STEM II Initiative-Updates from Participating Institutions (Part 1)

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USG STEM INITIATIVE: OVERVIEW AND LESSONS LEARNED

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Center for Advanced Communications Policy (CACP)
Georgia Institute of Technology

Project Director / Lead Evaluator
STEM Initiative Policy and Programmatic Support Project
Office of Educational Access and Success
University System of Georgia
Introduction

- Launched by Chancellor as Presidential Initiative in 2007
- Led by Office of Educational Access and Success (OEAS, formerly EPIR)
- Building on, advancing successful USG programs (e.g. Georgia PRISM)
- STEM I Initiative: 2007-2011
- STEM II Initiative: 2011-present
Initiative Overview, Pt. 1

Three Objectives (abbreviated)

1. To increase P-12 student preparation for and interest in STEM in college,
2. To increase the success rates and number of students in college who pursue the STEM disciplines, and
3. To increase the number of teachers who are prepared in science and mathematics.
Initiative Overview, Pt. 2

Strategies and Implementation

12 strategies, including key programs

- Academy for Teachers (AFT)
- Mathematics, Engineering, Science Achievement (MESA)
- Fostering Our Community’s Understanding of Science (FOCUS)
- Mini-grants for P-16 Learning Communities

Annual budget: ~$2.6 million - $2.8 million

- All funds go back to USG institutions
Evaluation of STEM I Initiative

- Formative evaluation - late 2010
- Summative evaluation - late 2011

- Based on initial evaluation findings, STEM I Initiative revised, re-competed as STEM II Initiative in early 2011

- 5 returning institutions, 2 newcomer institutions
Key Evaluation Findings – Student Success Rates

Among participating institutions, FY2007-FY2011

- Total increase in STEM majors by *minimum* of 7.84%, up to a *maximum* of 66.18%
- Increase in A/B/C rates in biology (1.4%), chemistry (3.0%), mathematics (1.1%), and physics (1.5%)
- Increase in STEM degree completion: 1.71% (with controls); 19.71% (without controls)
Key Evaluation Findings – Teacher Preparation

Among Six Baccalaureate Institutions, FY2007-FY2011

• STEM education majors increased by 40.56% (from 633 to 946)

• STEM education degrees increased by 37.67% (from 215 to 296)
Key Evaluation Findings – Ongoing Challenges

• Comparability and reliability of data collected

• Outputs-oriented indicators regarding programs; Need for outcomes-oriented indicators

• Despite overall progress, variable institutional performance
STEM II Initiative Competition

Two RFPs Released in December 2010

- Category 1 - Returning institutions (5 selected)
- Category 2 - Newcomer institutions (2 selected)
- Total of 28 proposals received
- Review panel included USG leadership, USG university president, outside reviewer
Priorities for STEM II Initiative

• Emphasis on innovation (newcomers) and refinement and scaling of best practices (returners)

• Higher priority placed upon institutional programs

• Dissemination of findings for benefit of entire USG
Update on the STEM II Initiative at Columbus State University

Tim Howard, Director
Math & Science Learning Center

Kim Shaw, Co-Director
UTeach Columbus
Components of the CSU Project

• Service learning course
• Peer instruction study
• Faculty SoTL mini-grants
Service Learning Course

Hired a New Master Teacher, Gail Sinkule

- National Board certified
- 30+ years of K-12 experience
- Former president of GSTA
- Taught to a broad spectrum of socio-economic backgrounds
- First offering of course Spring 2012
Service Learning Course

Step 1: Inquiry Approaches to Teaching (*new*)

- Teach math/science lessons in elementary schools
- Students from any major
- One credit hour
- Meets UTeach Columbus requirement
- Spring 2012 enrollment 32 (25% above goal)

Step 2 course planned for Fall 2012
Peer Instruction Study

Investigators: Cindy Henning, Tim Howard, Kathleen Hughes, Kim Shaw

- 19 Peer Instruction Leaders (PILs)
- About 1400 students served
- Core courses in BIOL, CHEM, MATH, PHYS, STAT
Peer Instruction Design

- Matched-pair design
- PIL assigned to one lab section
- PIL attends lectures, *lab*
- PIL meets with instructor at least 4 times
- Help sessions available to all students with that instructor, both in Peer Instruction section and in control section
- Data collection ongoing to determine effectiveness on larger scale
Faculty SoTL Mini-grants

Funding to support

• Participation in efforts to strengthen student learning and achievement
• Contributing scholarship that promotes student learning and achievement
• Development and/or implementation of new instructional methods or techniques
• Projects that promote the success and recruitment of traditionally underrepresented groups
Faculty SoTL Mini-grants

Zdeslav Hrepic: Methodology and/or Technology: Making a Difference in Improving Students’ Problem Solving Skills

Rajeev Dabke: Development of Undergraduate Curriculum in the Area of Experimental Physical Chemistry

John Barone: Use of a Writing Consultant in a Science Course

Kathleen Hughes: Evaluation of Two Peer-Assisted Learning Strategies in BIOL 2221
Reaping Additional Benefits

- UTeach Columbus - $1.4 million grant
- Robert Noyce Teacher Scholarship program – $1.2 million grant from NSF
- SoTL STEM Seminar
- Math & Science Teachers Council (MAST)
- Math & Science Learning Center
- Higher profile for STEM Education efforts
For Additional Information

See our poster following this session!

Contact us!

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  Tim.Howard@ColumbusState.edu

• Kim Shaw
  shaw_kimberly@ColumbusState.edu
Georgia Gwinnett College
School of Science & Technology

STEM Initiative II Program

Dr. Thomas Mundie, PI
Dr. Judy Awong-Taylor, Dr. Allison D’Costa, Dr. Greta Giles, Dr. David Pursell, Dr. Clay Runck, Co-PIs
1. Promote K-12 student preparation for and interest in majoring in STEM in college.
2. Increase the success of STEM majors in college.
3. Advance the production of science and mathematics teachers for the schools, which in turn will lead to improved preparation of K-12 students in science and mathematics.

**Strategies**

1. Establish a structured mini-grant program targeted toward STEM faculty
2. Develop a service learning course to provide STEM undergraduates the opportunity to gain teaching experience in science and math at K-12 level
3. Institution-specific strategies that address instructional needs specific to the institution in the area of STEM through innovative approaches
Establish a 4-Year Undergraduate Research Experience Program (4-yr URE)

- Aligned with SST’s 4-yr URE Program
- SST 4-yr URE Committee
- Early and active involvement in systematic investigation and research.
- Promote the success of STEM students

Strategy 1

Structured “mini grant” program

- Fund 4-yr URE Mini-Grants
**Biology Major: General**

- **Freshman**
  - BIOL 1107K & BIOL 1108K
    - Principles of Biology I & II
  - CHEM 1211K & CHEM1212K
    - Principles of Chemistry I & II

- **Sophomore**
  - BIOL 3400K
    - Cell Biology
  - CHEM 2212K
    - Organic Chemistry II

- **Junior**
  - BIOL 3500K
    - Ecology

- **Senior**
  - STEC 4500
    - Research
  - BIOL 4800
    - Internship
  - BIOL 4570
    - Experimental Methods
  - BIOL 4560
    - Research Methods In Biology
**Communication**
Scientific communication requires good listening and note-taking skills, the ability to find information from current primary literature sources, and the skills to disseminate information in both written and oral form using proper scientific formatting.

- Ability to search for appropriate materials using both traditional (journals, books) and electronic libraries
- Ability to read, understand, and follow complex directions and instructions, including lab/equipment manuals and system references;

**Critical Thinking and Quantitative Reasoning**
Scientists must collect and analyze data using proper statistical significance, controls, and mathematical analyses. They must apply these same quantitative reasoning skills to literature and peer submissions.

- Ability to follow a scientific/technical methodology, to apply mathematical or IT solutions, and to adapt the methodology/models if necessary;
- Ability to problem-solve or trouble-shoot an experiment/experimental procedure/equipment using appropriate resources;

**Creativity:**
Scientists exhibit creativity through the development of research projects, including the generation and testing of a hypothesis and the troubleshooting skills necessary to overcome experimental obstacles.

- Ability to design and implement research projects;

**Collaboration:**
Scientists must act in a global, diverse, and multidisciplinary context and follow universal moral and ethical principles at all times. They are leaders in their community and must always act in good faith.

- Ability to participate or take lead in a research team setting;
- Ability to follow required regulations and to act ethically during research.
Research Skills for Math Majors

Senior
- Synthesis of all freshmen, sophomore, junior experiences

Junior
- Writing reports more advanced
- Read research articles
- Propose research problems

Sophomore
- Visualization for 3D and other types of functions
- Analyze and model data
- Writing reports
- Proof writing

Freshmen
- Visualization for 2D of Polynomial functions
- Use technology (Computer algebra system like Maple)
- Analyze, model data - Optimization Problems
Strategy 1: SST’s 4-Yr URE Mini-Grant Program

Three Categories of 4-yr URE Mini-Grants

- Course-imbedded research projects that promote the 4-yr URE model (Priority)
- Individual or small group Undergraduate Research (STEC 4500) Projects aligned with the 4-yr URE model
- Development, implementation, and research of innovative instructional strategies that pertain to the Scholarship of Teaching and Learning (SoTL)
Project Types

- **Pilot Projects** (involve one section to test an idea; one semester; funds used for supplies)
- **Small Scale Projects** (involve 2-3 sections; 1-2 faculty; 1-2 semesters; funds for supplies/equipment; possible funds to support decrease in teaching load)
- **Large Scale Projects** (involve multiple sections; 2 or more faculty; 2-3 semesters; etc.)
- **Collaboration**: strongly encouraged within disciplines & between schools

Funded Projects

- 22 funded mini-grants
Develop a service learning course

- Aligned with GGC’s mission
- Provide opportunities for GGC’s STEM majors to gain teaching experience at the K-5 level
- Promote research-based science projects
- Curriculum Repository
  - Virtual Labs
  - Resources
**Strategy 3 & 1: Assessment of 4-yr URE & Mini-Grant Program**

Assessment of 4-Yr URE Program using Mini-Grants
- 1. Student attitudinal surveys
- 2. Course content assessment
- 3. Faculty Attitudinal Survey
- 4. Student Performance Data (BOR)

**Strategy 2: Assessment of Service Learning Course**

Assessment of Service Learning Course
- 1. Student attitudinal survey
- 2. Course content assessment
- 3. Student Performance Data (BOR)
Georgia College

USG STEM Initiative Programs
Rosalie A. Richards
Georgia College

- Georgia’s Public Liberal Arts University
- three locations: Milledgeville, Macon, Warner Robins
- over 6,000 students (~5,000 undergraduates)

Four STEM II Components

- STEM Faculty Mini-grant program
- Service Learning - Project FOCUS
- STEM Retention Initiative
- STEM Faculty lines
Faculty Mini-grant Program

GOALS

- to stimulate innovative projects that improve instruction and student learning in STEM and in programs that lead to initial teacher certification in these areas
- to foster collaborations among faculty within/external to GC
- to seed projects that are competitive for external funding
  - grants up to $7,000
  - 57 projects funded since 2008
  - annual STEM Symposium
Examples of Projects Funded: 2011-12

• Assessing learning gains and the role of Tutoring Services in successful completion of students in an introductory physics course – Hauke Busch, Lori Robinson

• Peer-teaching in computer science through videos – Gita Phelps

• Isolating, identifying and characterizing bacteriophages: new course designs that target STEM educators, K-12 and undergraduate students – Amanda Chase, Samuel Mutiti

• From Shallow to Deep: revising the Introduction to Environmental Science Lab Manual with a focus on local water issues – Caralyn Zehnder
Impact of Mini-grant Program

• **Numerous presentations and publications**
  o North American Diatom Symposium, 2009
  o *Physics Teacher*, 2011

• **External funding**
  o SENCER Grant, 2010
  o Robert Noyce Scholarship Program - NSF

• **Support for innovation** → more than a dozen STEM/STEM Ed. courses revised, novel instructional materials developed

• **Student learning** → FY07 - FY11, DWF rates decreased from 27% to 20% across courses in STEM disciplines

• **Impact on over 3,000 K-16 faculty, teachers and students**
Service Learning Initiative - Project FOCUS

• provide service learning experience for STEM and STEM education majors in area schools

• work with host teachers to develop learning experiences for K-12 students

BENEFITS OF Project FOCUS

• Inquiry-based, hands-on STEM instruction

• Learning about schools and community

• Interest in teaching as a career

• Developing habit of service to the community
Supplemental Instructors - advanced undergraduate students in targeted STEM courses

• SIs meet with classes

• SIs provide bi-weekly tutoring support for students enrolled in course

• departments collect data on effectiveness of SIs in their courses.
  
  o e.g. multi-year study in biology showed 50% reduction in DFW rates using SIs
Supplemental Instructor Program

• SIs in 55 sections of introductory STEM courses in FY12
• faculty SI coordinator (Lori Robinson), regular meetings
• professional development for SIs
• maintaining student logs and examining student performance data and feedback
• debriefings at end of each semester
• three faculty lines in mathematics, middle grades education, and physics
• increases in number of majors and degrees conferred in STEM and STEM Education
• Some data
  o FY07-FY11, 24% increase in STEM and STEM education majors
  o 81% increase in STEM degrees conferred
  o 11% increase in STEM Ed. degrees
Cultural Shift and Sustainability:

• *Collaboration with institutional programs* - connecting to campus initiatives: Service Learning, Academic Outreach, Millegeville YES, Science Education Center, Middle Grades Ed, STEM departments and institutional initiatives (e.g. GC1Y courses)

Acknowledgement:

• *College of Arts & Sciences*
• *College of Education*
• *Center for Program Evaluation and Development*
• *Science Education Center*
STEM II Initiative at Georgia Perimeter College

Pamela J. W. Gore
Kouok Law
Georgia Perimeter College

- Five locations + online
- 26,470 students Fall 2011
- 3rd largest institution in the Univ System of GA
- GA’s largest freshman class - 15,700 students
- The college of choice for more Georgia students
STEM II Faculty Mini-Grants

- Encouraging faculty collaboration
- Producing innovating educational materials
- Offering field research experiences for students in STEM gateway courses
- 8 mini-grants funded
- $4500
- More in review
STEM II Faculty Mini-Grants

1. Kim Bennekin – Fostering meaningful interaction in online college algebra courses
2. Behnaz Rouhani – Identifying students’ misconceptions in Calculus
3. Amy Cook - Lecture slides for Principles of Chemistry I and II
4. Amy Cook – Teaching demonstration videos for Principles of Chemistry II
STEM II Faculty Mini-Grants

5. Ilse Ricketts – *Introduction to Science Laboratory Bootcamp*

6. Allison Wolf – *More effective Resources – better results*

7. Jonathan Lochamy – *Discover Life Research Interns*

8. Carmen Hall - *Undergrad research at Snapfinger Creek Mitigation Bank*
STEM Peer-Led Undergraduate Study (PLUS) Tutors

- Hired 6 tutors
- 10 hours/week
- 1-2 per campus
- CHEM 1211
- CHEM 1212
Workshops and Seminars for Faculty and K-12 Teacher Professional Development
Project MESA

• Preparing educationally disadvantaged STEM majors (female, minorities, low-income, 1st generation) to transfer and graduate from a four-year institution with a math-based degree.

• Assists students in:
  ✓ developing academic and leadership skills,
  ✓ increasing educational performance, and
  ✓ gaining confidence in their ability to compete professionally
# GPC MESA Scholars

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<thead>
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<th>Summer</th>
<th>Fall</th>
<th>Spring</th>
<th>Total</th>
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<td><strong>FY-2008</strong></td>
<td>49</td>
<td>55</td>
<td>70</td>
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<td><strong>FY-2009</strong></td>
<td>35</td>
<td>96</td>
<td>115</td>
<td>142</td>
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<td><strong>FY-2010</strong></td>
<td>32</td>
<td>79</td>
<td>53</td>
<td>110</td>
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<td><strong>FY-2011</strong></td>
<td>24</td>
<td>69</td>
<td>71</td>
<td>95</td>
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<td><strong>FY-2012</strong></td>
<td>28</td>
<td>77</td>
<td>85?</td>
<td>125?</td>
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<td><strong>TOTAL</strong></td>
<td>119</td>
<td>370</td>
<td>379?</td>
<td>542?</td>
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## GPC MESA Transfers

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<th>Summer</th>
<th>Fall</th>
<th>Spring</th>
<th>Total</th>
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<tr>
<td>FY-2008</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>12</td>
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<tr>
<td>FY-2009</td>
<td>9</td>
<td>24</td>
<td>16</td>
<td>49</td>
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<tr>
<td>FY-2010</td>
<td>8</td>
<td>24</td>
<td>20</td>
<td>52</td>
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<tr>
<td>FY-2011</td>
<td>15</td>
<td>16</td>
<td>14</td>
<td>45</td>
</tr>
<tr>
<td>FY-2012</td>
<td>11</td>
<td>30</td>
<td>24</td>
<td>65</td>
</tr>
<tr>
<td>FY-2013</td>
<td>12?</td>
<td>32?</td>
<td>28?</td>
<td>72?</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>56</strong></td>
<td><strong>131</strong></td>
<td><strong>108</strong></td>
<td><strong>295</strong></td>
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</table>
GPC MESA Transfer Chart

![Graph showing transfer data for different fiscal years and seasons, with FY-2008 to FY-2013 on the x-axis and numbers on the y-axis. The graph indicates the number of transfers for summer, fall, and spring seasons for each fiscal year.]
## GPC-MESA Cumulative GPA

<table>
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<tr>
<th>FY</th>
<th>2007*</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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<td>CGPA≥3.5</td>
<td>20.5%</td>
<td>30.0%</td>
<td>31.0%</td>
<td>25.5%</td>
<td>37.9%</td>
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<tr>
<td>3.0≤CGPA&lt;3.5</td>
<td>31.8%</td>
<td>21.4%</td>
<td>22.5%</td>
<td>35.5%</td>
<td>28.4%</td>
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<tr>
<td>2.5≤CGPA&lt;3.0</td>
<td>20.4%</td>
<td>25.7%</td>
<td>19.0%</td>
<td>18.2%</td>
<td>21.1%</td>
<td>?</td>
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<tr>
<td>2.0≤CGPA&lt;2.5</td>
<td>9.1%</td>
<td>18.7%</td>
<td>20.4%</td>
<td>13.6%</td>
<td>9.5%</td>
<td>?</td>
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<tr>
<td>CGPA&lt;2.0</td>
<td>18.2%</td>
<td>4.3%</td>
<td>7.1%</td>
<td>7.3%</td>
<td>3.2%</td>
<td>?</td>
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</table>
## GPC-MESA STEM Grades

<table>
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<th>STEM Course</th>
<th>MESA #</th>
<th>MESA ABC</th>
<th>MESA ABC %</th>
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<td>Math-1111</td>
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<td>10</td>
<td>71.4%</td>
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<tr>
<td>Math-1113</td>
<td>20</td>
<td>19</td>
<td>95.0%</td>
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<tr>
<td>Math-2431</td>
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<td>20</td>
<td>74.3%</td>
</tr>
<tr>
<td>Math-2432</td>
<td>17</td>
<td>11</td>
<td>64.7%</td>
</tr>
<tr>
<td>Phys-1111</td>
<td>15</td>
<td>11</td>
<td>73.3%</td>
</tr>
<tr>
<td>Phys-1112</td>
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<td>1</td>
<td>100.0%</td>
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<tr>
<td>Phys-2211</td>
<td>16</td>
<td>16</td>
<td>100.0%</td>
</tr>
<tr>
<td>Phys-2212</td>
<td>20</td>
<td>18</td>
<td>90.0%</td>
</tr>
<tr>
<td>Chem-1211</td>
<td>28</td>
<td>24</td>
<td>85.7%</td>
</tr>
<tr>
<td>Chem-1212</td>
<td>20</td>
<td>20</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>186</strong></td>
<td><strong>156</strong></td>
<td><strong>83.9%</strong></td>
</tr>
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</table>
Culture Shift and Stimulus for External Funding

The USG STEM Initiative stimulated GPC faculty to collaborate and apply for external funding, resulting in nearly $3.5 million in new funding to promote student success over the next five years.
Grant-Funded STEM Programs at GPC

• **STEP** (Science, Technology, Engineering, and Mathematics Talent Expansion Program)
• **ENLISTEM** (Educate and Nurture Leadership in Science Technology Engineering and Mathematics) scholarship program
• **PSLSAMP** (Peach State Louis Stokes Alliance for Minority Participation Scholars Program)
• **BreakThru STEM Accessibility Alliance**
New Executive Director of STEM
Dr. Cynthia Lester

• Providing collegewide coordination of STEM grants and grant-related activities
We thank you for your support.
STEM Education at Georgia State University: Innovation and Administration

Dabney W. Dixon
<table>
<thead>
<tr>
<th>PI(s)</th>
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<tr>
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<tr>
<td>Iman Chahine and Margo Alexander</td>
<td>Building Technology-Supported Environments for Teaching Undergraduate Mathematics Courses to Early Childhood and Middle Level Prospective Teachers</td>
</tr>
<tr>
<td>Marcus Germann and Valerie Miller</td>
<td>Calculus for Biological Sciences</td>
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<tr>
<td>Jeremiah Harden and Joan Comar</td>
<td>Computer-based Homework in Organic Chemistry</td>
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<td>Sumith Doluweera and Brett Criswell</td>
<td>Creating a Formula for Preparing Better Physics Teachers in Georgia</td>
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<td>Timothy Hawthorne and Dajun Dai</td>
<td>Enhancing STEM Education through Field-Based Problem Solving and Real-World Applications of Geographic Information Systems</td>
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<td>Sutandra Sarkar and Gigi Ray</td>
<td>Freshmen Chemistry-based Problems in Mathematics</td>
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<td>Saeid Belkasim and Raj Sunderraman</td>
<td>Improving Student Learning Using an Online Tutoring Community</td>
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<td>Improving Supplementary Calculus Instruction through Enhanced Coordinated Support of Student Assistants</td>
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<td>Learning to Teach Mathematics in Hybrid University and Field Spaces</td>
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<td>Yanqing Zhang</td>
<td>Portable Multi-course Lab for Enhancing the Research Ability of Undergraduate Students</td>
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<td>John Evans, Gigi Ray, and Therese Poole</td>
<td>Redesign of College Physics for Biological Science Majors</td>
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<tr>
<td>Lisa Martin-Hansen and Chris Atchison</td>
<td>Refining and Examining a Collaboratively Taught Earth Science Course for Future Middle School Teachers</td>
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<td>Marion Reeves and Chris Atchison</td>
<td>Revising ISCI 2001 to Better Support Future Elementary Teacher Science Understanding</td>
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<tr>
<td>Iman Chahine, Mark Grinshpon, and Robert Clewley</td>
<td>Using Hybrid Instructional Support in Precalculus Concepts to Advance Undergraduate Students’ Success in Calculus</td>
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<td>Brian Thoms</td>
<td>What Limits the Learning of Students in Introductory Physics Courses at GSU?</td>
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<td>Teachers</td>
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<td>Marcus Germann and Valerie Miller</td>
<td>Calculus for Biological Sciences</td>
</tr>
<tr>
<td>Jeremiah Harden and Joan Comar</td>
<td>Computer-based Homework in Organic Chemistry</td>
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<tr>
<td>Sumith Doluweera and Brett Criswell</td>
<td>Creating a Formula for Preparing Better Physics Teachers in Georgia</td>
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<tr>
<td>Timothy Hawthorne and Dajun Dai</td>
<td>Enhancing STEM Education through Field-Based Problem Solving and Real-</td>
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<td>World Applications of Geographic Information Systems</td>
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<tr>
<td>Sutandra Sarkar and Gigi Ray</td>
<td>Freshmen Chemistry-based Problems in Mathematics</td>
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<tr>
<td>Saeid Belkasim and Raj Sunderraman</td>
<td>Improving Student Learning Using an Online Tutoring Community</td>
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<td>Mark Grinshpon, Iman Chahine, and Robert Clewley</td>
<td>Improving Supplementary Calculus Instruction through Enhanced Coordinated</td>
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<td>Support of Student Assistants</td>
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<tr>
<td>Stephanie Behm-Cross, Nermin Bayazit, and Christopher Jett</td>
<td>Learning to Teach Mathematics in Hybrid University and Field Spaces</td>
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<tr>
<td>Mark Grinshpon, Iman Chahine, and Robert Clewley</td>
<td>Monitoring and Assessing Weekly Homework to Improve Student Learning and</td>
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<td></td>
<td>Success Rates in Calculus Courses</td>
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<tr>
<td>Anu Bourgeois and Raj Sunderraman</td>
<td>Online Portal for Computer Science Education Visualization Tools</td>
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<tr>
<td>Yanqing Zhang</td>
<td>Portable Multi-course Lab for Enhancing the Research Ability of</td>
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<tr>
<td></td>
<td>Undergraduate Students</td>
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<tr>
<td>John Evans, Gigi Ray, and Therese Poole</td>
<td>Redesign of College Physics for Biological Science Majors</td>
</tr>
<tr>
<td>Lisa Martin-Hansen and Chris Atchison</td>
<td>Refining and Examining a Collaboratively Taught Earth Science Course</td>
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<td>for Future Middle School Teachers</td>
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<tr>
<td>Marion Reeves and Chris Atchison</td>
<td>Revising ISCI 2001 to Better Support Future Elementary Teacher Science</td>
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<tr>
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<td>Understanding</td>
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<td>Iman Chahine, Mark Grinshpon, and Robert Clewley</td>
<td>Using Hybrid Instructional Support in Precalculus for Enhancing the</td>
</tr>
<tr>
<td></td>
<td>Undergraduate Students’ Success in Calculus</td>
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<tr>
<td>Brian Thoms</td>
<td>What Limits the Learning of Students in Introductory Physics Courses</td>
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<td>at GSU?</td>
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</tbody>
</table>

**Organic Chemistry**
DATA ANALYSIS FOR ON-LINE
ORGANIC CHEMISTRY HOMEWORK

The Effectiveness of OWL Homework in Organic Chemistry II

Fall 2011  MWF 3:00pm-4:10pm

- Passed Course
- Failed Course

<table>
<thead>
<tr>
<th>Overall Homework Grade</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did Not Attempt</td>
<td>2</td>
</tr>
<tr>
<td>0-10%</td>
<td>32</td>
</tr>
<tr>
<td>11-30%</td>
<td>21</td>
</tr>
<tr>
<td>31-50%</td>
<td>17</td>
</tr>
<tr>
<td>51-70%</td>
<td>19</td>
</tr>
<tr>
<td>71-90%</td>
<td>24</td>
</tr>
<tr>
<td>&gt;90%</td>
<td>34</td>
</tr>
</tbody>
</table>
DATA ANALYSIS FOR ON-LINE ORGANIC CHEMISTRY HOMEWORK

• STEM Office provides data analysis for the online-homework
• Data collection and analysis begins immediately after the homework is due
• The STEM Office works to provide 24-hour turnaround
• List of the easiest and hardest problems for each assignment as well as the average student score and percent of students completing the assignment

<table>
<thead>
<tr>
<th>Assignment</th>
<th>% Who Attempted</th>
<th>Average Grade</th>
<th>Most Missed Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1 Homework Questions</td>
<td>92%</td>
<td>90%</td>
<td>1.6-1.10d TUT - Determining Shapes of Molecules (Tutor)</td>
</tr>
<tr>
<td>End of Chapter Questions</td>
<td>82%</td>
<td>74%</td>
<td>9460 - There are four different substances with the formula C5H10 that contain a ring with 3 carbons. Draw them.</td>
</tr>
<tr>
<td>Chapter 2 Homework Questions</td>
<td>86%</td>
<td>81%</td>
<td>2.9 - Answer questions a-c about the Brønsted acid-base reaction below</td>
</tr>
<tr>
<td>End of Chapter Questions</td>
<td>68%</td>
<td>64%</td>
<td>9720 - What is the pH of a 5.00E-2 M solution of acetylsalicylic acid, pKa = 3.52.</td>
</tr>
</tbody>
</table>
SUPPLEMENTAL INSTRUCTION

- Peer-assisted study sessions; leaders attend same classes as students
- Offered for historically difficult courses, including Organic Chemistry and Calculus
- SI leaders trained in proactive learning and study strategies and facilitation skills
- Approximately 8 SI leaders are funded by the GSU STEM Office each semester

Course GPA (≥ 5 sessions/semester)

<table>
<thead>
<tr>
<th>Course</th>
<th>SI Course GPA</th>
<th>Non-SI Course GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>3.04</td>
<td>2.56</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3.09</td>
<td>2.72</td>
</tr>
<tr>
<td>Math</td>
<td>2.52</td>
<td>2.15</td>
</tr>
<tr>
<td>Physics</td>
<td>2.92</td>
<td>2.37</td>
</tr>
</tbody>
</table>
EXTRA GRADING TO FREE UP FACULTY FOR WEEKLY SI/TA SESSIONS

• Well-trained and prepared teaching assistants and supplemental instructors are a key factor in the success of students in traditionally difficult courses

• The STEM Office is funding extra grading hours for instructors in these courses

• Graders are paid for an extra 2 hours of grading per week and an extra 5 hours of grading for each exam given in the course

• The extra grading hours free up the instructors to hold weekly meetings with TAs and SI Leaders for their courses

• The weekly meetings consist of a review of the material covered in the course that week and instruction on how to best present that material to students in review and SI sessions

• TAs and SI Leaders are paid for the time they spend in these meeting each week
Approximately 80 students and 5 teachers from Clayton County

- Lectures (45 min)
  - Lab tours by ugrad STEM majors:
    - Mass Spectrometry Facility
    - Biology laboratory
    - VizW all

- Students were also given a Glactone demonstration and teachers were provided with copies of the program for classroom use

- The event closed with a student panel

Schedule of Events

9:30am  Arrive at Petit Science Center (PSC), Room 101
9:35am  Welcome
        Dr. Timothy Renick, Associate Provost for Academic Programs
9:50am  Introduction of Speakers
        Dr. Dabney Dixon, Coordinator of STEM Education Initiatives
9:55am  Science Talk
        Dr. Donald Hamelberg, Assistant Professor of Chemistry
10:15am Lab Tours, Glactone Demonstration, and Viz Wall Viewing
        (a schedule of tours will be provided upon arrival)
11:40pm Lunch and Student Panel Discussion
12:25pm Closing Remarks
        Dr. Dabney Dixon
DATA ANALYSIS FOR CALCULUS I

What majors take Calculus I?

How is performance a function of the prerequisite course?

How does major affect performance?
Science majors were taking Introduction to Mathematical Modeling (MATH 1101), a course designed for non-science students.

The STEM Office collaborated with the Office of Graduate and Scheduling Services to create a registration restriction that restricts science majors registering for the course.

Most pre-med Biology majors are under the impression that Calculus is required for Medical School; this is no longer generally the case.

The STEM Office has worked to make pre-med advisors aware of this.

To help students make informed decisions, we have begun to email all Biology majors enrolled in Calculus I prior to each semester to make them aware that it is not a required course.
**ADVISING EXCEL SPREADSHEET**

- Gives students a visual picture of their plans to graduation (courses in the major only)
- Can require students to fill out before seeing advisor
- Especially useful if not all courses are taught in all semesters
- Useful in majors with many prerequisites for a given course (e.g., Chemistry)

<table>
<thead>
<tr>
<th>Undergraduate Advising Worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 1212K</td>
<td>Math 2211</td>
<td></td>
</tr>
<tr>
<td>Chem 2400</td>
<td>Chem 3100</td>
<td></td>
</tr>
<tr>
<td>Chem 4110</td>
<td>Chem 4120</td>
<td>Chem 4160</td>
</tr>
<tr>
<td>Chem 4190</td>
<td>Chem 4210</td>
<td>Chem 4600</td>
</tr>
</tbody>
</table>

- Required Classes
  - Chem 1211K, Math 1113, Chem 1212K
  - Math 2211, Chem 2400, Chem 3100
  - Physics 2211K, Chem 3410
  - Chem 4110, Chem 4120, Chem 4160
  - Chem 4190, Chem 4210, Chem 4600

- ACS Certification
  - Chem 4350, Chem 4170, Chem 4210
  - Chem 4600
INCEPT is the new student orientation required for all incoming freshmen.

Recognizing the need for math and chemistry placement testing prior to advising, the STEM office worked with INCEPT staff to develop an overnight program.

Math and Chemistry exams are held the first morning.

Immediate grading provides results to students just before dinner on the first day (colored cards outline their course options).

Advising takes place on the second day.

The event was a success and a second Overnight Incept has been scheduled for summer 2012.
• Portal for Georgia State’s undergraduate STEM majors

• Calendar of Events highlights STEM speakers, seminars, and club meetings, as well as local and regional STEM events

• Showcases USG funded STEM mini-grants and other funded STEM projects at Georgia State

• Lists of Summer Internships and Paid Programs

• Georgia State’s College of Education is currently constructing a second STEM website that will highlight the College’s STEM projects and faculty
With thanks to:
Dr. Susan Swars
Dr. Timothy Renick
Dr. Charles Derby
Dustin Butts
Luna Liu

The USG STEM Initiatives Program of the Board of Regents of the State of Georgia
The University of Georgia
STEM Initiative II
Projects, Programs, and Partnerships
Charles Kutal and Nancy Vandergrift
UGA Office of STEM Education
STEM Faculty Dedicated to Improving Instruction and Student Learning

Four Tenure-Track Faculty Hired

- Mathematics – David Gay
- Engineering Education – Joe Walther
- Science Education – Ji Shen
- MS Science Education – Ajay Sharma
- Awards: NSF CAREER, NSF REESE
STEM Mini-Grants Program

• Encouraging innovative instruction in introductory STEM courses
• Contribute to the Scholarship of Teaching and Learning
• Approximately 10 mini-grants awarded each year
• Amount awarded per grant = $9,000
• Norris Armstrong – *Moving from an Instructor-Centered to a Student-Centered Class in Introductory Biology*

• Fanbin Kong – *Development of a Video Game as a Tool to Teach “Heat Transfer” Fundamentals in Undergraduate Courses at UGA*

• Leidong Mao – *Lab-on-a-Chip Teaching Module for Undergraduate Students at UGA*
STEM Learning Communities

UGA Faculty and K-12 Educators Work Collaboratively

- Meet on a regular basis
- Discuss, share, and implement ways to improve teaching and student learning
- 8-10 funded each year
## A.P. Calculus Learning Community

The Mean of A.P. Calculus Students’ Scores of Teachers in A.P. Calculus LC

<table>
<thead>
<tr>
<th>State of LC</th>
<th>School Year</th>
<th>AP Calc LC</th>
<th>State</th>
<th>Nation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to LC</td>
<td>2004-05</td>
<td>2.00</td>
<td>2.80</td>
<td>2.94</td>
</tr>
<tr>
<td>Began 12/05</td>
<td>2005-06</td>
<td>2.63</td>
<td>2.85</td>
<td>3.02</td>
</tr>
<tr>
<td>Second Year</td>
<td>2006-07</td>
<td>3.73</td>
<td>2.82</td>
<td>2.92</td>
</tr>
<tr>
<td>Third Year</td>
<td>2007-08</td>
<td>3.35</td>
<td>2.70</td>
<td>3.01</td>
</tr>
</tbody>
</table>
Fostering Our Community’s Understanding of Science

Project FOCUS

• Service-learning course
• STEM undergraduates teach inquiry-based lessons in K-5 classrooms
• This year:
  • 114 undergraduate students enrolled
  • 8 elementary schools served
2012 Regional STEM Institute on Teaching and Learning

Saturday, April 14
Classic Center, Athens, GA

Presentations and Discussions:

• The importance of STEM Education Reform
• Leveraging the NSF Broader-Impacts Criterion
• Contributions to the Scholarship of Teaching and Learning
The UGA Office of STEM Education

Provide Campus-Wide Leadership for STEM Activities

- Clearinghouse of STEM opportunities
- Partner with local school districts
- Proposals submitted: CIRTL, NSF STEP

- Website: www.ose.uga.edu
Acknowledgements

• USG STEM Initiative II
• The University of Georgia
STEM Initiative at West Georgia: Our Story

Farooq A. Khan
Myrna W. Gantner
Satyanarayana Swamy-Mruthinti
UWG UWise

• STUDENTS
  – Summer Bridge Program (Summer)
  – Follow-up Interdisciplinary Course (Fall)
  – Research and Peer Mentoring (Spring)
  – UTeach Connection (Step 1 and 2 Courses)

• FACULTY
  – Mini-Grants (Fall and Spring)
  – UTeach Connection (Teaching)
Summer Bridge Program

- 2 weeks in early August

- 100 incoming freshmen interested in majoring in STEM

- The summer program’s designed outcomes:
  - Give students a taste of what’s to come as a STEM major
  - Students build bonds among themselves and with faculty
Summer Bridge Findings

• **Overall Sense of Accomplishment**
  “Summer Bridge Program taught [me] that effort can make things possible.”

• **Math Instruction**
  – Statistically significant improvement in pre-post math scores ($t=7.80$, $p=.000$), although 2 weeks too short
  – Males outperformed females
  – Each group improved (males, females, whites, nonwhites)
  – Whites made the greatest gains
  – Nonwhites made the least gains
XIDS Seminar Course (Fall)

- Students:
  - 81% (N = 79) of Summer Bridge participants (N = 98) enrolled in Fall XIDS 2002

- Design:
  - 8 weeks - Informal dialogue with invited speakers, professors
  - 6 weeks – Selected from 2 tracks
    - STEM communication (anticipated Uteach enrollment)
    - STEM discipline-specific activities

- Learning goals:
  - Increased awareness of STEM careers, to include teaching

- Significant result:
  - 38% of XIDS students (N = 30) enrolled in UTeach Step 1 course
  - These students are giving serious consideration to teaching as a career
  - UTeach is a national replication program designed to prepare secondary teachers in mathematics and science
A Success Story!

Where would you place teaching (elementary, middle, or high school) a STEM subject as a potential career?

- **Pre Survey**
  - Definitely Consider: 7.4%
  - Would Consider: 14.8%
  - Would Not Consider: 37.0%
  - Definitely Would Not Consider: 37.0%
  - Not on List: 7.4%

- **Post Survey**
  - Definitely Consider: 13.1%
  - Would Consider: 37.0%
  - Would Not Consider: 7.4%
  - Definitely Would Not Consider: 37.0%
  - Not on List: 7.4%
Faculty Mini-Grants

Biology
- Podcasts for intro biology labs

Chemistry
- Vernier data collection in intro chemistry labs
- Video, ItunesU in chemistry labs

Computer Science
- Learning videos for intro CS
- Robots as a teaching tool in introductory CS

Mathematics
- App based learning Software
- Tutoring
- Online tutoring

Physics
- Worships in Intro Physics
- Recitations in intro Physics

STEM Education
- Calculator-Based Learning for Pre-service teachers
Initial Lessons Learned

• 2012 adjustments based on lessons learned from 2011:
  – Build more time and structure into Summer Bridge
  – Provide students with intense writing instruction within the context of STEM critical thinking
  – Purposefully address learning styles and pedagogy for 2012 Summer Bridge, particularly for those with least gains in 2011 Summer Bridge
  – Create informal, safe environment for faculty development
• STEM Communication in XIDS linked to motivation for UTeach enrollment
Next Steps for 2012-2013

• Double length of Summer Bridge Program from 2 to 4 weeks
• Summer Bridge: 2 credit-bearing courses (Areas B and C)
  – Writing-intensive STEM connection
  – Education faculty will co-teach with Science and Math faculty
  – Strengthened coordination of XIDS content
• Continue with structured peer-mentoring in Fall and Spring
Acknowledgements

Board of Regents of the University System of Georgia STEM 2 Initiative

**COSM Faculty Collaborators**
- Biology (Heidi Banford and Nancy Pencoe)
- Chemistry (Sharmistha Basu-Dutt, Anne Gaquere, Victoria Geisler)
- Computer Science (Michael Orsega, Duane Yoder)
- Geosciences (Brad Deline, Karen Tefend)
- Mathematics (Ayona Chatterjee, David Leach, Scott Sykes, Mohammad Yazdani)
- Physics (Ajith de Silva, Javier Hasbun)

**COE Faculty Collaborators**
- Judy Cox, Jill Drake, Gail Marshall, Thomas Thrasher