



COPPIN STATE UNIVERSITY

SCIENCE, TECHNOLOGY, ENGINEERING,  
AND MATHEMATICS(STEM) EDUCATION

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## 5-Year Strategic Plan

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**A Report from the Provost Committee on STEM Education**

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# Executive Summary

The United States has traditionally produced the world's top research scientists and engineers which has led to life changing breakthroughs in both science and technology. These scientific and technological innovations are changing the way we work, the way we live, and the way we socialize. Accordingly, it is not surprising that Science, Technology, Engineering, and Mathematics (STEM) are by far, the most important driver to the United States' economic competitiveness and growth. According to a report by the Joint Economic Committee on STEM Education [2], more than half of the economic growth in the United States over the past fifty years is attributable to improved productivity resulting from innovation. However, American pre-eminence in STEM will not be secured or extended without a renewed commitment to effort, time and investment. According to the U.S. Department of Labor [3], the nation faces four areas of challenge in terms of meeting the 21<sup>st</sup> century STEM workforce:

- **inadequate K-12 student preparation in science and mathematics**
- **limited undergraduate interest in science and engineering majors**
- **significant student attrition among science and engineering undergraduate and graduate students, and**
- **science and engineering education that in some instances inadequately prepares students to work outside of universities**

No one will argue that one of the keys to improving success in science and mathematics is to increase interest in those subjects. However, given the fact that our teachers are generally unprepared in both content and pedagogy, the task becomes exponentially more difficult. According to the U.S. Department of Labor [3], analyses of the teacher pool indicates that an increasing number do not major or minor in the discipline they teach and further states that “about 30% of high school mathematics students and 60% of those enrolled in physical sciences have teachers who did not major in the field”.

The Coppin-STEM program is proposing to address the nation's approach to strengthening the STEM workforce in four areas:

- **building a pipeline of students who enter STEM careers;**
- **using best practices to retain STEM students, especially practices that help retain historically underrepresented groups including women;**
- **using best practices to teach STEM fields, especially practices that help retain historically underrepresented groups including women and**
- **providing professional development to public school teachers to improve their content knowledge.**

## Overview

Coppin State University(CSU) follows the guidelines of the National Science Foundation on what constitutes a STEM field which includes subjects in the fields of Chemistry, Computer and Information Technology Science, Cyberinfrastructure, Engineering, Geosciences, Life Sciences, Mathematical Sciences, Physics , Social Sciences (Anthropology, Economics, Psychology and Sociology), and STEM Education and Learning Research.

In particular, the **Coppin-STEM** program will expand an existing After-School Math Program, wherein students from three nearby well established high-schools are provided with STEM tutoring, with the expectation that it will evolve into a program where students can have dual enrollment into college level math and sciences classes. To retain students who are already enrolled at CSU, we will implement a variety of intervention strategies that have proven to be successful in **retaining** minority students in the STEM fields. These integrated intervention strategies will be anchored by an intensive early two-year institutional research experience. Equally important to the success of our students will be a redesign of our curriculum to encourage computer laboratory experiences, discovery learning, technical writing, and oral communication (recommended by Tsui [6]). The culminating point of the Coppin-STEM model will be the need to provide K-12 teachers with effective professional development that will improve their content knowledge across disciplines.

Coppin State University has had a very good history of producing successful programs in STEM. Most notably, during the 1970's, CSU established dual degree programs in Engineering, Dentistry and Pharmacy that produced numerous scholars. In particular, the dual degree engineering program started in 1974 when Dr. Flossie M. Dedmond(Dean of A&S), structured a task force to initiate the program with the University of Maryland at College Park. The program began in September of 1976, which was coordinated by Dr. Narayan R. Joshi and graduated its first student, Jaye Richardson, in 1981.

Throughout the 1980's and 1990's, the STEM program produced many graduates. Many of the scholars who graduated with STEM degrees also graduated from prestigious institutions with doctoral degrees in biology, chemistry, mathematics, medicine, pharmacy and pharmacology. It is also interesting to note that many of these scholars with terminal degrees have been international students and/or student athletes. The evolution of the dot.com industry in the early part of the millennium boosted the number of students who graduated with STEM degrees, with the math & computer science department benefiting greatly from this booming industry(See Figure 1 & Figure 2 ).

However, after the slow-down and shift in the industry to servicing of computers, protecting networks and managing the exponential growth in data, the computer science department never offered programs that focused on computer hardware, network security and the collection, storing, application and security of data. Consequently, the computer science program has seen a rather sharp decline in the number and quality of its student population. Furthermore, the department lost two of it's most renowned computer science teachers in Dr. Edward Sommerfeldt and Mr. Glenn Dorsey with no replacement faculty.

Figure 1: STEM Degrees Awarded from 1994-2013

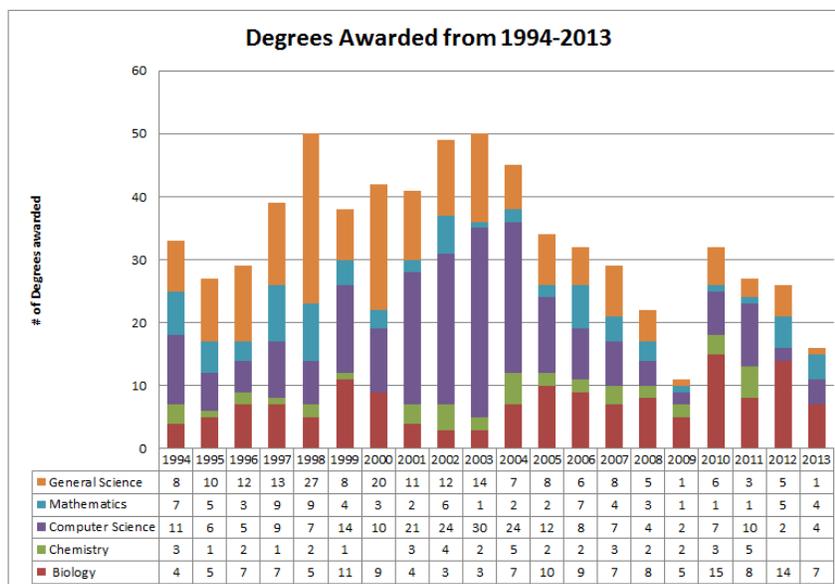
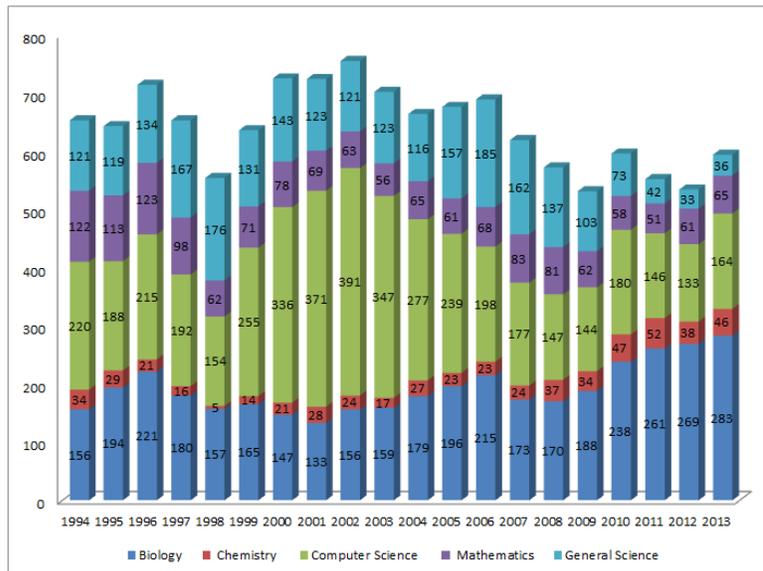


Figure 3: Student Enrollment in STEM Degrees from 1987-2013

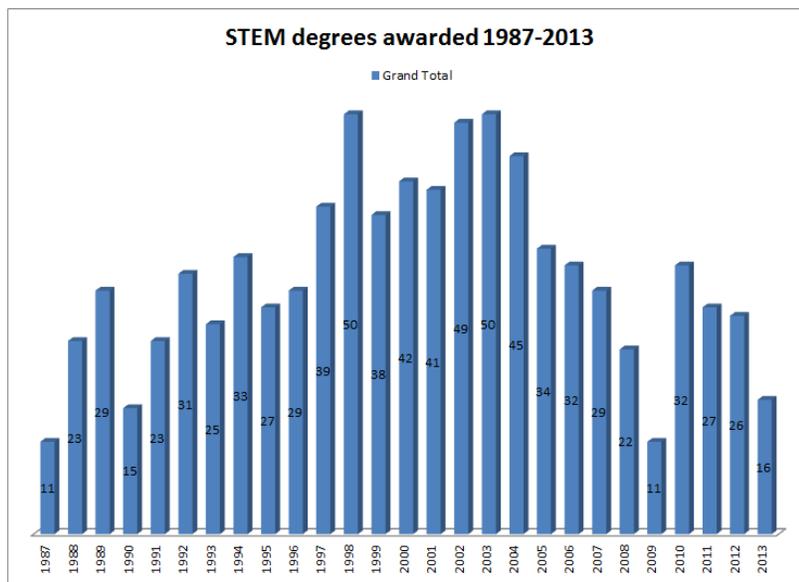


Actually, the decline in the quality of the STEM program started when the University stopped offering calculus based physics courses which were critical to the maintenance of the dual degree engineering program. In addition, the chemistry program has never been certified by the American Chemical Society, a critical program for any sufficiently strong STEM program. Currently, majority of the interest in our STEM students is in biology (See Fig 3).

Given these and other challenges, the provost charged the committee in May 2013 to conduct a comprehensive review and assessment and to make recommendations to build a strong STEM program at CSU. In particular, the provost charged the committee to develop recommendations to:

- increase student enrollment in STEM
- increase student retention and improve student success in STEM
- strengthen academic programs and faculty in STEM
- increase resources/funding for STEM

Figure 2: Total Number of STEM Degrees Awarded from 1987-2013



The committee was chaired by Nicholas Eugene, Co-ordinator of STEM and included Gilbert Ogonji, Hany Sobhi, Wanda McCoy, Sisir Ray, Moses Wekesa, Clarence Williams, Tatiana Roth and Sean Brooks. The committee worked for three months starting in May 2013 and assessed all aspects of STEM at the institution. The committee met 18 times, engaged a wide ranged of constituents including the VP of Information technology, VP of Institutional Advancement, VP of Academic Affairs, Alumni and former departmental chairs, and students.

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## Findings

Among the committees findings are the following:

- There are many faculty who are very devoted to student success
- There were many successful students with STEM degrees who went on to get terminal degrees from prestigious institutions.
- Many of our STEM graduates with terminal degrees are international students or student athletes or both.
- There are many opportunities for students to partner with outside federal agencies through the **Exposure Program** and the **Medical Career Initiative**.
- There is a high-school on Campus that Coppin can use to recruit students into the STEM field
- There is an **After-School Math Program(CAMP)** that can be used to attract students into the STEM field
- The number of students enrolled in STEM majors have decreased from a high of 750 in 2009 to a low of 530 in 2012.
- The number of degrees awarded in STEM field decreased from a high of 50 in 1998 to a low of 11 in 2009
- There is no pathway to an engineering program
- There is no program offering in network security or cyber-security.
- There is no physics faculty in the department of Natural Sciences
- There is inadequate private fundraising for STEM initiatives
- There is inadequate scholarship designated to attract STEM students
- There is inadequate partnership with surrounding secondary and post secondary schools to create a pipeline of students in the STEM workforce.

## A Funding

In 2002, the **National Science Foundation** awarded the department of Mathematics and Computer Science the CSEMS scholarship grant(\$171,874) for up to twenty-five mathematics and computer science majors per year. The scholarship amount was \$3125. The requirements to be admitted to the scholarship program were:

- United States citizen, refugee alien, or permanent resident alien
- Have financial need, defined by the U.S. Department of Education rules for Federal financial aid
- Formally declared as a mathematics, computer science, or dual degree major
- Be enrolled full-time in computer science and/or mathematics program
- 60 or more credits completed
- Cumulative GPA (based on a 4 point system): 2.8 (70% of 4.0)
- Semester GPA in Math/Computer Science courses: 3.0
- Computer Science majors should have completed Computer Science II (COSC 221) with a B or better
- Mathematics majors should have completed Calculus I and II (MATH 201 and MATH 202) with a B or better in each

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The National Science Foundation also awarded CSU an HBCU-UP STEM grant(\$2,499,550) for the period 09/01/2004-09/30/2009. The goals of the grant were:

- Recruit, retain, and graduate well-qualified STEM students
- Enable Coppin to offer more competitive STEM programs through faculty and curriculum development

The **recruitment** objectives were to:

- Enroll 300 STEM freshman (at the end of year 5)
- Increase number of STEM freshmen scoring at or above 1000 on the SAT, from 20 in year 1 to 80 in year 5
- Build relationships with high schools and community colleges
- Engage STEM students and faculty in recruitment

The **retention** objectives were to:

- Increase pass rates by 50% in gateway/bottleneck courses over 5 years
- Increase retention of STEM students to 60% over 5 years

The **graduation** objectives were to:

- Increase the number of STEM graduates from 48 to 150 over the five-year project period
- Increase the number of STEM graduates admitted to graduate programs 10 in year 1 up to 45 in year 5

## B STEM Graduates

Many STEM scholars were produced via the Maxier Collier Scholarship program and the McNair Scholar Program. For example, the graduating class of 1994 produced many scholars such as:

- Karen Russell, MD Wayne State University
- Kevin Jones, PH.d Pharmacology, Duke University
- Nicholas Eugene, Ph.D Mathematics, Central Michigan University
- Marcia Jones, MD
- Bridgette Thomas, Pharmacist,
- Kenyatta Cosby, MD Howard University
- Nickie Peters, Ph.D Nuclear Chemistry, University of Missouri

It is important to note that Karen Russell, Kevin Jones, Nicholas Eugene and Nickie Peters were all student athletes and that Karen Russell, Nicholas Eugene, Marcia Jones and Bridgette Thomas were all international students from the Caribbean.

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## Recommendations

Based on the findings above and the recommendations of the the Special Committee's Report, the committee included the following among its many recommendations to help Coppin-STEM move forward. We have outlined the following goals, characterized by its **broader impact** on STEM education, with the indicated outcomes:

- **Increase Student Enrollment in STEM**

1. Increase scholarships for students to major in STEM Fields

Actions Needed:

- (a) Provide scholarship for 5 STEM Education teachers each year.
- (b) Provide scholarship for 5 Engineering students each year.
- (c) Provide scholarship for 5 General STEM majors each year.

2. Hire a dedicated recruiter for STEM

Outcomes:

- (a) Increase the number of "high ability" students who major in STEM by at least 30% in 2015
- (b) Increase the number of students who major in STEM by at least 30% in Fall 2015
- (c) Increase enrollment in STEM subjects by at least 30% in in Fall 2015

3. Create a pipeline of students who are prepared to enter Coppin and graduate with a degree in STEM by increasing the number of students who are dually enrolled at the University (recommended by Tsui [6]).

Actions Needed:

- (a) Increase the number of partnerships we have with nearby well established secondary and post-secondary institutions.
- (b) Expand the efforts of the Coppin After-School Math Program
- (c) Offer STEM classes to partnering high school students

Outcomes:

- (a) By 2015, increase the number of students from our after school math program, who take at least two college level science classes to 60 and set a goal of the number who pass those classes to 50.
- (b) Improve K-12 science and mathematics education by providing summer internships and research opportunities that provide valuable laboratory experience for high-school students.
- (c) Increase the number of science faculty who serve as mentors to high-school students.

4. Increase **funding for STEM** students. Outcomes:

- (a) Apply for the NSF Robert Noyce Teacher Scholarship grant
- (b) Apply for the NSF HBCU-UP grant
- (c) Apply for the NSF S-STEM grant
- (d) Apply for the NSF STEP-STEM grant
- (e) Leverage available resources to support STEM students
- (f) Increase the number of partnerships we have with private corporations

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- **Improve Student Success**

1. Increase Coppin's talent pool by **retaining** the number of students who pursue careers in science and mathematics (recommended the U.S. Department of Labor [3]).

Actions Needed:

- (a) Enhance the learning infrastructure and support system for students by improving teacher preparation and encouraging a culture that values academic excellence among families, local communities and schools.
  - (b) Renew our efforts to create learning environments that nurture and celebrate intellectual achievement.
  - (c) Implement activities that include parents/guardians.
  - (d) Engage students in hands on **research** either in an academic setting or off-campus in a position with industry research(recommended by Tsui [6]).
  - (e) Redesign some of our freshman mathematics and science courses to use key features such as **active learning**, increased use of **group learning**, linked courses, increased student/faculty contact and other pedagogical methods(recommended by Tsui [6]).
  - (f) Provide encouragement and motivation for majoring in the sciences by providing pre-college and in-college seminars on career development and early career guidance recommended by Tsui [6]).
  - (g) Provide financial support to students(recommended by Tsui [6]).
  - (h) Provide workshops and seminars to combat feelings of isolation and awareness of school policy, procedures and support program (recommended by Tsui [6]).
2. Implement a mentoring program that forges motivation, achievement, and creativity by peer interactions.

Actions Needed:

- (a) Implement the Freshman Male Initiative program
- (b) Implement the intensive mentoring program
- (c) Provide incentives for faculty to mentor students
- (d) Fully integrate STEM students into campus activities and groups in ways that enrich the socialization of all students.

- **Improve Academic Programs and Faculty**

1. Re-establish the dual degree in engineering with other USM institutions
2. Develop a program in computer network security and/or a program in cybersecurity
3. Increase the content knowledge of K-12 teachers by providing rigorous professional development in science and mathematics education(recommended by the U.S. Department of Labor [3]).

Outcome:

- (a) Encourage the creation of positive school environments that foster excellence by providing professional development opportunities for teachers, principals, counselors, and other key school staff.
- (b) For teachers, provide professional development in STEM instructional practices shown to improve achievement, creativity, and motivation among talented students.
- (c) For principals and other administrators, provide professional development opportunities aimed at strengthening the leadership skills necessary to cultivate a supportive learning ecosystem for both teachers and all students.
- (d) For counselors and other key school staff, provide professional development aimed at understanding the educational needs of talented students from diverse backgrounds and with diverse interests. Attention should be given to professional development aimed at transforming negative attitudes and mindsets of educators and students regarding abilities and intelligence, and reversing underachievement in students with high potential.

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- (e) Strengthen the skills of 100 teachers through training and education programs by upgrading the skills and knowledge of as many as 25 practicing teachers each summer. The material covered would allow teachers to keep current with recent developments in science, mathematics, and technology and allow for the exchange of best teaching practices.
  - 4. Institutionalize student learning communities and faculty learning community to aid with the retention of students.
  - 5. Develop a structure so that linked courses can be effective in student enhancement so that team taught classes can flourish
  - 6. Increase faculty interest in undergraduate teaching and learning
  - 7. Develop a system that encourages faculty and staff to collaborate across disciplines
  - 8. Develop a system that encourages Faculty Development

## Implementation Plan

Goals	Actions Needed	Success Indicators	Time-line	Responsible Person	Cost
Goal 1: <b>Increase Student Enrollment in STEM</b>	1. Increase scholarships for students to major in STEM fields	1. Fund five(5) scholarships for STEM Teachers	Fall 2014	Provost	\$50,000
		2. Fund five(5) scholarships for pre-engineering programs	Fall 2014		\$50,000
		3. Fund five(5) scholarships for general STEM students	Fall 2014		\$50,000
	2. Hire a dedicated recruiter for STEM programs by Fall 2014	1. Increase the number of “high ability” students who major in STEM by at least 30% .	Fall 2015	Provost	\$80,000
		2. Increase the number of students who major in STEM by at least 30%.	Fall 2015		
		3. Increase enrollment in STEM subjects by at least 30%.	Fall 2015		
	3. Enlarge the pipeline of students who are prepared to enter Coppin and graduate with a degree in STEM by increasing the number of students who are dually enrolled at the University	1. Increase the number of partnerships we have with nearby well established secondary and postsecondary institutions.	Fall 2014	Recruiter  N.Eugene	\$15,000
		2. Expand the efforts of the Coppin After-School Math Program	Fall 2014		
		3. Offer STEM classes to partnering high school students	Fall 2014		
	4. Increase funding for STEM students.	1. Apply for the NSF Robert Noyce Teacher Scholarship grant	Fall 2014	N.Eugene  Clarence Williams  Al Essien	\$0
		2. Apply for the NSF HBCU-UP grant	Fall 2014		
		3. Apply for the NSF S-STEM grant	Fall 2014		
		4. Apply for the NSF STEP-STEM grant			
	5. Leverage available resources to support STEM students	Fall 2014			
	6. Increase the number of partnerships we have with private corporations				

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**Goal 1.1: Increasing STEM education majors**

<b>Majors</b>	<b>Fall 2014</b>	<b>Fall 2015</b>	<b>Fall 2016</b>	<b>Fall 2017</b>	<b>Fall 2018</b>
Biology	2	4	6	8	8
Chemistry	1	2	3	4	4
Math/Comp.Sci	2	4	6	8	8
<b>Cost</b>	\$50,000	\$100,000	\$150,000	\$200,000	\$200,000
<b>Institutional</b>	\$50,000	\$100,000	\$125,000	\$150,000	\$150,000
<b>Private Fundraising</b>	\$0	\$0	\$25,000	\$50,000	\$50,000

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**Goal 1.2: Increasing the number of students who major in pre-engineering programs**

<b>Majors</b>	<b>Fall 2014</b>	<b>Fall 2015</b>	<b>Fall 2016</b>	<b>Fall 2017</b>	<b>Fall 2018</b>
Pre-Engineering	5	10	15	20	20
<b>Cost</b>	\$50,000	\$100,000	\$150,000	\$200,000	\$200,000
<b>Institutional</b>	\$50,000	\$100,000	\$125,000	\$150,000	\$150,000
<b>Private Fundraising</b>	\$0	\$0	\$25,000	\$50,000	\$50,000

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**Goal 1.3: Increasing the number of students who major in general STEM programs**

<b>Majors</b>	<b>Fall 2014</b>	<b>Fall 2015</b>	<b>Fall 2016</b>	<b>Fall 2017</b>	<b>Fall 2018</b>
Biology	2	4	6	8	8
Chemistry	1	2	3	4	4
Math/Comp.Sci	2	4	6	8	8
<b>Cost</b>	\$50,000	\$100,000	\$150,000	\$200,000	\$200,000
<b>Institutional</b>	\$50,000	\$100,000	\$125,000	\$150,000	\$150,000
<b>Private Fundraising</b>	\$0	\$0	\$25,000	\$50,000	\$50,000

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Goals	Actions Needed	Success Indicators	Time-line	Responsible Person	Cost
<b>Goal 2: Improve Student Success</b>	1. Increase Coppins talent pool by retaining the number of students who pursue careers in science and mathematics			N. Eugene	\$0
	2. Implement a mentoring program that forges motivation, achievement, and creativity by peer interactions.	1. Implement the Freshman Male initiative program 2. Implement the intensive mentoring program 3. Provide incentives for faculty to mentor students 4. Fully integrate STEM students into campus activities and groups in ways that enrich the socialization of all students.		N. Eugene S. Delice	\$0
	3. Establish a student development plan	1. Establish at least four(4)-student lead STEM groups		N. Eugene Moses Wakesa Hany Sobhi	\$0

Goals	Actions Needed	Success Indicators	Time-line	Responsible Person	Cost
<b>Goal 3: Improve Academic Programs and Faculty</b>	1. Re-establish the dual degree in engineering with other USM institutions	Hire a Physics Faculty to teach 4 core calculus based physics courses		Provost	\$100,000
	2. Continue funding in support of the development of new courses/programs that increases students success in Maryland's workforce	1. Develop a program in computer network security and/or a program in cyber-security	Fall 2015	S. Ray	\$0
		2. Develop a Medical technology program	Fall 2016	C. Williams	
	3. Increase the content knowledge of K-12 teachers by providing rigorous professional development in science and mathematics education			N. Eugene	\$0
	4. Institutionalize student learning communities and faculty learning community to aid with the retention of students.	Create a STEM Center on campus to bring together the expanding arrays of programs and initiatives for increase synergy and visibility.		N. Eugene	\$0
	5. Develop a structure so that linked courses can be effective in student enhancement so that team taught classes can flourish			N. Eugene	\$0
	6. Increase faculty interest in undergraduate teaching and learning			N. Eugene	\$0
	7. Develop a system that encourages faculty and staff to collaborate across disciplines	1. Provide seed money that can be used to for faculty to collaborate across disciplines 2. Develop new courses that cross disciplines and inform wider teaching and research practices 3. Encourage reflection about general education and the coherence of learning across disciplines		N. Eugene	\$0
8. Develop a System that encourages Faculty Development	1. Provide seed money that can be used for faculty to re-tool themselves into programs that are more attractive to our students. 2. Develop a Faculty Development Plan with an associated time schedule for implementation.		N. Eugene	\$0	

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- [5] National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education *TABLE 5-8. Bachelor's degrees awarded by all institutions and by HBCUs to black U.S. citizens and permanent residents, by field: 200110*, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 200110. Retrieved February 10th, 2013 from <http://www.nsf.gov/statistics/wmpd/tables.cfm>
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