Report of the JMU Task Force on Science, Mathematics, Engineering, and Technology Outreach

Respectfully Submitted to Provost Douglas Brown on 1 May 2005.

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Executive Summary

The Task Force proposes the formation of a Center for Science, Technology, Engineering and Mathematics (STEM) Outreach and Education as a means of building a collaborative infrastructure on campus and with our partners in K-12 and higher education across Virginia. Such a Center will provide a means for faculty to interact and reconceptualize programs to educate new teachers of STEM disciplines, continue our work with in-service STEM teachers, examine teaching and learning in the STEM disciplines, and to rethink what role STEM education plays in the experience of all JMU students.

We propose a unique two-step process for creating the Center. The first stage is an initial two-year effort led by three JMU faculty members. One full-time Director and two part-time Assistant Directors will be responsible for developing the connections with the various stakeholders, fostering initial program offerings, building collaborations, and designing the on-going structure of the Center. After two years, there will be a national search for a Director who will assume permanent leadership for the Center.

We propose the following goals for the first year of the Center:
1. Establish the Center by
   a. building relationships between faculty, colleges, and departments on campus, and with external partners, such as K-12 schools, VA Dept. of Education, etc
   b. developing and communicating the Center's mission to stakeholders
   c. identifying and promoting the working relationship between faculty and the Center

2. Develop an Advisory Committee structure and membership (internal and external)

3. Develop programming for JMU STEM faculty and interested K-12 faculty that promotes dialogue and establishes relationships

4. Identify funding sources for activities already taking place on campus

5. Begin the process of curriculum discussion and review for science teacher education, including alternative licensure.
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“Our economy relies on a workforce that is adaptable, motivated and flexible; educated at our schools, colleges, and universities in STEM areas to prepare for highly skilled and productive jobs.”

Sustaining the Nation’s Innovation Ecosystem, 2004

Chapter I – Introduction

In 1983, in their report on “A Nation at Risk,” the National Council for Excellence in Education warned of declining student performance in math, science and technology and declining enrollment of college students in math, science and technology programs. They also projected a significant shortfall in qualified middle school and high school math and science teachers.

In some ways, more than 20 years later, we are still “at risk.” According to “Sustaining the Nation’s Innovation Ecosystem, a Report on Maintaining the Strength of Our Science & Engineering Capabilities” (http://www.ostp.gov/PCAST/FINALPCASTSECAPABILITIESPACKAGE.pdf, June 25, 2004), U.S. students still pursue STEM careers at significantly lower rates than their international counterparts. U.S. students are still performing at or below international averages in some measures of math and science proficiency. There is still a shortfall of qualified math and science teachers. For example: the Committee for Economic Development (2003) pointed out that “93% of middle school science students are taught by out-of-field teachers. Out-of-field teachers teach 70% of middle school mathematics students.”

As our society and the economy become more complex and technologically driven and dependent, it is essential that science, technology, engineering, and mathematics (STEM) education be strengthened to prepare students to be competent, productive workers and citizens. Generally speaking, in the United States low expectations and low performance pervade science and mathematics with only pockets of excellence in student achievement in these disciplines.

In Virginia, science and math, especially middle school science and math, are listed as two of the 2004-2005 Top 10 Critical Shortage Teaching Areas. In the National Assessment of Educational Proficiency, 37% of Virginia middle school students scored “below basic” in science and 28% scored “below basic” in math.

James Madison University is at or near the top of all colleges in Virginia in graduating future teachers. Thus, there is both an opportunity and a responsibility for JMU to make a significant difference in STEM education. We need to improve our efforts to recruit, educate and retain K-12 STEM teachers.

We also need to increase outreach in communities statewide to promote science and mathematical literacy in an effort to attract students to STEM disciplines. A necessary part of this effort must include improving undergraduate STEM education. This is
particularly important in low-income areas and areas of Virginia with high minority populations.

JMU has made strides in recent years to rethink and improve the mathematical and scientific education of PreK-8 prospective teachers. Faculty across the university have been engaged in developing and revising curriculum to align with recommendations set forth by national organizations such as the Conference Board of Mathematical Sciences in the *Mathematical Education of Teachers* (2001). The university is poised to capitalize on this work in teacher education to address the broader issues of attracting and preparing students to the disciplines of mathematics, science, and technology. However, this new initiative must recognize some of the challenges faculty have faced in implementing these improvements. Currently, it is difficult to be aware of the various efforts that are required to facilitate the collaboration and communication across campus needed to bring about this change. Moreover, opportunities to join larger consortia which are working to improve STEM education abound. However, without an existing structure and identified personnel to facilitate these efforts, these opportunities often go unrealized.

A task force, consisting of mathematicians, scientists, mathematics and science educators, and mathematics and science public school personnel, was charged with developing a solution to the problem of coordinating and improving our efforts in science, technology, engineering and mathematics education. Quoting from Provost Brown's memo forming the task force, "... I am asking you to serve on a task force that will have the responsibility for developing a new collaborative structure encompassing all elements of science, mathematics, and technology both within James Madison University and within selected public school systems throughout the state. It is clear to all that significant collaboration will be necessary in order to enhance the science, mathematics, and technology curriculum at all levels of the educational system. This includes pre-service and in-service education for teachers as well as the development of innovative science, mathematics, and technology program concepts particularly at the middle and high school levels." The members of the task force and their affiliations are listed in Appendix A.

Over the course of the 2004-2005 academic year, the committee met bimonthly to discuss issues surrounding the development of a collaborative structure for STEM education at James Madison University. We began by identifying the stakeholders and their major issues in STEM education at the local, state, and national levels. We also brainstormed potential goals and objectives for the new collaborative entity, rank ordering those we identified, then distinguishing which goals should be accomplished within the first years of this effort. Through numerous discussions, the committee developed a proposed structure for a Center for STEM Outreach and Education, including suggestions for the leadership team, staff, advisory committees, faculty involvement, and the physical and organizational locations within the university. Throughout the year, we have identified potential benefits, as well as potential hurdles, to the university and community at large. Throughout the process the goal was to create a sustainable structure that will attract more students to STEM disciplines and effectively prepare them to be competent, productive workers and citizens in a scientific and technological world, as well as to develop more K-12 STEM teachers and support them throughout their careers.
Chapter II – Center for Science, Technology, Engineering and Mathematics (STEM) Outreach and Education

We began our work by identifying all of the stakeholders in JMU’s work in STEM education and outreach. The stakeholder list is given in Appendix B. This activity involves many elements of the campus community including the Colleges of Education, Integrated Science and Technology, and Science and Mathematics. It touches all students through either their general education or major studies and it extends throughout the Commonwealth via the STEM teaching in Virginia's schools, as well as in the deliberations of the Legislature. In order for JMU to continue and improve our efforts in this area, the collaborative structure for STEM Outreach and Education must be both local and far-reaching.

We next identified and prioritized the goals of the Center for STEM Outreach and Education. The full list of goals is listed in Appendix C. In order to be successful in establishing and nurturing a STEM education and outreach presence at JMU, the organizing unit must

1. strongly link K-12 schools and JMU STEM faculty
2. support innovative efforts to dramatically influence STEM education, and
3. establish internal connections between the various units involved in STEM Education and Outreach at JMU.

Each of these high priority goals has distinct objectives that must be addressed as the organizing unit is formed and moves forward. The objectives for each goal are as follows:

1. **Strongly link K-12 schools and JMU STEM faculty**
   a. Communicate between various interested groups/entities and stakeholders
   b. Build innovative in-service support/staff development for K-12 faculty
   c. Explore alternative licensure (discuss possible paths to a teaching license)
   d. Serve as a clearinghouse for funding opportunities / provide seed money to develop innovative (and fundable) projects
   e. Support faculty and other partner grant activity
   f. Promote and encourage faculty wanting to work on STEM education issues (faculty becoming members of the unit for a period of time)
   g. Investigate collaborative initiatives such as JMU faculty in residence in schools and K-12 faculty in residence at JMU

2. **Support innovative efforts to dramatically influence STEM education**
   a. Examine what skills and knowledge are most necessary to be a STEM teacher and how best to provide such skills and knowledge to our students
   b. Explore how we balance content and pedagogy - structurally and philosophically
   c. Sponsor and support discussions and efforts to redesign curriculum for pre-service STEM students with input from content specialists and the College of Education
   d. Support faculty as they explore new curricula for pre-service teachers
   e. Build innovative in-service support/staff development for K-12 STEM faculty
i. Explore alternative licensure
ii. Serve as a clearinghouse for funding opportunities / provide seed money to develop innovative (and fundable) projects
iii. Support faculty and other partner grant activity
f. Serve as advisory resource to state and federal government agencies on issues such as Praxis, Policy, etc.
g. Promote and encourage faculty who want to explore STEM education issues (faculty becoming members of the Center for a period of time)
h. Investigate the need for a formal evaluation mechanism of participating faculty. For instance, how do we ensure departments value work completed in the Center?

3. Establish connections between STEM at JMU and other parts of the university
   a. Inform decision-making at all levels of JMU
   b. Focus on broadly impacting the JMU educational experience

As we considered what sort of structure would help JMU achieve these goals and objectives, we examined the organization of approximately 22 other institutions (see Table I) that had dedicated structures to support similar science and math education initiatives. The Centers were chosen to provide a broad spectrum of institutions—some very similar to JMU and others very different. Universities with the most highly visible STEM activities, and most easily discernable STEM support, had dedicated STEM-focused centers. These were typically located in either the President’s office, Vice-President of Academic Affairs office, graduate school, or even within one of the various colleges supporting these Center’s efforts. Of particular interest was the University of Kansas Center for Science Education, an interdisciplinary collaborative center formed by a Task Force similar to ourselves.

### Table I: STEM Centers Examined

<table>
<thead>
<tr>
<th>Institution</th>
<th>Website</th>
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<tbody>
<tr>
<td>Boston Univ.</td>
<td><a href="http://www.bu.edu/smecc">www.bu.edu/smecc</a></td>
</tr>
<tr>
<td>Cal State – Chico</td>
<td><a href="http://www.csuchico.edu/cmse/">www.csuchico.edu/cmse/</a></td>
</tr>
<tr>
<td>Carnegie Mellon</td>
<td><a href="http://www.cmu.edu/mcs/alumcom/outreach.html">www.cmu.edu/mcs/alumcom/outreach.html</a></td>
</tr>
<tr>
<td>Case Western</td>
<td><a href="http://www.cwru.edu/artsci/csm">www.cwru.edu/artsci/csm</a></td>
</tr>
<tr>
<td>Colorado School of Mines</td>
<td><a href="http://www.mines.edu/research/cee">www.mines.edu/research/cee</a></td>
</tr>
<tr>
<td>Georgia Tech</td>
<td><a href="http://www.ceismc.gatech.edu">www.ceismc.gatech.edu</a></td>
</tr>
<tr>
<td>Illinois State Univ.</td>
<td><a href="http://www.ilstu.edu/depts/cemast">www.ilstu.edu/depts/cemast</a></td>
</tr>
<tr>
<td>Maine Teacher Collab.</td>
<td><a href="http://www.umedu.maine.edu/coehd/mmstec/mmstechc.html">www.umedu.maine.edu/coehd/mmstec/mmstechc.html</a></td>
</tr>
<tr>
<td>Michigan Tech</td>
<td>wupcenter.mtu.edu</td>
</tr>
</tbody>
</table>
After exploring the efforts at other institutions and considering a variety of different organizational structures to address the challenge of coordinating our STEM efforts at JMU, the Task Force came to the consensus that this institution would be best served by the establishment of a Center for STEM Outreach and Education.

In the next chapter, we'll describe the details of creating and sustaining the Center. However at the outset, we want to stress that due to the strong interdisciplinary (and non-college or departmental specific) nature of the Center's activities, it is important that the Center be placed organizationally in the Provost's office. Through this reporting structure, the Center will be able to effectively work across the institution and have the political leverage to engage the various campus constituencies in this important work.
Chapter III– Implementation Details

We had extensive discussions about how the Center should be organized, in terms of leadership, resources, initial focus, and sustainability. The consensus of the Task Force was that it would be very difficult to specify a formal structure that would best suit JMU's long-term needs. As a consequence, we propose a unique evolutionary strategy for the start-up and ongoing activity of the Center.

Leadership
In the initial two year start-up phase, we propose that a director (full-time) and two assistant directors (half-time or two-thirds time) to lead the Center. Given the desire to get the Center started quickly, the initial leadership team should be chosen from current JMU faculty. The leadership team needs to represent the broad cross-section of campus units involved in STEM education and outreach. The Task Force felt that the initial director should have strong STEM content credentials as well as experience in STEM outreach to build credibility across JMU. The assistant directors should be chosen from other STEM disciplines so that the leadership team is balanced across the primary STEM units, the Colleges of Education, Integrated Science and Technology, and Science and Mathematics. The choice of the leadership team should be made in consultation with faculty and college administrators to ensure that the director works well with various constituencies.

After the start-up phase, we propose that a national search be conducted to hire a permanent director for the Center and the staffing of the Center be reexamined. The Task Force feels an intensive effort will be required at the outset to build the relationships and structures needed to foster collaboration and communication across campus. As this infrastructure is established, the Center can focus on sustaining the relationships and structures as well as developing new programs. Such efforts may require different kinds of staffing. The proposed evolution of the leadership structure is intended to keep the Center responsive to the needs of JMU and our stakeholders.

While the leadership team will play an important role, the Task Force proposes two advisory groups to oversee the activities of the Center: an executive (external) advisory board and an oversight (internal) advisory committee. The executive board will consist of state and industry leaders that can provide encouragement and support for the center’s initiatives. This committee will meet once or twice a year.

The oversight committee (internal advisory committee) will consist of faculty, JMU and school administrators and community representatives (e.g. teachers). It will be a working body that generates ideas and oversees current projects. This committee will meet as often as needed and we anticipate it will play a large role in establishing and monitoring the direction of the Center. One of the first year goals for the Center will be to establish both of these advisory groups.
**Resources**
The Center will require a variety of different kinds of resources, including personnel, equipment, operating budget, and physical space. The Task Force feels strongly that in order to be successful, the Center must have an ongoing, reliable source of funding for its base level of activity. Developing externally funded projects will likely become a significant activity of the Center. Having to rely on external grants and contracts, however, for most/all of its funds will potentially impede the communication and collaborative work of the Center, as the Center is forced to follow the current rage in various funding circles just to remain in operation. We examined numerous examples of Centers at other institutions whose external funding forced them to exclude key STEM areas (often Mathematics).

**Personnel**
Along with the budgetary lines for the Center leadership, the Center will require an administrative assistant (we suggest full-time, but at minimum half-time). We also propose that there be funds to hire student assistants to help with a variety of tasks and to engage STEM students (including future teachers) in the work of the Center. The Task Force suggests that funds be made available for a K-12 STEM teacher in residence who would work in the Center and teach in appropriate areas on campus. Funds will also be needed to support faculty who commit considerable amounts of time to Center projects. As the Center's activities grow, a position for a grant writer would greatly assist in the pursuit of externally-funded projects.

**Equipment**
The Center will require computer hardware and software for the leadership and clerical staff. It will also require a variety of equipment for giving in-service and outreach workshops, including computers, probeware, lab kits and supplies, etc. We anticipate the Center developing an inventory of equipment/resources that can be shared with the STEM K-20 Education community. While there is a need for the computers at the outset, the other equipment can be acquired over time.

**Operating Budget**
The Center will require an annual operating budget. The budget will need to accommodate office expenses, travel (including vehicle access for in-state travel), web design/development, programmatic expenses, etc.

**Space**
The center needs to have dedicated space on the greater JMU campus with access to parking. Without a welcoming and accessible physical presence, the Center will be challenged to interact with our external partners (this lack of space and parking has had a deleterious effect on our STEM outreach work with local schools over the last decade). The decision of where the Center should be located is complicated by uncertainty in the available space but the following constraints and ideas should be considered:

- If a large space could be identified that linked several ongoing community endeavors relating to STEM education, it would greatly enhance the Center’s productivity. For example, if the Harrisonburg High School property could
house classroom space for IDLS teacher education, the Center's administration with meeting rooms for workshops, and a satellite branch of the Virginia Science Museum, then one could imagine a very dynamic environment for encouraging science education.

- Some other science-oriented areas at JMU might also serve the above purpose, such as the JMU Arboretum.
- The space should include offices for the Center’s personnel and K-20 collaborative partners, meeting rooms, perhaps classrooms, resource area, and computer access areas for visitors. We propose the following:
  - Wet laboratory (seating 25-30)
  - 2 Technology mediated classrooms (flexible seating for 30)
  - Conference room/resource library
  - Administrative/Faculty offices (6 offices)
  - Storage space
  - Work room

**Sustainability**

The Center needs to develop a relationship with the colleges and the university support systems (infrastructure). The Center should not be seen as a replacement for existing university resources but rather as an entity that strengthens and combines current capabilities. While faculty and staff may eventually be supported directly by the Center, most of the personnel will be gathered from the JMU and K-12 community. The Center should not become an autonomous body that can act as an independent advocate or developer but must rely on the community in order to be successful. The Center should not assume responsibilities that belong in other places. If grant writing becomes an important activity of the Center it may be necessary to have some specialized personnel but every effort should be made to strengthen and link these personnel with the Sponsored Program office rather than duplicate existing support.

The Center needs to impart a level of prestige to those who work through it and be viewed by the JMU and K-12 community in this same light. The Center should strive to acknowledge and reward those that succeed in advancing the goals and generating a sound direction. Part of the rewards will be discussed under incentives below. Additional activities to build the Center's reputation should be considered. The administration could greatly add to the prominence of the Center by frequently working with the directors and advisory board and by offering public encouragement to those committed to the Center’s work. Attaining and maintaining prestige and prominence to the JMU and K-12 community will encourage participation by faculty and staff. The importance of being a part of the Center will be a consideration that supervisors and colleagues will value and encourage.

To be successful in generating enthusiasm for STEM activity in the community the Center should be careful not to weaken efforts already in place or damage relationships that are crucial for the improvement of the STEM areas. Here are a few cautionary remarks for consideration.
• The Center should not replace services that are housed in other areas of the university and that draw strength from their current relationship.
• The Center should be willing to support positive efforts that prefer not to work through the center.
• The Center should encourage broad participation and not become reliant on a few individuals.
• The Center should recognize the immense diversity in styles and approaches and not become dogmatic.

We'll explore these issues and other potential concerns in the next chapter.

**Initial Focus**
Pivotal to the success of the Center is establishing it as a respected and influential organization. Accordingly, the Task Force focused on the initial activities of the Center. We propose the following goals for the first year of the Center:

1. Establish the Center by
   a. building relationships between faculty, colleges, and departments on campus, and with external partners, such as K-12 schools, VA Dept. of Education, etc
   b. developing and communicating the Center's mission to stakeholders
   c. identifying and promoting the working relationship between faculty and the Center

2. Develop an Advisory Committee structure and membership (internal and external)

3. Develop programming for JMU STEM faculty and interested K-12 faculty that
   a. promotes dialogue and establishes relationships

4. Identify funding sources for activities already taking place on campus

5. Begin the process of curriculum discussion and review for science teacher education, including alternative licensure.

We had a wide-ranging discussion of other activities that the Center might pursue. This list is included as Appendix D.
Chapter IV Issues and Concerns

We identified five key areas of concern for the long-term viability of the Center for STEM Outreach and Education. We'll discuss each area of concern in turn and suggest possible courses of action to address the issues raised.

a. Making the center sustainable
b. Engaging the campus community
c. Rewarding work done in the center (Merit, Promotion/Tenure)
d. Transitioning from start-up to on-going operation
e. Where does the center exist in the JMU structure

a) Making the center sustainable:
A major concern is the sustainability of the Center. Clearly, financial resources are imperative to its success and continued existence. Resources required for startup were detailed in a previous section of this report, however, a consistent resource flow is necessary if the Center is to achieve its goals (highlighted above). Additional resource needs are expected as the mission and activities of the center evolve. What concrete renewable sources of income will be available, or created, to make a thriving STEM Center a reality? If the Center is to be a hallmark of the university, grants cannot be the primary funding source, but they can, and should, play a significant role in ongoing projects.

This venture presents significant opportunities for unique collaborative educational efforts with far-reaching implications for K-20 education, outreach, and research. The Center has the potential to be a “jewel” of the university, so careful consideration must be taken in its creation. A key to sustainability is being able to create an image of prominence and prestige for the Center in the both the university and public eye. Commitment to the Center concept, goals, and activities by all colleges involved and the university leadership is essential. This commitment must take many forms, including, but not limited to, the development of a system that supports and provides incentives for faculty involvement.

Even if every detail essential to start-up (see section III) is implemented, the Center will be difficult to sustain if the necessary relationships between faculty, departments, colleges, K-12 schools, community colleges, the Virginia Department of Education, and other representatives in state and local governments are not initiated and secured. Any prior mistrust must be overcome, because these relationships are vital for the ultimate success of the Center. Relationship nurturing entails significant time and effort, and the university must be willing to allow the release time required to build these relationships. Furthermore, the leadership of the Center, along with university leadership, must facilitate a common vision.

In addition to these more global issues, there are more tangible issues related to the operation of the Center. For example, how do we persuade tenured faculty that it is a significant honor to serve on the internal advisory committee?
For the center to remain sustainable, it is important that the accomplishments of the Center receive appropriate university, local, and national recognition. Prominence and prestige are key to establishing an encompassing presence for STEM outreach and education at JMU. In turn, this impacts decision-making at all levels of JMU and can broadly impact the JMU educational experience. The impact could include the publicizing of STEM careers and opportunities and assisting in both recruiting and retaining students across JMU STEM programs.

b) Engaging the Campus Community:
The Center will be in a precarious position if it cannot engage a large portion of the campus community. Confronting this concern may be more challenging than securing funding for the Center. Such engagement could be impeded by issues related to trust and respect between the various units on campus, along with the physical distance that currently exists between some of the constituent groups. A suitable physical space for the Center that both encourages the establishment and nourishment of on-campus relationships while allowing easy access for off-campus participants will support collaborative (and, ostensibly, engaging) Center efforts. Finding such space, however, could be problematic.

Productive senior faculty already balance numerous tasks related to teaching, scholarship, and service. It may be a challenge to induce them to engage in a high-priority activity outside of their current nucleus of activities. Typically, these same faculty are also more prone to pre-established feelings of mistrust, however, if younger faculty do not see their senior colleagues engaging in the Center there is a chance that they also will be skeptical of the relative importance of the Center. There must be suitable and attractive incentives to draw both senior and junior faculty into the Center. If this can be accomplished the university will reap a considerable return on the cross-disciplinary relationships and connections created, both in productive thought, common vision, and cohesive spirit. Cooperation among all involved parties could promote willingness for an open and productive review and discussion of curriculum.

The relationships established through the Center would naturally lead to the possibility of engaging JMU administrators in the Center as they could view it as a tactical resource for strategic planning and prioritization of university needs. The Center should also appeal to the JMU student body as a source for possible scholarship and service opportunities, a repository of STEM educational tools, and a place to establish important career contacts. The Center should ultimately be able to engage K-12 educators and administrators outside the campus. It should be an invaluable resource for the evaluation and reformation of courses, a source of innovative in-service support/staff development, a location where school systems could strongly link K-12 educators with JMU content specialists, and a place where K-12 administrators could be connected to a clearinghouse of very highly qualified future K-12 STEM teachers.
c) **Rewarding Work Performed through the Center:**
As the university values the mission of the Center it is important to establish assurances for faculty who participate in it with regards to merit, tenure, and promotion. Standards regarding credit towards merit and promotion for work done in the Center need to be developed at the outset and be well articulated within each department in the university that has a connection to the Center. Furthermore, departments should encourage faculty that desire to work on STEM education issues to participate in the Center, and their participation should be valued and rewarded by the department regardless of rank. Departments should be encouraged to consider as scholarship education-related STEM activities, for example exploration of new curricula for pre-service teachers. The task force also believes the annual review of a faculty member contributing to the Center should contain an evaluative component from the Provost's Office or from the Center leadership.

Content area faculty who affiliate with the Center for a period of time need to do so with the assurance that their careers in their respective departments are secure, and that their commitment to the center is highly valued by their departments, colleges, and university. The timeline for communicating this concern to the respective departments is somewhat limited, as the task force recommendations include forming the 2005-2006 internal Oversight Advisory Committee which would contain representatives from each STEM department.

d) **Transitioning from Start-up to On-going Operation:**
In the beginning, the Center will likely be in a fairly significant state of flux as it attempts to achieve its preliminary goals and ascertain its future aspirations. Identifying the “right” personnel for the initial year is paramount to a smooth transition later. This opinion is well supported by history. The right group of individuals will establish in due course the correct balance of resources necessary to economically optimize the operation of the Center. Even though the taskforce has identified several broadly defined potential STEM activities for the center, it will be crucial for the Center’s leadership team to hone and prioritize these, setting precise goals and determining successful strategies for achieving the goals. The task force has already sought out established STEM centers at several universities in the United States and exchanged some ideas via phone contact. Our Center would be well advised to continue to learn from the experiences of similar, established centers throughout the country to aid in addressing numerous issues, including how to transition from start-up to on-going operation.

e) **Where Does the Center Exist in the University Structure:**
The most fertile location in which to place the Center within the current university structure must be determined immediately if the Center is launched in the 2005-2006 academic year. For the Center to engage large portions of the campus community, it should not be attached to any of one of the existing colleges in the university. The Center should have some autonomy from the present college structure, and its leadership should report directly to the Provost. While this might cause some in the university to be skeptical about the administration’s role in the Center, the task force believes this
arrangement is ultimately best, and believes that when the Center is successful, any skepticism will quickly fade.
Chapter V – Conclusions

From its inception, JMU has a long and proud tradition of providing high quality teacher education. Throughout our history, we've made a difference in the education of Virginia's children. As we approach our centennial year, we have the opportunity to develop a structure that will coordinate and improve our efforts in STEM Outreach and Education, building on the work of many dedicated faculty and staff on campus. There is strong national imperative for such efforts, and every year Virginia colleges and universities don't supply enough highly qualified teachers to fill the growing need. The proposed Center for STEM Outreach and Education offers us the opportunity to position JMU to continue to dramatically influence the education of the next generations of Virginians.
References


Appendix A

Task Force Membership and Affiliation

- Dr. Steve J. Baedke – Associate Professor of Geology, James Madison University
- Dr. C.J. Brodrick - Assistant Professor of Integrated Science and Technology, James Madison University
- Mr. Andy Jackson - Physics Teacher and Science Supervisor, Harrisonburg City Public Schools
- Dr. Cindy Klevickis – Associate Professor of Integrated Science and Technology, James Madison University
- Dr. Kevin Giovanetti – Professor of Physics, James Madison University
- Dr. Bob Kolvoord – Task Force Chair – Professor of Integrated Science and Technology, James Madison University
- Mr. Patrick Lintner, - Mathematics Teacher and Mathematics Supervisor, Harrisonburg City Public Schools
- Dr. LouAnn Lovin – Assistant Professor of Mathematics Education, James Madison University
- Dr. Sharon Lovell – Associate Professor of Psychology and Associate Dean of the College of Integrated Science and Technology, James Madison University
- Dr. David Slykhuis – Assistant Professor of Science Education, James Madison University
- Dr. Paul Warne – Associate Professor of Mathematics, James Madison University
Appendix B

Stakeholders in STEM Education

Students
- JMU Students – IDLS, STEM majors, Gen Ed students, Teacher Education minors (Secondary content), Service course students
- Community College students
- K-12 students

Parents

Faculty
- JMU Faculty
  o School of Ed
  o CISAT
  o CSM
- K-12 STEM instructors
- Community College STEM instructors

Administrators
- JMU Administrators
- K-12 Administrators
  o Superintendents
  o Curriculum specialists
  o Principals
  o School Boards

Government
- State Legislature
- State Department of Education
- SCHEV
- Governor
- Local Government
- Federal Government partners (i.e. Shenandoah National Park)

Others
- Funding Agencies
- Professional Organizations (NSTA, NCTM, etc.)
- Business and Industry
- NGO's
Appendix C

Possible STEM Outreach Goals

Communications/Public Relations

___ C1. Communicate between various interested groups/entities and stakeholders
___ C2. Promote/publicize JMU efforts in this area
___ C3. Promote/publicize links/connections between interested constituencies
___ C4. Publicize STEM careers and opportunities (help to recruit and retain students across JMU STEM programs)
___ C5. Promote STEM to local community (incl. K-12 students) – careers, research areas…
___ C6. Harvest and share good things going on elsewhere on an ongoing basis

Organizational Goals

___ O1. Provide joint ownership / shared responsibility so that governance mimics the kind of collaboration we want to promote
___ O2. Joint leadership with administrators and faculty
___ O3. Strongly link K-12 schools and JMU STEM faculty (JMU faculty in residence in schools and K-12 faculty in residence at JMU)
___ O4. Serve as advisory resource to state government (possible Feds as well) on such issues as Praxis, Policy, etc.
___ O5. Serve as advisory resource to K-12 and JMU administrators for strategic planning and other needs
___ O6. Establish a presence for STEM at JMU in everything we do
   - Inform decision-making at all levels of JMU
   - Focus on broadly impacting the JMU educational experience
___ O7. Promote science (STEM) for social justice – support innovative efforts to dramatically influence STEM education for at-risk/under-served populations
___ O8. Support innovative efforts to dramatically influence STEM education
___ O9. Increase recruitment of potential STEM educators

Activities

___ A1. Provide access to space and resources to support K-16 STEM education
___ A2. Provide a content repository
A3. Support summer and academic year staff development for K-16 STEM teachers

A4. Review/Develop curriculum for pre-service STEM educators (serve as research center/test-bed as opposed to administrative/approval structure)

A5. Coordinate any STEM education focused pieces (e.g. Science Specialist Master’s)

A6. Build innovative in-service support/staff development for K-12 faculty
   - Explore alternative licensure (discuss possible paths to a teaching license)
   - Serve as a clearinghouse for funding opportunities / provide seed money to develop innovative (and fundable) projects
   - Support faculty and other partner grant activity

A7. Examine what it means to be a STEM teacher – what skills and knowledge and how best to provide that to students.
   - Explore how we balance content and pedagogy? Structurally and philosophically
   - Sponsor and support discussion and effort to redesign curriculum for pre-service STEM folks w/content and CoEd folks?
   - Support faculty as they explore new curricula for pre-service teachers (Geology curriculum example from Kevin G.

A8. Figure out how to influence parents of potential STEM majors or STEM teachers
   - Identify best practices (supported by evidence) in STEM areas, document our successful efforts with research and disseminate that research

A9. Promote and encourage faculty wanting to work on STEM education issues (faculty becoming members of the unit for a period of time)
   - Do we need a more formal evaluation mechanism (or not)? How do you keep the tight connection w/departments (how to incentivize?)

A10. Teach JMU classes (dual enrollment) instead of AP at local schools – JMU faculty (or others) (be careful of resentment from HS faculty). Better if you team…. Professional development opportunity for JMU faculty and for pre-service teachers

A11. Can we identify incentives for pre-service folks (internal or external) – scholarships, research, work opps, modify curriculum to make it easier? What can content departments do? What can CoEd do?

A12. Mentorship of young in-service teachers?
Appendix D

Other Possible Center Activities

To clarify the centers role in STEM education the following is a sample list of roles in an unranked order that the center might embrace:

- Develop online resource database of stem materials. The center could choose to provide central management when resources and needs are poorly linked.
- Educators join the center to devote a block of time to developing STEM curricula. The importance of developing curriculum at all levels is clear. The center should develop methods to support and encourage these efforts.
- Educator joins the center to devote a block of time to evaluating STEM policies (e.g. STEM standards, mandates and requirements). The center could play a key role in providing feedback to education policy makers. The center might develop ways to evaluate current and future state and federal mandates.
- Faculty could team with teachers to develop programs that satisfy the federal requirements for continued teacher certification. As teacher certification requirements change the center could be at the forefront by developing the required certification courses and programs.
- Support ideas for STEM resources, for example, a Virginia Science Museum satellite at JMU.
- Serve as a clearinghouse for ideas.
- Serve as a resource that links the various constituencies.
- Provide support in terms of space, time, equipment and funds to STEM educators. The center should have a pool of resources that can be used by those involved in STEM education. It should have resources for teachers in K-12 and for faculty at JMU.
- Develop and promote outreach activities.
- Provide organization for K-12 school children participation in teacher education and outreach.
- Serve as a home for some STEM organizations.
- Award meritorious activity in STEM Education and Outreach