departments, while STEM scholarships and summer bridge programs help recruit new students, particularly students from underrepresented groups, and support them through the transition to college. For women and minorities considering STEM careers, personal encouragement from instructors or counselors is often effective.

  - **Perceived similarity to the organization matters.** For example, the ethnic diversity of a recruitment advertisement can impact the perceived attractiveness of an organization, the perceived compatibility to the organization, as well as organizational image. The level of diversity presented in advertisements was especially powerful for minority participants, and minorities are more likely to be attracted to ads in which diversity extends to supervisory levels, not just lower level employees. (Perkins and Thomas et al. 2000; Avery 2003).

  - **Recycle—link science and teaching.** A program at the Technion University in Israel invites STEM graduates back to the campus to study toward an additional bachelor's degree in its department of education in technology and science, which awards a teaching certificate for high school STEM subjects. Technion graduates enrolled in this program receive full study scholarships for two years and are not required to commit themselves to teach in the education system. Extending the program over two academic years enables the graduates to continue working as scientists and engineers in industry in parallel to their studies (one day or two half-days each week).

  - **Heavily expand recruitment of international students.** There is significant interest in STEM fields among international students studying in U.S. There is much to be gained
by increasing the number of international students in general and in STEM fields in particular. International students have relatively much higher retention and graduation rates. They therefore contribute to improve these important university statistics. They also pay non-resident tuition rates which brings additional tuition revenues to the university and the academic units.

• **Expand geographical area of STEM recruiting efforts.** Historic reports from the Genesee Intermediate Schools District (GISD) clearly point to a consistent decline in the number of high school graduates in Genesee County. This phenomenon is expected to continue for some time. Further, there are only a handful of high schools in the region with future graduates sufficiently prepared to handle the rigor of STEM fields. We must expand our reach into other parts of Michigan and other states to expand the pool of potential future recruits who are interested in and have been prepared to major in STEM fields.
Appendix D – K-12 Partnerships

The goals of K-12 partnerships at UM-Flint should be: 1) Encourage student interest in STEM for the sake of our disciplines and a well-educated society, and 2) Connect students to UM-Flint as a place where engaging STEM programs exist. To reach these goals, we make the following recommendations:

1. Focus on Elementary Teachers
   - The NSF data indicates that most kids have already lost interest in science and math long before they reach high school. Consequently, any effective K-12 program must also target elementary and middle school age kids too. We can reach the greatest number of these students by targeting their teachers. If elementary teachers are given the proper tools, they can create excitement in their students year after year. While teachers can easily access videos of cool demonstrations or experiments, actually knowing how to do them and understanding the concepts behind them can be very daunting for someone with little in-depth STEM knowledge. Therefore, we recommend a series of workshops in each of the sub-STEM disciplines that teach teachers how to incorporate these hands-on experiences in the classroom and provide them with the materials to do it.
   - These workshops and programs would be incentivized by offering continuing education credit to the teachers. With proper funding, we should also provide the teachers with the materials to conduct many of the activities in their classroom. Partnerships with school districts, such as GISD, and our TCP faculty and students would make these programs directly relatable to the classroom by aligning them with the required Common Core standards.
   - To incentivize faculty participation, we recommend more direct recognition for their efforts in tenure and promotion standards. Community engagement is one of the three pillars of the University’s Mission. STEM outreach should be put on the same level as other civic engagement efforts on this campus. Faculty could also apply for spring/summer stipends to develop or redesign these STEM outreach programs.

2. Expand Existing Programs
   - Current programs like Super Science Friday could be expanded to a series of programs that lead to more in-depth exploration of a subject for interested students (i.e. “Awesome Science Saturday”). These events could be either on campus or in partnership with existing resources such as Sloan/Longway.
   - We would also recommend a more targeted STEM focus for our current High School programs like GEC and DEEP.

3. Educate High School Students on STEM careers
   - In order for potential UM-Flint students to major in STEM, they need to know what they can really do with their degree. Many students leave high school with limited views of STEM professions--all chemists work at Dow, all engineers make cars, and all physicists work at NASA. We recommend working with Admissions and University Relations to
hold specific STEM events that connect prospective students to STEM faculty and alumni.

4. Hire a specific STEM K-12 Coordinator
   - All of these recommendations will take a significant amount of planning, promotion, and networking. Successful implementation of these new programs will take more time and effort than our faculty currently have. Therefore, we recommend hiring a dedicated staff member to coordinate the programs, departments, and to seek specific STEM funding for these outreach programs.
Appendix E – Faculty Survey

In the Fall 2012 and Winter 2013 semesters, we surveyed faculty members from Biology, Chemistry/Biochemistry, Computer Science, Earth and Resource Science, Engineering, Mathematics, and Physics/Astronomy. We received a total of 55 responses out of 55 survey requests. The survey contained three types of questions: those that compared importance of an issue versus the respondent’s satisfaction with it (gap question); those that were just evaluative and sought the respondents’ views or assessment of a topic; and open ended questions, allowing a written response to the question.

Gap Analysis Questions

The goal of these survey questions was not to accomplish a differential analysis; rather, we sought to obtain a snapshot of STEM faculty opinions and attitudes about various issues facing them. The gap questions included a number of categories, most of which were divided into sets of questions about importance versus satisfaction, in order to analyze the average gap in faculty perceptions of importance and satisfaction. The categories of questions asked included the following:

- Physical infrastructure to support STEM initiatives
- Organizational support of STEM initiatives
- External funding opportunities
- STEM student retention efforts
- Student support in STEM initiatives
- STEM promotion and advertising

For the gap-type questions we used a 7-point Likert scale to categorize the degree of importance and satisfaction among faculty. For importance, these included the following options: 1: not important at all; 2: very unimportant; 3: somewhat unimportant; 4: neutral; 5: somewhat important; 6: very important; 7: extremely important. For satisfaction, we used similar answers to correspond to the importance categories: 1: very dissatisfied; 2: dissatisfied; 3: somewhat dissatisfied; 4: neutral; 5: somewhat satisfied; 6: satisfied; 7: very satisfied.

Although all categories of questions had a mean importance greater than 5 (indicating a collective opinion of the faculty that all questions were between somewhat important to very important), the following categories were found to have the highest importance among the surveyed faculty (mean importance 5.7 or greater):

---

3 After the original survey was completed by the STEM faculty, the same survey was administered to the faculty from the Department of Psychology. Seven faculty members completed the survey. The above results do not include their responses since we could not merge the surveys.
• Equipment to conduct instructional activities: 5.74
• Implementing measures to increase/improve retention in your discipline on the departmental level: 5.78
• Support structures for STEM student success: 5.79
• Adequate support to retain faculty: 5.80
• Start-up funding to attract new faculty: 5.81
• Implementing measures to increase/improve retention in your discipline on the college level: 5.84
• Funding for STEM disciplines: 5.86
• Adequate support for faculty development: 5.87
• Competitive salaries for faculty: 5.87
• Growth in full-time faculty (commensurate with majors): 5.94

A number of questions were rated rather low in terms of the collective faculty satisfaction. Here, we report the questions identified with mean levels of satisfaction being 3 or lower, i.e. indicating somewhat dissatisfied or worse. These included the following:

• Adequate time to work on external research proposals: 2.66
• Growth in amount of full-time faculty (commensurate with growth in majors): 2.68
• Advertising/promotion at the college/school level: 2.80
• Release time to conduct external research projects: 2.83
• Release time to work on external research proposals: 2.85
• External research grants to improve instrumentation/equipment: 2.86
• Competitive salaries for faculty: 2.92
• Equipment to conduct research: 2.94
• Start-up funding to attract new faculty: 2.94
• Research lab space: 2.98
• Funding for STEM disciplines: 2.98

The questions exhibiting the largest gaps (2.70 or greater) included:

• Equipment to conduct research: 2.70
• Adequate support to retain faculty: 2.72
• Advertising/promotion at the college/school level: 2.87
• Start-up funding to attract new faculty: 2.87
• Funding for STEM disciplines: 2.88
• Competitive salaries for faculty: 2.95
• Growth in amount of full-time faculty (commensurate with growth in majors): 3.26
Not surprisingly, many of the above questions are on all three lists – i.e. they were rated as having the highest importance, the lowest overall satisfactions, and consequently the highest gaps. These included:

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean Importance</th>
<th>Mean Satisfaction</th>
<th>Mean Gap</th>
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<tr>
<td>Start-up funding to attract new faculty</td>
<td>5.81</td>
<td>2.94</td>
<td>2.87</td>
</tr>
<tr>
<td>Funding for STEM disciplines</td>
<td>5.86</td>
<td>2.98</td>
<td>2.88</td>
</tr>
<tr>
<td>Competitive salaries for faculty</td>
<td>5.87</td>
<td>2.92</td>
<td>2.95</td>
</tr>
<tr>
<td>Growth in full-time faculty commensurate with majors and number of students</td>
<td>5.94</td>
<td>2.68</td>
<td>3.26</td>
</tr>
</tbody>
</table>

Two questions were below a mean value of 5.7 in importance but also displayed among the lowest satisfaction and highest gaps. Including these in the table above produces the following, which is essentially a list of the categories that have among the highest mean importance, the lowest mean satisfaction, and accordingly the largest gaps. They are presented in increasing order of importance (and increasing mean gap):

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean Importance</th>
<th>Mean Satisfaction</th>
<th>Mean Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment to conduct research</td>
<td>5.64</td>
<td>2.94</td>
<td>2.70</td>
</tr>
<tr>
<td>Advertising/promotion at the college/school level</td>
<td>5.67</td>
<td>2.94</td>
<td>2.70</td>
</tr>
<tr>
<td>Start-up funding to attract new faculty</td>
<td>5.81</td>
<td>2.80</td>
<td>2.87</td>
</tr>
<tr>
<td>Funding for STEM disciplines</td>
<td>5.86</td>
<td>2.98</td>
<td>2.88</td>
</tr>
<tr>
<td>Competitive salaries for faculty</td>
<td>5.87</td>
<td>2.92</td>
<td>2.95</td>
</tr>
<tr>
<td>Growth in the amount of full-time faculty (commensurate with growth in majors)</td>
<td>5.94</td>
<td>2.68</td>
<td>3.26</td>
</tr>
</tbody>
</table>

It is also important to note that although a significant number of questions related to research were not necessarily rated among the highest importance levels, they did exhibit among the lowest mean satisfaction levels. That is to say that overall, there is a sense among STEM faculty that support for research activities are lacking.

**Questions Outside the Gap Analysis**

Additional questions asked for specific numbers and/or specific opinions and thus did not produce a gap analysis. These questions include the following:

- Whether (and how many) faculty candidates had turned down job offers due to perceived inadequacies, as well as the reasons behind them.
- Whether the discipline has trouble attaining or maintaining accreditation
- Whether the discipline has sufficient faculty to adequately offer its programs
- Whether teaching load has interfered with scholarship
- Whether and how many external research proposals had been submitted
Preference for STEM organizational structures

The questions related to faculty applicants and accreditation are addressed below. In the question concerning faculty numbers, 42 of 54 respondents (78%) indicated that the discipline does not have sufficient faculty to adequately offer its programs. In the question related to teaching load, 42 of 53 respondents (79%) indicated that course preparations have interfered with conducting research and scholarship. Related to this, the average number of proposals submitted in the past 10 years was reported to be slightly above 2 (2.17), and the average number of proposals funded in the past 10 years was reported as less than 1 on average (0.76).

Concerning the question about the number of faculty applicants that had turned down job offers due to perceived inadequacies, 25 participants responded to this question, and the average number was reported to be 3.88 or approximately four candidates in each discipline within the past 10 years. A related question was also asked: “what inadequacies do you believe contributed to your discipline losing faculty applicants?” Here, respondents were allowed to choose all reasons they felt would apply. These included: non-competitive salaries (85% agreed); inadequate startup funding (80%); inadequate facilities (65%); poor/limited office space (15%); instrumentation/equipment (60%); other (specified as lack of lab space for research, or staffing) (10%).

In the question concerning accreditation, 11 of 42 respondents (26%) reported problems attaining or maintaining accreditation. A related question was also asked: “why do you believe your discipline has trouble attaining or maintaining accreditation?” The majority of responses in this case indicated either inadequate facilities/instrumentation or a lack of faculty (in terms of sufficient numbers). Several respondents also indicated a lack of support from the college/university.

Several questions were also asked to solicit specific feedback – i.e. suggestions and/or thoughts from the faculty. These included the following:

- What is the university doing well in support of STEM?
- What can the university do to improve its support of STEM?
- How do you believe the university should promote and/or develop STEM opportunities to students?
- How do you believe we can make STEM disciplines more attractive to college students, high-school students, and young children?

In all of these categories, the responses were too numerous and varied for us to report all of them. Hence, we attempt to summarize the most common responses in the following discussion.

In terms of the faculty thoughts on what the university is doing well in support of STEM, a high number of respondents indicated negative thoughts – i.e. that they felt the university and/or college is not currently doing much. However, there were also a significant number of
respondents who indicated positive thoughts about one-time events (e.g. Super Science Friday, Astro Night), tutorial services, and internal grant programs.

Accordingly, the respondents also had significant thoughts on what they felt the university could do to improve support of STEM. These included: hiring more faculty and otherwise ensuring adequate staffing; improving recruitment; reducing faculty administrative tasks and/or other bureaucracy; improving research and travel funding; and doing a better job at recruitment. There were also a significant number of respondents here who indicated support for the formation of a separate college.

Related to the promotion and development of STEM opportunities to students, respondents were given a number of choices and asked to select all that apply. These are reported in the following table:

<table>
<thead>
<tr>
<th>Choice</th>
<th>Responses</th>
<th>Percentage</th>
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<tbody>
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<td>Summer camps at an early age</td>
<td>31</td>
<td>60%</td>
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<tr>
<td>One-time events (e.g. AstroNight and Super Science Friday)</td>
<td>24</td>
<td>46%</td>
</tr>
<tr>
<td>Early college in STEM</td>
<td>35</td>
<td>67%</td>
</tr>
<tr>
<td>Align our curricula better with that of other institutions</td>
<td>13</td>
<td>25%</td>
</tr>
<tr>
<td>Create pipelines with community colleges</td>
<td>23</td>
<td>44%</td>
</tr>
<tr>
<td>By providing more research opportunities for students</td>
<td>37</td>
<td>71%</td>
</tr>
<tr>
<td>Recruiting international students</td>
<td>23</td>
<td>44%</td>
</tr>
<tr>
<td>Integrated science teaching program</td>
<td>14</td>
<td>27%</td>
</tr>
<tr>
<td>Professional development opportunities for K-12 teachers</td>
<td>26</td>
<td>50%</td>
</tr>
<tr>
<td>Other method(s). Please specify</td>
<td>12</td>
<td>23%</td>
</tr>
</tbody>
</table>

The responses indicate that the strongest support is for summer camps, an early college in STEM, and greater research opportunities for students, as well as to provide professional development for K-12 teachers and the one-time events like Super Science Friday. In the category of “other”, most responses focused on better recruitment/advertisement strategies, better transfer agreements, and better opportunities for research.

In terms of how we can make STEM disciplines more attractive to college students, the responses primarily focused on promotion of the disciplines, providing greater opportunities to the students (i.e. undergraduate research), and improvement of facilities. For the same question as it applied to high-school students: improved recruiting, improving the web site, better summer camps/activities, better advertisement/promotion, and a more integrated educational approach. For the same question as it applied to young children: primarily outreach activities, such as summer camps, one-time events, and greater contact with K-12 teachers.

The faculty members were also asked questions related to organizational structure – i.e. whether they preferred to maintain the existing structure or to create some kind of new university organization in support of STEM. The choices included doing nothing, creating a STEM center or institute, creating a STEM division within CAS, or creating a new STEM school or college.
An overwhelming majority, 89%, felt that some new structure was necessary. In particular, 13% felt that a new STEM center or institute was appropriate, 17% favored a new STEM division in the College of Arts and Sciences, 59% favored creation of a new college/school, and 11% felt the university should do nothing. This is also supported in a question in which STEM faculty were asked the degree to which they agreed with a couple of organizational structure choices: “Creating a special [structure] would help to promote STEM research and education”, where the structure choices include creation of a STEM division within the college and creation of a STEM college. In the case of a STEM division, 24 of 52 or 46.2% indicated agreement or strong agreement. In the case of a STEM college, 34 of 52 or 65.4% indicated agreement or strong agreement.
Appendix F – Organizational Structure

We examined a number of different organizational structures that would support the planned expansion of the STEM fields. These included creating: a STEM center; a STEM institute; a STEM division within CAS; a STEM division within Academic Affairs; a STEM college; or maintaining the existing structure. In this section, we present a brief overview of each option, as well as degree of complexity of implementing each option, rough estimate of resources needed, advantages and disadvantages particularly as they relate to potential for: recruitment, K-12 partnerships, new program developments (for credit), industry connection, student support and retention, expanding financial resources, addressing STEM faculty concerns and their potential impact on expanding STEM fields.

It should be noted that our evaluation of the stated options was done independently and not in conjunction with any other possible University efforts. For instance, it is conceivable that one may create an institute within Academic Affairs (outside any school or the college) and then have a series of initiatives launch by the schools and the college at the same time. Incorporating such an approach in our analyses would make it near impossible to determine the absolute strength of each of the options we considered since one would have to have an idea of the depth and breadth of such local initiatives.

Maintaining the Existing Structure

One obvious course of action would be to maintain the current organizational structure at UM-Flint and continue with small changes to procedures within CAS. This option, while worth a consideration, was not as aligned with our charge as the provost wanted a specific set of recommendations including “structural” that would result in significant expansion of the STEM fields across the campus. One might argue, rather than proposing a brand new structure, perhaps the College of Arts and Sciences could undertake a set of initiatives to promote the STEM fields. First, our focus was to determine a structural change that would result in the greatest expansion/enhancement of STEM field irrespective of any possible future initiatives within the College. Second, this approach would limit such initiatives to just the College and not the entire campus. Third, the approach would not address many important challenges facing the STEM fields at UM-Flint such as the need for a distinct identity, focused recruiting, curricular and faculty autonomy, and less competition for resources. Lastly, if such a set of activities would be offered under an umbrella with a distinct identity, this would be equivalent to creating a STEM division within CAS which will be discussed below.

STEM Center

A center within the University of Michigan system is a budget unit with a specific focus, either academic or service-oriented. Examples on the Flint campus include Thomson Center for
Teaching and Learning (TCLT), Center for Environmental Research (CARE), Women Educational Center (WEC) and the International Center (I/C). Centers are normally intended to promote a specific concept such as teaching and learning by TCLT or environmental issues by CARE. They may have faculty affiliates and offer educational programs in the form of workshops or even professional development/continuing education. A center can be housed inside or outside of a school or college.

A major advantage of creating a STEM center is that the process will be straightforward, as it would primarily require adequate personnel, such as a director, administrative support, etc. and some space, as well as faculty affiliates and/or an advisory board. Another advantage is that it will not be overly controversial and could be conceived relatively quickly.

With respect to assisting with student recruitment, a center can provide some assistance for instance by providing outreach efforts such as summer camps for high school students, etc., Similarly it can assist with K-12 partnerships by offering outreach programs and activities. A center can promote connection with industry and offer retention programs for students. However, centers do not offer for-credit academic programs and cannot develop new STEM degree programs. They can, however, assist with undertaking market studies, identifying potential new academic programs.

Some centers are expected to be self-funded (or require minimal general funds) via generating external funds, and some are entirely funded by general funds, particularly if they are service providers. A center would be able to facilitate applying for external grants and or other types of external funding. It is not clear that a center would be in a position to address some of the STEM faculty concerns such as workload, release time for research, curriculum matters, and the need for additional faculty.

**STEM Institute**

An institute is similar to a center in many respects, but perhaps at a much larger scale. An institute is also a budget unit with a specific focus that could be broader than that of a center. In fact, an institute may contain one or more centers. An example within the University of Michigan is the Institute for Social Research (ISR), perhaps the world’s largest academic social science survey and research organization. ISR is composed of five research centers and an administrative support unit, the Center for Institute Services. As with centers, institutes may have faculty affiliates and offer educational programs in the form of workshops or even professional development/continuing education; they do not offer for-credit academic degrees or programs; and they are expected to be self-funded (or require minimal general funds).

Creation of a STEM institute at the University of Michigan-Flint would be somewhat more complex because it will require Regental approval. It would also require adequate personnel such as a director, administrative support, etc., and some space. Once again, it will have faculty affiliates and/or an advisory board.
All of the stated advantages of a center apply to a STEM institute with perhaps the possibility of added prestige in undertaking scientific research and applying for external grants. The same limitations of a STEM center also apply to an institute, particularly in its ability to address faculty concerns. Financial requirements for creating an institute would depend upon its complexity.

**STEM Division**

A division within (or outside) a school/college might be viewed as a consortium of two or more departments of homogeneous academic disciplines. To our knowledge, there is no universal definition of a “division” – rather, its scope/authority will depend upon the specific implementation. For instance, a division might have total budgetary autonomy, very minimal autonomy, or none. Similarly, a division might have near complete autonomy over its tenure/promotion standards, policies, and practices or be bound by those of the larger unit. An example of a divisional organization is the College of Arts and Sciences at the University of North Carolina at Chapel Hill. In this case, the College is divided into four divisions: the Division of Fine Arts; the Division of the Humanities; the Division of Natural Sciences and Mathematics; and the Division of Social Sciences. All departments and curricula are assigned to one of these four divisions. Each division has a head as well as a faculty representative, who serves on the Arts and Sciences Advisory Committee (ASAC).

Creation of a STEM Division within CAS would require approval by the CAS Governing Faculty as well as the Departments to be placed within such a division. It would also require a division head and possibly some additional administrative support personnel such as a budget person, administrative assistant, etc., and possibly some administrative offices. The complexity of creating a division would depend upon its scope and authority. For instance, if a division were to function nearly autonomously, with its own budget, personnel policies/procedures, admission standards, etc., such terms would require extensive negotiations/approval from the host unit (i.e., the college). Whereas, if a division would be responsible for a limited number of its operating functions (e.g., just recruiting), creating it would require minimal efforts.

In addition to the advantages associated with a center or an institute, a division will have the ability to offer academic degrees and for-credit programs because it consists of existing academic departments. A division may assist in supporting sponsored research and external grants, but is not generally expected to be self-funded, since it generates tuition dollars. Among the potential shortcomings of a division is lack of complete autonomy. This includes certain curricular matters; admission standards and graduation requirements; personnel policies such as promotion and tenure and compensation; lower profile identity, especially as it relates to securing external grants; having to compete for resources with numerous other departments/divisions within the college; and lack of access to the senior university leadership (i.e., provost). Some of the above potential shortcomings (e.g., curricular matters, admission
standards, compensation issues, etc.) of a division can be avoided by clear policies and procedures, agreed upon by the entire college faculty and administration.

Financial requirements for creating a division would depend upon its complexity and structure. A division’s ability to address all of the issues identified in this report is much greater than that of an institute but still face certain limitations. A division outside of a college (i.e., at the provostial level) would be similar to a center/institute if it would not be allowed to offer academic degrees. It would function similar to a school/college if it could offer degree programs.

STEM College

A STEM college would be similar to one of the existing professional schools at the University of Michigan-Flint. It would be comprised of two or more academic departments within the fields of science, technology engineering, and mathematics. It would function as an autonomous academic unit with its own budget, faculty, departments, policies/procedures, codes, governing bodies (e.g., executive committee, etc.) curricula and other pertinent components.

Establishment of a STEM college would require negotiations with would be affected parties as well as approval by the Regents. A college would require a dean and possibly some additional administrative support personnel such as an associate dean, a budget person, administrative assistant, etc., and possibly some administrative offices.

Advantages of a STEM college include all of those associated with a center, institute as well as its ability to offer academic degrees and for-credit programs such as certificates and non-credit programs such as professional development and continuing education. A college will have a distinct identity and will be able to more effectively apply for sponsored research and external grants. It will have complete autonomy over its programs, faculty, students and staff (within the acceptable larger university policies.) This includes curricular matters; admission standards and graduation requirements; personnel policies such as promotion and tenure and compensation. A college would have the potential for responding to its faculty needs somewhat more expeditiously, not have to compete for resources with many other departments within a school or a college. It will have access to the senior university leadership (i.e., provost). The departments within a STEM college would also benefit from having Deans and committee members from disciplines that are more comparable to their own.

Among possible shortcomings of creating a college will be the initial increase in overhead costs such as expenses associated with a dean’s office etc., perceived fragmentation of the college faculty, a need to develop and/or revise existing policies and procedures, and increased management efforts by the provost. A college’s ability to address many of the issues identified in this report in some respects is greater than the other options considered above. The limitations would be similar to those faced by other professional schools at UM-Flint and would pertain to the campus policies and procedures.
Appendix G – Open Forums

Open Forum
2/28/13

Capacity Considerations

• What is the number or percentage of current STEM students at UM-Flint?
• What is our current capacity?
• At what point do physical spaces limit capacity? How does the building remodel impact these issues?

Faculty Survey

• A survey of a broader faculty group (outside of STEM) might show gaps in similar areas of concern.

Organizational Structure

• What is the focus of the STEM structure? Have we looked at models for STEM Centers or Institutes?
• Having a STEM focus helps when applying for federal grants and corporate relations funding.

Current Offerings

• Have we considered joint programs with Kettering?

Recruitment

• Growth in STEM areas will impact other areas on campus as well (e.g. Gen Ed).
• STEP collaboration with Mott focused on outreach, retention and creating a pipeline of students interested in STEM. Projects must be creative to get funding.
• ACT data – what does it tell us?
• How might this knowledge affect curriculums?
• How would STEM impact graduate programs?
• Observation – STEM programs tend to have resource intensive needs.
• Pipeline preparation should be a priority.

Link to Student Success/Retention

• There must be a link to Student Success Center initiative.
• Students need good advising and support early on – especially in math.

Connections to Industry

• Do we have a master list of companies that have an interest in supporting STEM initiative?
• Engineering has an industry advisory group.
• Have we considered Civic Engagement Courses and experiential learning opportunities?

‘Big Picture’ Considerations

• Have we thought about the big goal that we are looking to accomplish with this initiative?
- Enrollment increases
- Maintaining interest in the sciences / promoting that students have a broader knowledge base
- Career-oriented
- Research and development opportunities
- Graduate school opportunities

Open Forum
3/18/13

Committee Participation
- Would the committee consider adding a non-STEM faculty member?
- There was brief discussion regarding the idea of changing STEM to STEAM to include arts into the discussion and bring more players to the table.

Capacity/Budgetary Considerations
- Available lab/research space was not addressed in Open Forum presentation. There was consensus that more space is needed.
- There was discussion regarding the lack of fundamental resources for instrumentation, research, etc. currently. There has been underfunding at the College level that needs to be addressed.
- External funding is more readily available if there is a STEM focus.

Faculty Survey
- There were comments about re-administering survey to non-STEM faculty.
- Clarification was sought regarding faculty load question and computation of gaps.

Organizational Structure
- Has the cost of a new college/school been determined? Cost structures need to be evaluated. Has the committee considered credit hour production by STEM/Non-STEM faculty? Would there be a recommendation to seek a change in the budget model funding percentages?
- Observation – the College of Engineering & Applied Science at Western Michigan University is an impressive program/facility with links to industry.
- There was concern that the separation of STEM fields will impact the ability to collaborate and provide interdisciplinary options/connections.
- Don’t forget about traditional non-STEM fields that do in fact link to STEM areas. Examples discussed included linguistics in English, biological archeology in Anthropology, and interactive art/design in CVA. There was worry about losing interdisciplinary connections. Sometimes, non-STEM faculty need STEM-related research equipment. More openness is needed.
- Comment: Fragmentation promotes narrowness and selfishness. People may begin to work against each other, instead of working together.
- Comment: Interdisciplinary research/collaboration has been successful between SHPS and CAS.
- The recommended structure needs to support strategic objectives and needs to benefit students. The process should be conducted in the spirit of openness and collaboration.
- If a new school/college is chosen, the committee needs to determine what the impact would be to the remaining programs that are left in CAS.
• CAS governing faculty would need to vote on a new organizational structure.

Recruitment
• Relationship between STEM and Honors should be considered as many STEM students enter UM-Flint through Honors.
• Increasing STEM student enrollment has positive effects across the university as STEM students take General Education courses thereby increasing enrollment in other areas.

Link to Student Success/Retention
• Improving student’s writing skills is important to their success in STEM fields.
• Observation – improved student placement in jobs could be benefited by STEM designation.

Curriculum Considerations
• What would the impact be to curriculum?
• General education courses need to stay in CAS. Gen ed courses should not be duplicated across units.
References

1. President Obama, 2013 State of the Unions Address, located at:

2. Report to the President – Realizing the full Potential of Government-Held Spectrum to Spur Economic Growth, Executive Office of the President, President’s Council of Advisors on Science and Technology, July 2012, located at:

   http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_federal_stem_education_coordination_report.pdf


5. Report of the University of Michigan-Flint Blue Ribbon Commission, April 2007, located at:
   http://www.umflint.edu/provost/documents/BRC.pdf

6. Excellence by Design, University of Michigan-Flint 2011-2016 Strategic Plan, located at:
   http://www.umflint.edu/strategicplan/

7. Students Who Study Science, Technology, Engineering and Mathematics (STEM) in Postsecondary Education, National Center for Education Statistics, July 2009, located at:

   http://www.fas.org/sgp/crs/misc/R42642.pdf
