USG STEM Initiative
Annual Report 2013-2014
School of Science & Technology, Georgia Gwinnett College

I. STEM Initiative Program Overview

***A. Program Implementation and Operation* – This section covers the operation of your institution's STEM Initiative Program:**

1. Identify and explain the **key programs and projects** (i.e. mini-grant program, FOCUS-derived project, etc.) that comprise the STEM Initiative at your institution. (You will be asked more detailed questions about these later).

Georgia Gwinnett College's STEM Initiative is based on an integrated plan that utilizes all three strategies described in the STEM Initiative II RFP. Our key program is based on the School of Science and Technology's (SST) recent initiative to implement a ***4-year Undergraduate Research Experience*** (4-yr URE) for ***all*** SST students. At GGC, all SST majors are required to complete either undergraduate research or an internship in their junior and/or senior years. However, we recognized the importance and need to introduce systemic investigation and research experiences much earlier in a student's educational career. Our goal, therefore, is to develop a transformative STEM education model based on a 4-yr Undergraduate Research Experience that will allow ***all*** SST students to be engaged in authentic research during all four years of matriculation. The 4-yr URE model forms the basis of Strategy 3 (*Institution-specific strategies that address instructional needs specific to the institution in the area of STEM through innovative approaches).*

The second key program of our STEM Initiative is the establishment of a structured "mini-grant" program. This program is geared towards helping us achieve our institution-specific strategy of implementing a 4-yr URE Program and includes three funding categories:

- Course-embedded 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)

The structured "mini-grant" program forms the basis of Strategy 1 (*Establish a structured mini-grant program targeted toward STEM faculty).*

Our third program pertains to Strategy 2 (*Develop a service learning course to provide STEM undergraduates the opportunity to gain teaching experience in science and math at K-12 level).* SST has developed a "Service Learning" course designed to allow STEM majors to work directly with Gwinnett County's K-5 teachers and their students. In this course, our STEM majors (interns) use their content knowledge and experience to assist teachers in developing and implementing inquiry-based lesson plans, hand-on activities, and research-based science projects based on Gwinnett County's Academic Knowledge Skills (AKS). Ultimately, our goal will be to

post all lesson plans, activities, and projects developed on the partner school's and GGC's website as "freeware', thus providing a virtual repository of classroom activities and STEM projects. In addition to the web resources, all physical equipment and supplies will be reused and stored in a curriculum lab. This curriculum lab will serve as a physical repository of instrumentation, models, and consumables and will be available for use by all K-5 teachers. This program involves collaboration with GGC's School of Education and the Gwinnett County Public School System, and is funded through the University System of Georgia (USG) STEM Initiative II Grant. Our focus on elementary schools is a commitment to our belief in the importance of introducing STEM concepts to children at an early age.

2. Identify **key personnel** associated with your institution's STEM Initiative program and briefly describe **each person's role**. Be certain to include all personnel whose salaries have been paid, either fully or partially, by STEM Initiative funds. Include any faculty or staff receiving course release time or some comparable form of compensation to participate.

Key personnel involved in FY 13-14 activities include:

- Dr. Thomas Mundie, PI: Responsibilities include general oversight of the entire STEM Initiative II Program at GGC; final budget allocations. No compensation.
- Dr. Judy Awong-Taylor, Co-PI and Project Manager. Responsibilities include: overall management of the grant; ensuring that all strategies are correctly implemented; oversees budget of the STEM Initiative including mini-grant sub-award budgets; participation in weekly team meetings; participation in development and implementation of all strategies; website development and maintenance; organization and implementation of SST STEM Symposium. Annual part-time compensation.
- Dr. Clay Runck, Co-PI and Project Director for Assessment and Evaluation. Responsibilities include overall management of the assessment and evaluation component of the STEM Initiative; collection of assessment data on Class Climate; participation in weekly team meetings; participation in development and implementation of all strategies; website development and maintenance; organization and implementation of SST STEM Symposium. Summer compensation.
- Dr. David Pursell, Co-PI and Project Director for the Mini-Grant program. Responsibilities include overall management of the mini-grant program; participation in weekly team meetings; participation in development and implementation of all strategies; website development and maintenance; organization and implementation of SST STEM Symposium. Summer compensation.
- Dr. Allison D'Costa, Co-PI and Project Director for the Service Learning Program. Responsibilities include overall management and development of the Service Learning course including assessment and evaluation components; participation in weekly team meetings; participation in development and implementation of all strategies; website development and maintenance; organization and implementation of SST STEM Symposium. Summer compensation.
- Dr. Greta Giles, Co-PI and Project Director for the 4-year Undergraduate Research Experience program. Responsibilities include overall management of the 4-year URE model; chairing the 4-yr URE Committee and curriculum sequence development; participation in weekly team meetings; participation in development and implementation of all strategies;

website development and maintenance; organization and implementation of SST STEM Symposium. Summer compensation.

- Dr. Dr. Bernadette Peiffer, School of Education. Lead Researcher of Service Learning Course Assessment. Responsibilities include overall assessment and evaluation of the Service Learning Course and management and development of components of the Service Learning course. Summer compensation.
- Dr. Tirza Leader, School of Liberal Arts. Lead Researcher for 4-Yr URE Assessment. Responsibilities include overall assessment and evaluation of the 4-Yr Undergraduate Research Experience component of the STEM Initiative. No compensation.
- Ms. Cindy Lail, Part-time Administrative Accountant. Responsibilities include keeping track of STEM Initiative budget and mini-grant sub-award budgets. Annual part-time compensation.

The PI, Co-PIs, and Lead Researchers are involved in all decision making processes. Final decisions are made by the PI (Thomas Mundie).

3. Identify **partnering departments, offices, or centers** participating in the STEM Initiative at your institution. Briefly discuss their relationship with the STEM Initiative and note any relevant contributions.

The following offices and schools have participated and/or contributed to GGC's STEM Initiative:

- Office of Educational Technology (OET): Mr. Edward Maxwell and the staff in OET have assisted the STEM Initiative by ensuring that all technology-related requests (including technology for mini-grants) are in compliance with OET's security and network systems. Additionally, OET assisted in the development of our SST STEM Initiative webpage, http://www.ggc.edu/academics/schools/school-of-science-and-technology/sst-stem/ and our Service Learning Course.
- Office of Institutional Effectiveness (OIE): Dr. Juliana Lancaster (Director, Institutional Effectiveness) has worked closely with the STEM Initiative team in developing appropriate assessment instruments and evaluations for the 4-yr URE model. Dr. Lancaster is also head of the Institutional Review Board and has assisted the team with IRB submission and approval.
- Office of Institutional Research (OIR): Dr. Lily Hwang (Director, Office of Institutional Research) is responsible for providing STEM data information (leading and lagging STEM data) as requested by the BOR. She works closely with Dr. Awong-Taylor to ensure consistent and appropriate retrieval of STEM information.
- Accounting Services: Mr. Donell Nixon is responsible for ensuring that the STEM budget is in compliance with both GGC and BOR policies.
- School of Science and Technology (SST): Ms. Elizabeth Moale-Himmelein is an administrative assistant and is responsible for processing all STEM related payment requests and reimbursements, including travel and all mini-grant related expenditures and requests.
- School of Education (SoE): Dr. Bernadette Peiffer, Assistant Professor, and Dr. Julie Weisberg (Associate Dean) continues to assist in the development of our Service Learning Program. Dr. Peiffer has been instrumental in curriculum design, developing a collaborative

partnership with the Gwinnett Public School System, and evaluation of the program.

- Office of Development and Office of Research and Grants: Dr. Marie Firestone has been involved in the planning and development of GGC's STEM Initiative and continues to work with the team in leveraging the work of the STEM Initiative for external funding from both public and private sources.
- CTE: The Center for Teaching Excellence provides numerous workshops, programs, and faculty development opportunities for faculty to enhance their teaching (including educational technology) and to learn new pedagogies.

Personnel listed above were neither paid nor received funds from the STEM Initiative for their work. Their participation is a show of commitment and support to the STEM Initiative. The many hours of work committed to the STEM Initiative are therefore considered as cost-sharing and are detailed in the STEM Budget Template Report (Appendix A).

B. *Program Successes* – This section covers the key accomplishments of your institution's STEM Initiative program during FY2014:

1. Explain how your program has made progress toward Goal 1, **improving the readiness of P-12 students** for STEM in college. (You may wish to draw upon service learning programs, among other efforts. You also may wish to describe bridge programs or similar efforts directed at incoming freshmen.)

The School of Science and Technology is deeply committed to developing and advancing STEM skills and competencies for all our students. As part of our mission we continuously engage in innovative ways to encourage and attract students to STEM related degrees. The School of Science and Technology continues to develop partnerships and programs designed to promote and build STEM interest among K-12 students. Examples of our outreach efforts are described below and include programs developed as part of the STEM Initiative.

As previously noted, SST has developed a "Service Learning" course designed to allow STEM majors to work directly with Gwinnett County's K-5 teachers and their students. In this course, our STEM majors (interns) use their content knowledge and experience to assist teachers in developing and implementing inquiry-based lesson plans, hand-on activities, and research-based science projects based on Gwinnett County's Academic Knowledge Skills (AKS). This program involves collaboration with GGC's School of Education and the Gwinnett County Public School System. We are currently collaborating with McKendree Elementary School in the implementation of this course. At the end of FY 2014, Chesney Elementary School expressed interest in collaborating with us to introduce the Service Learning course at Chesney Elementary. We are currently looking into the feasibility of working with both elementary schools. Additionally, Dr. Allison D'Costa, Dr. Clay Runck and Dr. Judy Awong-Taylor have initiated conversations to submit a new course offering to the SST Curriculum Committee for an interdisciplinary Service Learning Course based on the current service learning course. A detailed report of the Service Learning Course is provided in Appendix H (Service Learning Final Report).

Faculty in the School of Science and Technology continue to engage and mentor high school students in a variety of research projects. Since 2007 we have worked closely with the *Gwinnett School of Mathematics, Science, and Technology* (GSMST) which is part of the Gwinnett County Public School System. As part of this collaboration, SST has: hosted groups of students coming to campus for "experience college class/lab days"; had faculty attend GSMST's freshmen "careers in science days"; invited juniors to conduct research on our campus with our faculty and students in the Junior Fellowship Experience (JFE); and mentored senior students conducting research on our campus via the Senior Fellowship Experience (SCE). In FY 2014 SST faculty served as research advisors to 14 GSMST students as part of our STEM Initiative's PreCollege Research Experience Program (PREP). We anticipate that these high school students will present their work at GGC's Science, Technology, and Research Show (STaRS), and at other professional meetings.

The School of Science and Technology continues to co-sponsor the GGC Summer Tech Camp for middle-school girls (http://www.ggc.edu/about-ggc/news/News/2014/02/25/wit-grant-supports-ggcs-technology-outreach-to-middle-school-girls-summer-camp). The GGC Summer Tech Camp is also partially funded by a *Women in Technology* (WIT) Grant and is designed as a hands-on, experience-based week of exposure to the future of computing and also promotes creative thinking and problem solving. This summer's GGC Tech Camp (GTC) took place on June 16- 20 and was designed to offer a "girl-friendly" curriculum to its 36 participants. Sessions focused on mobile applications, new devices, creativity and relationship building, and allowing participants to forge friendships that support their interests in computing-related activities. Campers experienced demonstrations, laboratory exercises and discussion groups, and the week culminated in a field trip to a local technology-rich company. Campers' families were invited to a reception where campers demonstrated the projects they designed during the camp.

SST faculty continue to be actively engaged in community service activities that pertain to STEM. Many of our faculty serve as judges for the Gwinnett Regional Science & Engineering Fair. Our faculty provide excellent and useful feedback to students on their science projects. This year, SST faculty and students participated in Family Science Nights and Science Fairs at several local area elementary school including McKendree Elementary, Walnut Grove Elementary, and Level Creek Elementary.

2. Explain how your program has made progress toward Goal 2, **improving student success and completion rates**, by discussing how your program, a) **increased STEM majors**, b) **supported student retention and progression in STEM**, and c) **increased STEM degree completion**.

Data on Leading Indicators (STEM majors, STEM Education Majors, Course Performance Data, Gender and Diversity) and Lagging Indicators (STEM Degrees Awarded) are provided in the required STEM Initiative Data Sheet. We have now collected three years of longitudinal data and plan on assessing and evaluating this data over the next fiscal year. Results of this analysis will be provided in next year's report. In the section below, we discuss and explain enrollment and retention data.

Table 1: SST Enrollment Data From Fall 2006 to Fall 2013								
	Fall 2006*	Fall 2007*	Fall 2008*	Fall 2009*	Fall 2010*	Fall 2011	Fall 2012	Fall 2013
Biology-non Teacher Certificate	18	107	206	442	725	1058	1286	1261
Biology-HS Teacher Certificate					1	12	8	6
Exercise Science					89	218	351	375
Information Technology		54	135	229	384	513	705	808
Mathematics-non Teacher Certificate				8	77	111	158	101
Mathematics-HS Teacher Certificate					5	14	19	12
TOTAL SST	**18**	**161**	**341**	**679**	**1281**	**1926**	**2527**	**2563**

Baseline Data-Pre STEM Initiative

Numbers indicate that enrollment has decreased in the following disciplines: Biology-non Teacher Certificate, Biology-HS Teacher Certification, Mathematics-non Teacher Certificate and Mathematics-HS Teacher Certificate. The decline in our Biology non-Teacher Certificate is most likely due to GGC's new Nursing Program (current enrollment is 993) and new Chemistry Program (current enrollment is 44) that started in Fall 2014. Approximately 75 biology majors transferred to the new chemistry and nursing programs. Additionally, 3 exercise science majors and 1 math major transferred to nursing. We are very concerned about the drop in enrollment in Biology-HS Teacher Certification and Mathematics-HS Teacher Certification. Follow-up conversations with students who have dropped out of these programs indicate that the high time commitment (credit hours and on-site student learning) is the main reason for leaving the program; not the course work. We are also seeing a trend towards students completing the baccalaureate degree and then pursuing graduate degrees in teaching. This trend makes it more difficult to recruit and retain students in the Biology and Mathematics-HS Teacher Certificate Programs. To assist in recruitment, a part-time plan has been provided to enable students to complete the bio-teacher track in 4-6 years

Table 2: SST Retention Rate of Students in the STEM Majors							
	Fall 2007*	**Fall 2008***	**Fall 2009***	**Fall 2010***	**Fall 2011**	**Fall 2012****	**Fall 2013****
Biology- all concentrations	66.0%	64.5%	67.0%	58.4%	59.9%	56.1%	48.6%
Exercise Science					61.8%	50.0%	42.2%
Information Technology		68.5%	64.2%	67.1%	60.7%	58.8%	57.7%
Mathematics-all concentrations				60.0%	56.1%	60.0%	45.0%
AVERAGE RETENTION RATE	**66.0%**	**66.5%**	**65.6%**	**61.8%**	**59.6%**	**56.2%****	**48.4%****

Baseline Data-Pre STEM Initiative
****See note about how these data were collected***

**A note on FY 2012 and FY 2013 data collection. Retention data for FY 2012 and 1213 were collected as follows: students were counted as being retained only if they returned to a STEM major. For instance, if a student was a BIOL major in fall 2012 but returned as a MATH major in fall 2013, they were counted in the retention numbers. If the student started as a STEM major

and switched to a non-STEM major, then the student was not counted. This change was enacted because we wanted to track retention rates specifically in the STEM major. These numbers are therefore lower than the data presented in years previous to FY 2012 since there are more constraints on counting who returned.

Retention rates from Fall 2007 to Fall 2013 are shown in Table 2. Retention rates declined in all four areas with significant declines in Biology, Exercise Science and Mathematics. Declines in the retention rates in Biology and Exercise Science are likely due to the new nursing major and chemistry major that started in Fall 2014. Many students who had originally declared a major in biology and exercise science have switched their major to Pre-Nursing and Pre-Chemistry. Another reason for the decline in retention rates is related to how we count SST majors. Students are counted as SST majors once they declare themselves as a STEM majors. This cohort includes freshmen who are not well prepared for college and are required to complete access math or MATH 99. Many of these students declare themselves as STEM majors but then drop out after failing to pass MATH 99. SST is currently conducting an internal study using a more realistic approach (including students who have passed Math 99 and/or access math and have started STEM courses) to determine retention rates of STEM majors. A third possible explanation for the decline in retention rates pertains to the fact that many students declare themselves STEM majors, take their core courses at GGC, and then leave to pursue STEM degrees not offered at GGC at other institutions.

Table 3: SST Degree Completion Data from FY 2009 to FY 2014

	2008-2009*	2009-2010*	2010-2011	2011-2012	2012-2013	2013-2014
Biology- all concentrations	11	11	30	43	67	77
Exercise Science				9	8	20
Information Technology	0	1	21	22	35	40
Mathematics-all concentrations					12	3
Biology-HS Teacher Certification					5	0
Mathematics-HS Teacher Certification					9	4
TOTAL SST	**11**	**12**	**51**	**74**	**136**	**144**

Baseline Data-Pre STEM Initiative

Degrees awarded continue to increase in all concentrations except Mathematics and both Teacher Certification programs. We continued to graduate more Mathematics HS-Teacher Certification in FY14. All graduates in our teacher certification programs were immediately employed, mainly by the Gwinnett County Public School System.

Table 4: Total SST Data

	Fall 2006*	Fall 2007*	Fall 2008*	Fall 2009*	Fall 2010*	Fall 2011	Fall 2012	Fall 2013
Total SST Enrollment	**18**	**161**	**341**	**679**	**1281**	**1926**	**2527**	**2563**
Average SST Retention Rates		**66.0%**	**66.5%**	**65.6%**	**61.8%**	**59.6%**	**56.2%**	**48.4%**
Total SST Degree Completion			**11**	**12**	**51**	**74**	**136**	**144**

SST's total enrollment and degree completions have increased over the three years of the STEM Initiative (2011-2013). This is partly due to the fast growth of the college, with many new students declaring STEM majors. Unfortunately, as the number of students increase it becomes increasingly more difficult to provide individualized attention to all students. Additionally, many students are unprepared for STEM courses and many switch majors after failing MATH 99 or access math, leading to lower retention rates over the years. We hope that the initiatives we have implemented will help retention rates over the next few years.

3. Explain how your program has made progress toward Goal 3, **improving the pre-service P-12 STEM teacher preparation and production**.

SST offers Teacher Certification Programs in Biology and Mathematics and both tracks are included in SST's 4-yr URE model. The new chemistry program will also offer a teacher certificate program and will develop a similar 4-Yr URE model that will allow all students on this track to be exposed to authentic research experiences.

Figure 1 illustrates the sequence of courses targeted for inclusion of authentic research experiences for the Biology Teacher Certification program. Courses in red have been re-designed to include an authentic research experience. Only three more courses in the Biology Teacher Certification Program URE Model remain to be redesigned.

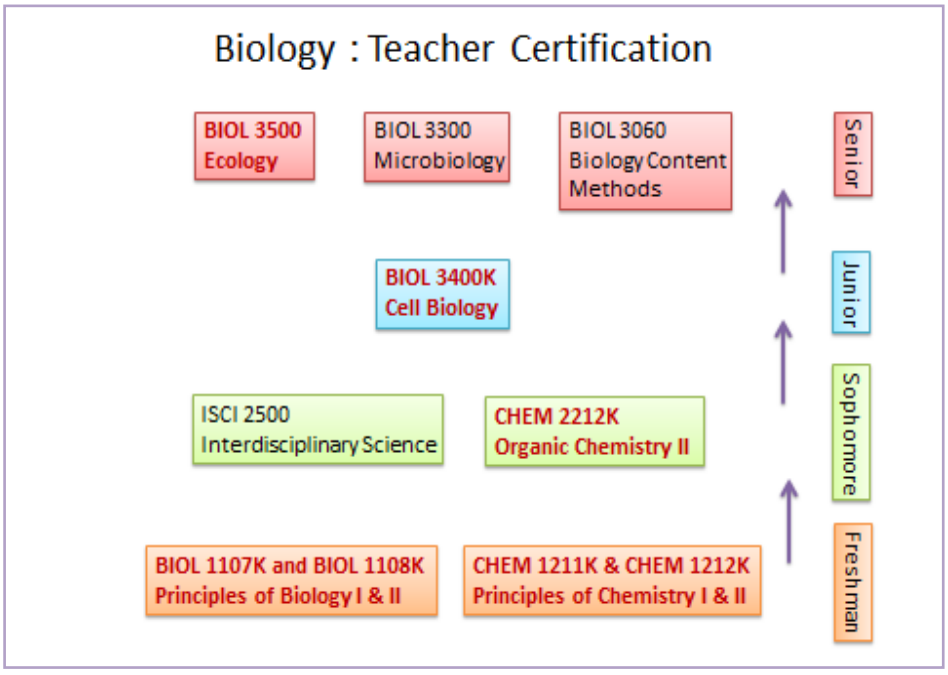

Figure 1: Biology Teacher Certification program: 4-Yr URE Model

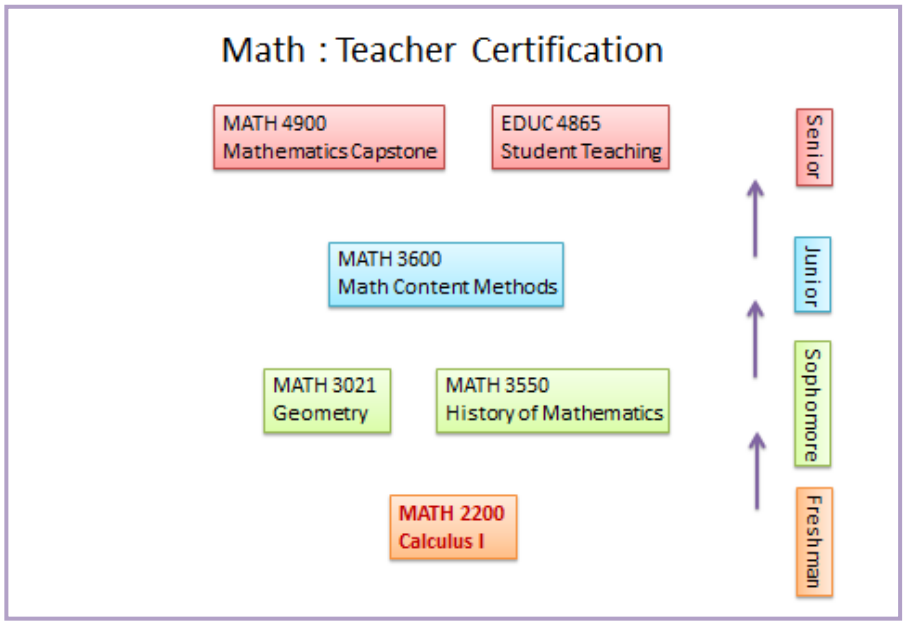

Figure 2: Mathematics Teacher Certification program: 4-Yr URE Model

Figure 2 illustrates the sequence of courses targeted for inclusion of authentic research experiences for the Mathematics Teacher Certification Program. Courses in red have been re-designed to include an authentic research experience. To date, many courses in the Mathematics Teacher Certification Program URE Model remain to be redesigned. We will attempt to focus efforts to work on re-designing these courses.

Our Service Learning Program continues to be successful and we hope that STEM majors who sign up for this program will consider teaching as a viable STEM career option. To date two of our Service Learning Interns have continued to pursue teaching careers after graduating from GGC.

4. Discuss **other key successes** of your institution's STEM Initiative program.

Some of the following successes were previously mentioned in our FY 12-13 annual report and are re-emphasized again in this report because we are continuously improving and modifying strategies.

- Additional courses that were re-designed to include research experiences have now been approved and accepted at the discipline level and all sections of these courses are now teaching the new research embedded material. We currently have 14 courses that have adopted course-embedded research projects and/or modules in all sections of the course. These courses include BCHM 3100K, BIOL 1107K, BIOL 3200K, BIOL 3300K, BIOL 3500K, BIOL 4000K, BIOL 4300, CHEM 1211K, CHEM 1212K, CHEM 2211K, CHEM 2212K, CHEM 3000K, EXSC 3101K, EXSC 3500K, EXSC 4100K. All costs associated with these courses are now fully supported by the School of Science and Technology. ***We continue to get requests from other institutions asking about our new research embedded courses.***

- Faculty continue to be energized and enthusiastic about the 4-Year URE Initiative. Faculty continue to submit innovative and interesting proposals in all three categories: research embedded courses, Scholarship of Teaching and Learning, and Undergraduate Research. Faculty continue to collaborate with faculty in other schools (School of Liberal Arts and School of Education) on proposals that have the potential to impact non-STEM majors as well. Faculty are also working at addressing courses within the 4-Year URE discipline models.

- Faculty continue to embrace the idea of providing a more active-learning environment for our students and are considering pedagogical approaches geared towards student-centered learning. This is evident even among faculty who have not submitted mini-grant proposals but have been exposed to sections that have adopted such models. We hope that over time this becomes part of the SST culture and the norm for how we teach.

- The scholarly work generated through this initiative continues to be considered as scholarship and will be considered for faculty promotion and evaluation.

- The Board of Regents approved a new Chemistry majors program with 3 tracks: industrial, professional, and teacher certification. The new program began fall 2014 and we anticipate that this new major will attract more STEM majors to GGC.

- In FY13-14, we continued to fund the highly successful ***SST Writing Days.*** These two days (one day per semester) were developed to provide faculty with an extended and dedicated time to evaluate the data they had collected in their mini grants or other professional activities and to compose conference presentations and/or publications to disseminate their results to the external academic community. One of the most common concerns articulated by faculty in SST at GGC is the difficulty in finding time to pursue their scholarly activities, to organize their results, and assemble the required background research to produce first quality presentations and papers for external dissemination. Two all day Writing Days were held, one in fall (December) and one in spring (May), and Reference Librarians were available to assist faculty on both days. Forty six faculty, library and CTE staff attended the SST Fall Writing Day and 52 faculty, library and CTE staff attended the SST Spring Writing Day. FY 13-14 attendance increased 79% compared to the previous year. Faculty feedback was extremely positive and we plan to continue to promote and support the SST Writing Days. The STEM Mini-Grant Advisory Committee will also be available at the SST Writing Days to answer questions about mini-grants and the 4-Year URE program.

- Faculty continue to conduct research with students, either in a course embedded project or in an independent research project with upper level students. Prior to the STEM Initiative, research with undergraduates was very limited. With the STEM Initiative, there has been an order of magnitude increase in numbers of students and faculty involved in research activities and projects. Following last year's successful SST Undergraduate Research Symposium, the college decided to develop a similar program and has now formed a college-level symposium, CREATE (Creativity, Research, Engagement, and the Arts Transforms Everyone), that showcases the research and creative activities of all GGC students. CREATE is now a regularly scheduled event that takes place at the end of spring and fall semesters.

- Our ***Service Learning Program*** was successfully implemented in FY 12-13 and continues to be very successful. Participants (GGC interns, elementary school teachers, and 5th grade students) are all every enthusiastic and supportive of this program. We have started the process of developing this program into an interdisciplinary SST Internship opportunity. We are currently developing a proposal to submit this program as an official course (STEC 4800-Service Learning Internship) to the Curriculum Committee. An executive summary on the Service Learning Program is provided later in this report and a full report is provided in Appendix H.

- Our ***STEM Undergraduate Research Program*** continues to grow and develop through partial support of the STEM Initiative. The ***STEM Undergraduate Research Lab*** (SURL) continues to be heavily utilized. GGC administration has been very supportive of our Undergraduate Research Program and has approved the conversion of 6 former teaching labs into research space. Equipment purchased with STEM funds continue to be shared among faculty and consumable items are now fully funded and supported by SST. Prior to this initiative, students did not have a dedicated space to conduct research. We anticipate that the SURL lab together with the new SST research labs will encourage undergraduate research and will continue to be actively used by students and faculty. Courses with embedded research have also led more students to continue research in the more traditional apprentice-style model via STEC 4500-Undergraduate Research.

- The ***Technology Resources Program*** that was implemented last year continues to be successful. Informal discussions with faculty indicated that faculty would be more inclined to incorporate active learning strategies in the classroom if various tablets were available for in-class use. Many faculty actually request iPads or other types of tablets in their mini-grant proposals but due to limited funds, many are not funded. To address this issue, all unused funds from the FY 12-13 Mini-Grant Program were used to purchase a variety of tablets for general class-room use. During FY 13-14, these technology resources were used by various faculty for a variety of different courses.

- We continue to develop a ***Peer-Mentoring/Supplemental Instruction Program***. We continue to implement and conduct a SoTL study to determine the impact and effectiveness of this program. Preliminary results indicate that this will be a good program to enhance student success in our STEM courses.

- We have successfully disseminated information regarding our 4-Yr URE program. This year faculty who received mini-grants presented their work at a variety of conferences and gave a total of 64 presentations. Student involvement with mini-grant projects resulted in 25 student presentations. Additionally, faculty have submitted manuscripts to at least seven journals. Faculty will continue to disseminate their results as additional data is collected and evaluated. A detailed list of our dissemination efforts is provided in Appendix F.

- Last year we developed a ***PreCollege Research Experience Program (PREP)*** with Gwinnett School of Mathematics, Science and Technology. In FY 13-14 SST faculty served as research advisors to 14 GSMST students as part of this program.

- Students continue to be enthusiastic about the new research-embedded modules. Faculty who teach upper-division courses have anecdotally noted that students are better prepared for upper-division labs and have better STEM skills and competencies.

C. *Program Challenges* – This section covers challenges that continue to face your institution's STEM Initiative program:

1. What challenges has your program encountered in **increasing the number of STEM majors**?

Rapid growth of the college continues to be both an asset and a challenge. Rapid growth has provided an opportunity for SST to recruit majors from a large cohort of incoming freshmen. However, as an access institution, many of our students arrive at GGC under-prepared for college-level course work. As previously mentioned, many freshmen are required to take redial math and/or access math before advancing to courses within the major. Students who fail to complete redial math will often switch to a non-STEM major. Limited classroom and laboratory space continued to be a challenge in FY 13-14 but this challenge should be alleviated in FY 14-15 with the opening of the new Allied Health and Science Building in fall 2014. The STEM Initiative continues to provide faculty the opportunity to develop and design innovative course-embedded research modules and creative curricula activities. The new science building will allow additional lab space for implementation of these innovative pedagogical activities.

2. What challenges has your program encountered in **increasing STEM degree production**?

Our greatest challenge for increasing STEM degree production continues to be the limited STEM programs offered at GGC. Many of our students complete their first two years at GGC and then leave for other institutions that offer more specific degrees such as microbiology, biochemistry, and cell biology. Many students who are interested in health professional careers attend GGC for their core courses and then transfer out of the system. As an access institution, we receive students who are ill-prepared for STEM college courses and may often have a difficult time with course work. However, we hope that elements of our STEM Initiative will eventually help us address this challenge. The new chemistry program should eventually increase our STEM degree production as these students matriculate through their chemistry program.

3. Are there any **program-specific** (i.e. mini-grants, service learning opportunities) challenges that your program has encountered?

The following challenges were described in the FY 12-13 Annual Report and continue to be challenges in FY 13-14. The STEM Initiative Program continues to grow and evolve, and while

this is energizing and invigorating, the volume and complexity of the work also grows. Administrative oversight and project management has become extremely time-consuming, especially with regards to management of the mini-grants (including review and selection of mini-grants, oversight of mini-grant budgets, ordering and tracking of supplies and equipment, collecting and maintaining reports and data, approval of travel for dissemination, and organization of the annual STEM Symposium). The PI and Co-PIs continue to spend tremendous time and effort in promoting the initiative and keeping the momentum going.

Collection, management, analysis, and assessment of the data collected over the past three years continue to be a challenge. As part of our assessment of the program, we conduct surveys to all students enrolled in all courses affected by the program. Dr. Clay Runck continues to invest a tremendous amount of his time working with Dr. Juliana Lancaster on developing ways for student surveys to be conducted via Class Climate or paper surveys. Preliminary work was started in spring 2013 and we were able to conduct all surveys via Class Climate in FY 13-14. Dr. Tirza Leader (Psychology, School of liberal Arts) joined our team in FY 13-14 and is now the lead researcher for the assessment and evaluation component of the program. We are still in the process of collecting, analyzing and assessing data.

We continue to improve and define our Service Learning Course as an internship course with McKendree Elementary School (MES) in the Gwinnett County Public School System (GCPS). We continue to use project-based learning scenarios developed during the first two years of the project to provide hands-on lab activities with real-world applications to 5th graders at MES. McKendree administration and teaching staff and GCPS' science coordinator continue to provide input on targeted academic standards and curriculum map schedules as well as evaluation of program quality and impact. Despite our success, some challenges still exist, especially with respect to coordinating classroom visits with MES and having reliable communications with MES teachers. Dr. Allison D'Costa, Dr. Clay Runck, Dr. Bernadette Pfeiffer and Dr. Judy Awong-Taylor continue to focus efforts in this component of the initiative. Drs. D'Costa and Runck continue to invest tremendous time and effort on this program.

4. Are there any **other challenges** that your program has encountered that you have not described (i.e. departmental buy-in, personnel issues)

As we end the third year and begin the fourth year of the STEM Initiative, our faculty are enthusiastic, energized and fully supportive of the goals of the initiative. However, as described above, as the STEM Initiative Program grows, the amount of work associated with the different aspects of the program continues to increase. Co-PIs are very active with all aspects of the program but do not get course release time during fall and spring. We have been fortunate to have faculty from the School of Education (Dr. Bernadette Peiffer) and the School of liberal Arts (Dr. Tirza Leader) join our team to assist in various aspects of the Initiative. SST has also graciously allowed us to use an SST administrative assistant to assist with purchasing and travel. We have also recruited additional faculty to assist with other our competitive Mini-Grant program and organization of our annual STEM Symposium. As data collection increases, we anticipate recruiting more faculty to assist with data mining and data analysis.

D. Did you implement the STEM Initiative program at your institution as described in your project proposal for FY2013? Please describe any notable changes from the proposal that you made (additional project components, project deletions).

For FY 13-14, GGC received **$244,817.00** to implement all three strategies. This was a decrease for the previous year's budget of $268,757. Budgets and salaries were adjusted accordingly to reflect the awarded amount. Key changes for FY 13-14 include the reduction of amounts available for the Mini-Grants Program and the Service Learning Program. Details are outlined below. There were no major deletions to our proposed project proposal. Additional project components were described in section B4: Other Key Successes and are outlined again below.

Strategy 1 (Mini-Grant Program) was implemented as described in our project proposal. Details of the Mini-Grant Program are provided elsewhere in this report.

Strategy 2 (Service Learning Program) was implemented as described in our proposal. Details of the Service Learning Program are provided elsewhere in this report.

Strategy 3 (4-yr URE Program) was implemented as described in our project proposal with the changes described in our last annual report. The PI and most Co-PIs are not paid during fall and spring and agreed to transfer the bulk of the original salary budget to other components of the 4-yr URE program. The PI and Co-PIs have committed numerous hours to this grant and this effort is considered as cost-share.

Additional Project Components:

- ***SST Writing Days.*** These two days (one day per semester) were developed to provide faculty with an extended and dedicated time to evaluate the data they had collected in their mini grants or other professional activities and to compose conference presentations and/or publications to disseminate their results to the external academic community. Faculty feedback on SST Writing Days has been extremely positive and we plan to continue to promote and support the SST Writing Days. The STEM Mini-Grant Advisory Committee will also be available at the SST Writing Days to answer questions about mini-grants and the 4-Year URE program. Attendance info is provided below.

	Fall Attendance	Spring Attendance	Total Attendance
FY 2012-13	29	26	55
FY 2013-14	46	52	96

- ***STEM Undergraduate Research Program and STEM Undergraduate Research Lab (SURL)***. This program and dedicated lab was developed as a direct result of SST's STEM Initiative and partially supported by the initiative. The program continues to grow and the SURL lab continues to be heavily utilized. GGC administration has been very supportive of our Undergraduate Research Program and has approved the conversion of 6 former teaching labs into research space. Equipment purchased with STEM funds continue to be shared

among faculty and consumable items are now fully funded and supported by SST. Prior to this initiative, students did not have a dedicated space to conduct research. We anticipate that the SURL lab together with the new SST research labs will encourage undergraduate research and will continue to be actively used by students and faculty. Courses with embedded research have also led more students to continue research in the more traditional apprentice-style model via STEC 4500-Undergraduate Research.

- ***Technology Resources Program.*** This program was developed to support the use of active learning strategies in the classroom. Informal discussions with faculty indicated that faculty would be more inclined to incorporate active learning strategies in the classroom if various tablets were available for in-class use. To address this issue, all unused funds from the FY 12-13 Mini-Grant Program were used to purchase a variety of tablets for general class-room use. During FY 13-14, these technology resources were used by various faculty for a variety of different courses. We will continue to track usage of the tablets for classroom activities.

- ***Peer-Mentoring/Supplemental Instruction Program***. A Peer mentoring program was implemented in FY 12-13 and we are currently investigating the use of supplemental instruction to determine the impact and effectiveness of this program on student learning and student success. Preliminary results indicate that peer mentoring may be a good program to enhance student success in our STEM courses.

- ***PreCollege Research Experience Program (PREP).*** In FY 12-13GGC partnered with Gwinnett School of Mathematics, Science and Technology to develop a program that would allow GSMST students to work with SST faculty on a variety of scholarly and creative projects.

II. Data Sheet Addendum

A. If you reported engineering majors in FY2012 (Row 12), please identify relevant subfields (mechanical engineering, electrical engineering, engineering technology, etc.) and specify the number of majors in each.

N/A.

B. If you reported majors in the field "Other" (Row 13), please identify those degree programs and specify the number of majors in each.

See attached STEM Data Sheet for details.

C. If you reported engineering degrees awarded (Row 73), please identify the specific degrees (i.e. BS in mechanical engineering, BS in electrical engineering, etc.) and specify the number of awardees for each.

N/A.

D. If you reported degrees in the category "Other" (Row 74), please identify the specific degrees and specify the number of awardees for each.

See attached STEM Data Sheet for details.

E. If you have any additional notes to offer relevant for the data sheet, please enter those here.

The STEM Data Sheet is attached as a separate file and is not included as part of this report. CIP codes are added next to the specific degrees awarded.

CIP codes for each degree program in SST are included in the table below. All degree programs will be impacted by our institutional STEM Initiative.

Major Programs CIP Codes			
Major	**CIP Code**	**Major**	**CIP Code**
Biology	26.0101	Information Technology	11.0103
Exercise Science	31.0505	Mathematics	27.0101
Biology Teacher Certification*	13.1205	Mathematics Teacher Certification*	13.1205

*We have elected to use an education-associated CIP code for HS Teacher Certification.

III. Programmatic Components

A. Faculty Mini-grants

1. Please provide a list of the mini-grants provided by your institution as part of its STEM Initiative for FY2014. You may use the following table or some alternate format, but please be sure to provide all of the information requested:

The following section provides a list of mini-grants awarded in FY 13-14 including faculty investigators, amount awarded, and title of the proposal. In order to provide a richer perspective of the mini-grant program, including description, research, and pedagogical outcomes, we have attached (Appendix B) the 2-page final reports of all mini-grants. PIs presented their results at the 2014 SST STEM Symposium. These Power Point presentations are available upon request.

Thirty one mini-grants were funded: 17 new proposals, 12 renewals and two SST Special STEM Initiative projects. Of the 31 funded proposals, 19 were Course-Embedded Research Projects (as part of the 4-Yr URE), 5 were Undergraduate Research Projects (STEC 4500), and 5 were Scholarship of Teaching and Learning Projects (SoTL). Funds for the 31 projects totaled $116,017.82.

Funds budgeted for the FY 13-14 Mini-Grant Program was $155,000 and included a budget for the 31 individual mini-grant projects ($116,017.82), travel for dissemination, and student lab support. At the end of the fiscal year, all unused mini-grant funds were "swept" and used to purchase "multi-use" equipment. "Multi-use" equipment are similar types of equipment that are requested in multiple mini-grant proposals. Rather than purchase multiple equipment for individual PIs, we decided that it would be more cost effective to remove the cost of these items from budgets and have multiple PIs share one or two pieces of equipment. This policy allowed us to fund more mini-grants.

Mini-Grants Funded: FY 2013-2014

Course Embedded Research Projects (CERP):

Engage IT and Physics Students by Developing Educational Videos with Blended Digital Media
PI: Cuilan Wang
Co-PI: Qing Shao
Funded: $2,400.00

Principles of Molecular Systematics: A Phylogenetic Case Study of the Perennial, Endemic Apiaceae Subfamily Apioideae of Western North America Based on Novel Plastid DNA
PI: Fengjie Sun
Co-PI: James Russell
Funded: $7,700.00

Design-Based Learning In Information Systems: The Role Of Knowledge And Motivation On Learning And Design Outcomes
PI: Joycelyn Streator
Co-PI: Sunyoung Cho
Funded: $460.00

GPS - Based Student Projects In Calculus III
PI: Andrei V. Olifer
Co-PIs: Keith Erickson and Amy H. Erickson
Funded: $2,462.25

Re-"Modeling" College Algebra: Improving Student Engagement through Hands-on Modeling of Real-World Problems
PI: Kathy Pinzon
Co-PIs: Dan Pinzon, Matt Stackpole, JoAnna Whitener
Funded: $6,813.72

Combinatorial Chemistry Module
PI: James Nolan
Funded: $4,010.00

Detection of *Bacillus thuringiensis* and Round-up ready crops in an Undergraduate Biotechnology Techniques Course
PI: Cindy Achat-Mendes
Co-PI: Jennifer Hurst-Kennedy and Robert Haining
Funded: $6,051.10

Develop Creative Laboratory Skills Through Student Self-Developed Activities
PI: Qing Shao
Co-PI: Joseph Ametepe
Funded: $735.00

Using *Caenorhabditis elegans* to teach principles of Mendelian Inheritance in an undergraduate genetics course
PI: Jennell Talley
Co-PIs: Jennifer Hurst-Kennedy and Rebekah Ward
Funded: $12,563.76

Identification And Classification Of Native Georgia Species Combining Taxonomy And DNA Barcoding
PI: Clay Runck
Co-PIs: James Russell, Elizabeth Sudduth, Erin Quinlan, Allison D'Costa
Funded: $7,011.22

Increasing Student Learning with the Expansion of the Cell Biology Fluorescence Microscopy Lab Module
PI: Alessandra Barrera
Co-PIs: David Barnes, Allison D'Costa, Jennifer Hurst-Kennedy
Funded: $4,267.12

Two-stage Course Embedded Determination of Caffeine and Related Compounds by HPLC in caffeine containing Food, Beverages and (or) Related Products.
PI: Xiaoping Li
Co-PIs: Rashad Simmons; Simon Mwongela
Funded: $7,997.88

Renewal: Research Experience for Students of Digital Media using Game Maker Software
PI: Shuhua Lai
Funded: $5,044.00

Workshop Integration into First Year Substantive Courses
PI: David Kerven
Co-PIs: Amanda Myers, Kris Nagel, Juliana Lancaster, DeAnna Jackson
Funded: $3,000.00

Renewal of the Information Security Awareness Research Project
PI: Shuting Xu
Co-PI: Yi Ding
Funded: $7,905.90

Amphibian Diversity at Georgia Gwinnett College
PI: Erin Quinlan
Co-PIs: Clay Runck, Elizabeth Sudduth
Funded: *$1,598.40*

Application of Physics and Biomechanical Analyses in Skill Performance Improvement for Physical Education Activities
PI: Karen Perell-Gerson PhD
Co-PIs: Kristie Walsdorf PhD & Edward (Ted) Forringer
Funded: $6,435.84

Fitness Profile of Undergraduate College Student at an Open Access Institution in Georgia
PI: Pam Anderson
Co-PIs: Lauren Tapp & Tim Tolbert
Funded: $7,255.44

Mobile Game Development: Using Cutting-Edge Technology to Promote Critical Thinking and Problem Solving Skills
PI: Xin Xu
Co-PI: Sonal Dekhane
Funded: $4,199.86

Scholarship of Teaching and Learning:

Flipping The Pre-Calculus Classroom – Where Are We? Where Are We Headed?
PI: Priya S. Boindala
Co-PIs: D. Natasha Brewley, Jennifer L. Sinclair, Keith Erickson
Funded: $2,496.00

Innovations in the Teaching of Proof: Using Modeling and Video-Based Peer-Instruction in Abstract Mathematics
PI: Stan Perrine
Co-PIs: Boyko Gyurov and Livinus Uko
Funded: $4,727.60

Integrating Computational Thinking into ITEC courses
PI: Sebastien Siva
Co-PIs: David Kerven, Stella Smith and Kris Nagel
Funded: $1,120.00

Effects of Utilizing a Common Approach to Teaching Mathematics in General Chemistry and Precalculus
PI: Greta A. Giles
Co-PI: Paula H. Krone
Funded: $325.00

Analysis of Students' Decisions to Withdraw from Biology Gateway Courses
PI: Latanya Hammonds-Odie
Co-PIs: Michael Erwin, Charmita Burch and JoAnna Whitener
Funded: $3,162.50

Undergraduate Research: STEC 4500

Behavioral Neuroscience Investigations Using Zebrafish Models
PI: Cindy Achat-Mendes
Co-PI: Andrew Kelly (SLA)
Funded: $6,662.34

Mechanisms of Capacitation in Equine Spermatozoa: The Influence of the Progesterone Receptor
PI: Christopher I. Brandon, Jr.
Co-PI: Bagie M. George
Funded: $3,064.10

Survey of the Microbial Flora of Northern Georgia Bat *Hibernacula* and Refinement of an Infectious Model System for Investigation of White Nose Syndrome Pathogenesis.
PI: Pratima Adhikari
Co-PIs: Lorina G. Boomhower; Jennifer Hurst-Kennedy and Cindy Achat-Mendes
Funded: $2,247.53

The Microbial Ecology of the Kudzu (*Pueraria Spp*.)-Rhizobia Symbiotic Relationship: An STEC 4500 Project
PI: Lee Kurtz
Co-PI: James Russell
Funded: $2,540.87

Statistical Analysis of Active Galactic Nuclei
PI: Amy M. Campbell
Funded: $6,580.00

Special SST STEM Initiative Projects

Two Faculty Development Days and A Student Publication to Encourage Dissemination of SST Mini-Grant Projects and Results using Special Initiative Funding
PI: Deborah Sauder
Co-PI: Stella Smith
Funded: $2,690.97

Using Peer Mentors to Enhance Research Process Skills in the Introductory Biology Lab Curriculum using Special Initiative Funding.
PI: Judy Awong-Taylor
Co-PIs: Michael Erwin, Latanya Hammonds Odie, Tirza Leader, Jennell Talley, Candace Timpte, Pat Huey
Funded: $9,162.50

2. State the **funding rate** for mini-grants at your institution (i.e. number of grants funded vs. total number of proposals received)? Discuss how proposals were **judged and awarded**.

Forty six (46) mini-grant proposals were submitted and thirty one (31) were funded. Funding rates for the past three years are shown below.

Year	Proposal Submitted	Proposal Funded	Funding Rate	Amount Funded
FY 11-12	36	22	61.1%	$136,242.19
FY 12-13	35	25	71.4%	$114,952.25
FY 13-14	46	31	67.4%	$116,017.82

A Request For Proposals (Appendix C) was posted in spring 2013. Maximum funding level was set at $8,000.00, but additional funding was considered for exceptional proposals. Mini-grant funding categories included:

- Development and implementation of course-embedded research projects that promote the 4-yr URE model (***Priority***)
- Development and implementation of individual or small group Undergraduate Research Projects associated with STEC 4500 and 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)

RFPs included review criteria and scoring guide. This scoring guide was used by the review team for judging and scoring all proposals. The review team consisted of eight SST faculty with representation from each discipline. All proposals were independently reviewed by all reviewers prior to a one day meeting during which all proposals were discussed and ranked. After each proposal was discussed, reviewers had an opportunity to adjust their scores based on the group discussion, individual scores were then collected and proposals were ranked according to the collective scores. Poorly written proposals were not funded. A separate budget was set aside for travel related to mini-grants and PIs applied for travel funds to disseminate their work.

3. For any of the mini-grants listed, do you **have evaluation data or other evidence suggesting the efficacy of the projects**? Also, please discuss the broader impacts for these projects (i.e. changes to instructional approaches, changes to departmental policies, etc.).

Final reports for all mini-grants are attached (Appendix B). All reports required some discussion on the impact (if any) of the project implemented. It should be noted that some projects will continue into FY14-15 and additional data will be collected. Additionally, assessment data for some mini-grants are still being analyzed and will be reported at the next SST STEM Symposium. To better understand the evaluation data from each mini-grant, we have elected to attach the final reports of all mini-grants. We believe the evaluation and assessment data would make more sense within the framework of the mini-grant reports.

The following information was required for all mini-grant final report:
***Purpose/Background**:* Describe the purpose of the research project and explain its significance related to the goals of the 4-Yr URE.
***Description of Research Project**:* Describe the implementation of the research project, including any specific, pertinent activities.
***Data Collection and Analysis**:* Describe types of data collected and methods of analysis. Include your assessment plan.
Findings: Describe your findings and how the research project impacted or did not impact student learning and attitude toward research.
Research Skills: Include a list of the research skills (general or discipline specific) that were addressed in the implementation of your mini-grant.
***Conclusions/Recommendations**:* Describe any conclusions and recommendations based on findings and overall study (not already covered in your findings section).
Dissemination: Include information concerning presentation proposals you have submitted this year (e.g., seminars, conferences, etc.).

Broader Impacts of Mini-Grant Program:

Faculty continue to be been very supportive and enthusiastic about the 4-Yr URE Program and the opportunity to participate in the Mini-Grant Program. It is still a challenge to re-design the curriculum for some of the courses on the 4-Yr URE sequences but faculty continue to be creative and have developed some innovative ideas that we hope can be adapted to fit these courses. The Mini-Grant program has also been instrumental in providing incentive for faculty to re-consider instructional approaches. As previously mentioned, administration has also been very supportive of this work. The Dean of SST continues to support all course redesigns including "experimental" or "intervention" sections and continues to schedule appropriate courses and sections to faculty awarded mini-grants. Additionally, any scholarly work (peer-reviewed papers or products) will be considered as scholarly contributions for promotion and annual evaluation.

Re-designing, implementing, and assessing the new courses has proven to be extremely challenging and time-consuming to faculty. Despite this challenge, faculty continue to participate in this program, mainly due to the Dean's support and acknowledgment of the work involved. We are extremely fortunate to have a core group of energetic and enthusiastic faculty who are willing to accept the challenge of changing the way we teach so as to better engage our unique student population.

Evidence Suggesting Efficacy of the Projects:

In FY 13-14, faculty wrote and submitted eight manuscripts based on the results of their STEM mini-grants. One manuscript has been accepted and publications; five are currently under review, and two are under preparation. We anticipate that more manuscripts will be submitted in the near future as a direct result of SST's STEM Initiative. A list of published and submitted manuscripts is provided below.

Published and Submitted Manuscripts:

1. Joseph C. Sloop, Leonard Anagho, Patrick Coppock, Greta Giles, Sang Park, Richard Pennington, David Pursell, Gillian Rudd, Mai Yin Tsoi. 2013. "Conformational Analysis, Modeling, Stereochemistry and Optical Activity of Cyclohexane Derivatives," *Journal of Laboratory Chemical Education*, 2013, *1(3)*, 39-44.

2. P. Boindala, D. Brewley, J. Sinclair, K. Erickson. (2014) Flipping an undergraduate pre-calculus course: Taking a different approach to engage students towards significant learning, PRIMUS Journal, UNDER REVIEW

3. P. Boindala, D. Brewley, J. Sinclair, K. Erickson. (2014) Ideation to Execution: Flipping and Undergraduate Pre-Calculus Course To Create Significant Learning Experiences, Implementation and Critical Assessment of the Flipped Classroom Experience (IGI Book Chapter), UNDER REVIEW

4. Pinzon, K., Pinzon, D. Stackpole, M. (2014). *Re"modeling" College Algebra: A flipped, inquiry-based approach.* Submitted to PRIMUS May 2014.

5. Sonal Dekhane, Xin Xu, Mai Yin Tsoi(2013). Mobile App Development to Increase Student Engagement and Problem Solving Skills. Submitted to the Journal of Information System Education

6. James E. Russell, Allison R. D'Costa, Clay Runck, David W. Barnes, Alessandra L. Barrera, Jennifer Hurst-Kennedy, Elizabeth B. Sudduth, Erin Quinlan, Mark Schlueter. (2014) Integrating the undergraduate curriculum using biodiversity and DNA barcoding to study the effects of campus urbanization. Submitted to CBE-Life Sciences Education. Under Review.

7. *David P. Pursell, Joseph C. Sloop, Richard Pennington, Mai Yin Tsoi, Julia Paredes, Patrick Coppock, Greta Giles, Leonard Anagho, Gillian Rudd, Sang Park. 2014. "Greening the First Semester Undergraduate Organic Chemistry Laboratory to Enhance Student Understanding of Structure, Function, and Mechanism in Preparation for a Second Semester Organic Chemistry Laboratory Synthesis Project." Manuscript in preparation for submission to *Green and Sustainable Chemistry*.

8. *Richard Pennington, David Pursell, Joseph Sloop, Mai Yin Tsoi, Julia Paredes, Patrick Coppock, Sang Park, Leonard Anagho, Gillian Rudd. 2014. "Enhancing Research Skills in the Undergraduate Organic Chemistry Lab via a Semester Long Synthesis Project." Manuscript in preparation for submission to *Journal of Chemical Education*.

B. Service Learning Opportunities (i.e. FOCUS-derived projects)

*1. Briefly describe the **operation of your institution's service learning opportunity** or FOCUS-derived project for FY2014, including the following:*

a. Name of project(s) or other branding

BIOL 4800- STEM Service Learning Internship.

b. Key Partners for your Project (i.e. Departments/Schools at your institution, participating P-12 schools/school districts, area businesses, etc.)

Key partners include:

- School of Science and Technology
- School of Education
- Office of Educational Technology
- Gwinnett County Public School System
- McKendree Elementary School

c. Data regarding participants (students taking part in project, number/classes of P-12 students engaged through project, number of teachers taking part, etc.)

Fourteen GGC students (interns), seven 5th grade classes at Mckendree Elementary School, and seven elementary school teachers participated in this program.

d. Primary activities and their operation

Executive Summary. As a part of a grant awarded through the University System of Georgia's STEM Initiative II, GGC's School of Science and Technology partnered with McKendree Elementary School for a third year to deliver a science curriculum enrichment program to McKendree 5th grade students during the 2013-2014 academic year. Georgia Gwinnett College's (GGC) School of Science and Technology (SST) offered a 3–credit Service Learning course to fourteen of its Biology majors which doubled GGC student involvement as interns compared to the 2012-2013 year. As part of the service learning course, these 14 GGC students prepared and executed a program of hands-on lab activities with real-world applications for the 5th grade students at McKendree Elementary School in the Gwinnett County Public School System (GCPS) based on the project-based learning scenarios developed during the first two years of the project. McKendree administration and teaching staff and GCPS' science coordinator provided input on targeted academic standards and curriculum map schedules as well as evaluation of program quality and impact.

Focused on the 5th grade Science GCPS science standards, the program was designed to provide supplemental science instruction and hands-on laboratory experiences, presented on site and during the school day. Each semester the McKendree students were challenged to solve a science mystery using a series of clues uncovered as a result of hands-on laboratory experimentation and analysis of results based on a real-life evidence-based scenario. Together, McKendree Elementary staff, GGC professors and GGC course instructors used evaluations from the previous year's project to increase the instructional impact of the series of real-world lab investigations developed during previous years of the project. Separate scenarios for fall and spring semesters targeted the system's science standards to create connections between results the 5th graders found in the lab and conclusions about a set of clues which McKendree 5th graders would use to solve a science scenario mystery. Additions to the 2013-2014 project year included use of a lab notebook, follow-up and extension activities for 5th graders to work on between lab sessions with GGC student interns, and additional technology activities using IPADs.

The cohort of 5th grade elementary students at the school was split approximately in half. One set participated in a fall 2013 forensic mystery aligned to the learning standards of the Fall GCPS 5th grade science curriculum map. The other set of students participated in a different spring 2014 forensic mystery lab series keyed to the learning objectives specified in the curriculum map for the spring semester. McKendree students chronicled their progress in using the clues uncovered in each of the hands-on laboratory investigations to solve the real-world forensic mystery of the semester and presented their findings in a final semester report-out science seminar setting using verbal, graphic, written and technology-rich communication formats. The fall 2013 McKendree student cohort presented their findings in a December Family Science Night program setting. The spring 2014 cohort presented during an afternoon science celebration to which family members were invited.

The ongoing evaluation of the impact of the project was continued and expanded in 2012-2013. In addition to pre-and post-experience student intern surveys, post-experience cooperating teacher surveys and the post-experience focus groups for GGC interns and cooperating teachers, analysis of GGC intern reflections, completed throughout both the fall and spring cohort semesters, was added this year. McKendree teacher participants and GGC interns reported project goals had been met and recommended several enhancements which have been incorporated into year four of the project. Cooperating teachers, most of whom were participating for the second year, reported their continuing approval of the impact of the program on their 5th grade students. The cooperating teachers from the elementary school particularly noted expanded student impact and quality of program activities and GGC intern instruction as compared with the first delivery year of the project in 2012-2013. They attributed this increased impact to the implementation of the joint recommendations made during the program evaluation phase of the 2012-2013 year made by the 3 GGC School of Science and Technology faculty and intern coordinator who planned and supervised the program this year. During the 2014-2015 academic year, the partnership will continue between GGC's School of Science and Technology and McKendree Elementary School with project delivery focused, once again, on the 5th grade classes.

During the 2012-2013 project year, increased focus on dissemination was implemented by participating GGC faculty and intern coordinator. In addition to presentations at GGC STEM

Initiative meetings, results and impact of the Service Learning Course was presented at five statewide and national conferences. During the 2014-2015 project year, participating GGC faculty and staff plan to submit articles on the project to statewide and national publications.

A detailed report on the Service Learning Course is provided in Appendix H.

e. Any outcomes data demonstrating the project's efficacy or effectiveness.

A detailed report regarding outcomes, assessment and evaluation of the Service Learning Course is provided in Appendix H.

C. Institution-Specific Projects

1. Identify your institution-specific project(s) outlined in your proposal for FY2014 (i.e. 4-Year Undergraduate Research Experience, Academy for Future Teachers, MESA, summer bridge programs, peer learning communities, STEM tutoring/learning centers, etc.). Discuss any specific branding.

Our institution-specific project is based on a 4-Year Undergraduate Research Experience Program designed to introduce systematic investigation and research experiences much earlier in a student's educational career. This model focuses on incorporating genuine research experiences and skills into key courses in each major. The selection of these courses ensures that students following a typical four year trajectory will be engaged in at least one genuine research experience during each year of their education. STEM faculty, working individually or in small teams continue to redesign STEM courses to replace "cookbook" laboratory exercises and textbook based problems with developmentally appropriate active research opportunities. Additional courses will continue to be revised, with a goal of having authentic research experiences that reach 100% of students in STEM courses each year. This project not only focuses on student success but encourages faculty engagement in the Scholarship of Teaching and Learning and promotes innovative methods of scholarly engagement.

Prior to receiving the USG STEM initiative II grant, the 4-yr URE Committee had identified and developed a list of research skills and competencies that would promote student success as students progressed through their courses. For each major and all tracks, we identified key courses throughout the 4-year curriculum that would be re-designed to include research skills and experiences. The selection of these courses ensures that students following a typical four year trajectory will be engaged in at least one genuine research experience during each year of their education. Our goal is that eventually the majority of courses taught in SST will have genuine research components embedded in the curriculum. The most current sequence of courses and list of research skills are attached (Appendix D).

We do not have a specific branding of our initiative.

*2. Provide data regarding the **level of participation** in each of these projects (i.e. number of faculty participants, number of student participants). Discuss their **scope** (i.e. oriented toward incoming freshmen, upperclassmen, STEM majors, education majors, all students, etc.)*

4-Yr URE Program FY2012-13 Level of Participation:

The following table contains information pertaining to the level of participation.

	FY 2012	FY 2013	FY 2014
Number of proposals submitted	36	35	46
Number of mini-grants funded	22	25	31
CIRPs	18	14	19
SoTL	1	5	5
STEC 4500	3	6	5
SST Special Initiatives			2
Number of courses impacted	17	29	31
Freshmen level	6	13	10
Sophomore level	3	5	6
Junior level	6	6	8
Senior level	2	5	7
Number of faculty participating	118	212	112
Number of Students Impacted *Unduplicated head count	2,001	2,407*	3,232*
Number of STEM sections	106	261	198
Dissemination Efforts			
Faculty Presentations & Posters	40	56	77
Student Presentations	32	37	25
Submitted Manuscripts			8

To date, a total of 41 unduplicated courses have been redesigned through mini-grant funding. These courses are listed below.

Redesigned Courses Funded by Mini-Grants FY 12 to FY 14

BIOLOGY	CHEMISTRY	EXERCISE SCIENCE	ITEC	MATH	PHYSICS	OTHER
BIOL 1101	CHEM 1152	EXSC 3500	ITEC 1001	MATH 1111	PHYS 1111	STEC 4500
BIOL 1107	CHEM 1211	EXSC 4100	ITEC 2110	MATH 1113	PHYS 2211	PHED 1120
BIOL 1108	CHEM 1212	EXCS 3000	ITEC 2201	MATH 2000		ENG 1101
BIOL 3200	CHEM 2211	EXCS 3101	ITEC 3150	MATH 2220		
BIOL 3400	CHEM 2212	EXCS 3300	ITEC 3450	MATH 2500		
BIOL 3500	CHEM 3000	EXCS 3800	ITEC 3860	MATH 3500		
BIOL 4200	CHEM 4100	EXCS 4300	ITEC 3870	MATH 4750		
BIOL 4300		EXCS 4410	ITEC 4801			
BIOL 4570			ITEC 4860			
BCHM 3100						
BIOL 3300						
BIOL 3550						
BIOL 4000						

*3. Discuss the **activities and operation** of your institution-specific project(s), including any efforts to connect multiple projects for synergistic impacts.*

Our institution-specific 4-Yr URE program is intrinsically tied to the structured "mini-grant" program (Strategy 1-*Establish a structured mini-grant program targeted toward STEM faculty).* Funding from mini-grants provide opportunities for faculty to develop new research-embedded curricula, collaborate with others, and to assess and evaluate the re-designed courses.

Specifically, mini-grants are used to encourage faculty participation in the 4-Yr URE program, thus helping us achieve our institution specific sooner than anticipated. Mini-grants are also used to fund specific undergraduate research projects (STEC 4500) and projects dealing with the Scholarship of Teaching and Learning (SoTL). In all cases, participation is recognized as scholarly work for Promotion and Credentialing (GGC dose not have a tenure process).

All majors and some tracks have developed and identified sequence of courses that are priority courses for re-design. Faculty have the opportunity to focus on just 1-2 sections of a course or all sections of the course. If assessment and evaluation indicates that the course-embedded modules are effective and successful at engaging students, then all sections of that course will adopt and incorporate the new research modules/labs. Further assessment will be conducted after the changes are implemented for 2-3 semesters. This assessment and evaluation data will be used by the discipline to vote on final acceptance of the changes. This process ensures that all recommended changes are vetted and accepted by all faculty within the discipline. We anticipate that several innovative modules will be introduced into courses but some may not be successful

or sustainable. We also encourage faculty to link courses between levels (e.g. between freshmen and sophomore levels) and even between disciplines.

Mini-grant funds are used to support sections that are being re-designed. This includes the cost of equipment and supplies. Once the new modules are incorporated into all sections, the cost of implementation (all supplies and expendables) are fully supported by SST's budget.

The Project Manager (Judy Awong-Taylor) and Administrative Accountant (Cindy Lail) are responsible for ensuring that all mini-grant budgets are in compliance. The Project Manager is also responsible for placing all purchase orders related to the mini-grants and works closely with the Office of Educational Technology (OET) to ensure security compliance for all technology associated purchases.

All PIs of mini-grants were required to conduct several assessments (described in next section) and submit a 2-page final report, a budget report, and student information data at the end of the year.

In FY 12-13, we began to develop and implement a formal **Peer-Mentoring Program** for introductory biology (BIOL 1107-Principles of Biology I) based on preliminary data from a former mini-grant. Preliminary results had indicated that the peer-mentoring program was very successful and provided help and support to both students taking the course and faculty teaching the course. This component was not part of the initial STEM proposal but our team recognized the potential impact of peer-mentoring for enhancing student success in introductory courses. We are still collecting data and will continue to evaluate the impact of the peer mentoring program. We hope to have a more comprehensive report in FY 14-15 Annual Report.

4. Provide any available ***outcomes data demonstrating the efficacy or effectiveness of the project(s)****.*

Assessment and Evaluation are important components of our STEM Initiative. The following section describes our assessment plan and some outcomes data.

4-Yr Undergraduate Research Experience Program

Assessments for key areas of our institution-specific project (4-yr URE Program) have been developed and are described below.

1. Student Attitudinal Surveys

To assess and evaluate the overall 4 yr URE Program, we developed student assessment surveys (IRB approved) for all mini-grants that implemented course-embedded research. Assessment surveys (Likert-type scales) were administered both pre- and post-exposure to the labs. Pre-Assessment Surveys were administered during the first week of class in all sections, both "course-embedded research section" and "control sections". An identical Post-Assessment survey was administered at the end of the semester. The Student Attitudinal Survey addressed three areas: attitudes about STEM, research skills, and understanding and awareness of research. Results of these surveys are still being analyzed (every mini-grant administered pre and post

assessments in multi sections), and we will use this data in a longitudinal study to determine if student attitudes about research change during their educational career. Prior to administration of all assessments, students were informed of the study and asked to sign an IRB approved consent form before participating in the study. All signed consent forms and student surveys are securely stored in the office of the Project Manager.

Data for 2012 and 2013 are currently being analyzed. Questions of interests are (1) Do students report more positive attitudes at the end of the course than at the beginning of the course? (2) Are these attitudes different in course sections that have implemented mini-grant initiatives compared to control sections? (3) Do attitudes for individual students change from their Freshmen to their Senior years in a STEM major? (4) Is there a greater change of attitudes over time for students that have participated in more mini-grant initiative sections?

Data is currently being aggregated, and inputted into an analysis program, and Fall 2014 data is still be collected. However, initial analysis of one of the larger mini-grant initiatives is already showing promising changes in attitudes for students. In Fall 2012, BIOL 1107 initiated an embedded research program throughout the lab portion of the course for only selected 'treatment' conditions. All students reported high levels of confidence in their research ablates. However, compared to control sections, students that had embedded research in their labs continued to report confidence in their research abilities at the end of the semester, whereas students who did not have embedded research showed a marked decrease in their confidence by the end of the semester. This suggests that students who do not have embedded research may be learning enough throughout the semester to realize how little they actually understand about science and research without actually gaining the skills necessary to gain new confidence in their abilities. However, those students that have experienced embedded research are gaining these new skills and so report confidence in their research abilities.

2. Course Content Assessment

PIs of mini-grants were asked to develop content assessments for the re-designed course. Pre-assessments were administered at the start of the semester or at the start of the new module; post assessments were administered at the end of the semester. Course content assessment also included components related to discipline-specific research skills and how the research-based module affected students' research skills. PIs were responsible for analyzing their content / research skills assessments, and results of these assessment are included as part of the final mini-grant reports. Outcomes data on the efficacy of some mini-grant projects are available in the mini-grant final reports.

3. Faculty Attitudinal Survey

An outcome of our institution-specific program is to encourage faculty to become more engaged in the Scholarship of Teaching and Learning and the way in which they teach and engage their students. Our goal is to change the culture of our faculty so that active student engagement is the norm. In order to determine if faculty attitudes will change over time, we developed a faculty attitudinal survey (IRB approved) that will provide longitudinal data over the course of the grant. This survey has been administered annually since Spring 2012, and will be administered in Spring 2015. Survey data included: faculty demographics, awareness of USG and SST STEM

Initiatives, STEM-related scholarship, and discipline perspectives on STEM.

Data is currently being aggregated, and Spring 2015 data is still be collected. However, initial analysis is showing that as the STEM initiative is progressing, faculty are participating in more and varied STEM initiative opportunities (e.g., mini-grants, working with colleagues, and working in K-12 schools), and reporting increasingly more positive attitudes towards the STEM initiative. Additionally, faculty are reporting using the STEM initiative strategies in their classes, and are becoming more motivated to change how and what they teach.

4. GGC Institutional Research Data

If possible, we will also collect longitudinal data on:

- student performance in subsequent courses
- improved performance tied to research skills
- completion rates for key courses
- changes in number of STEM majors
- completion of STEM teachers who complete SST degree programs
- number of STEM teachers employed as a STEM teacher in Georgia
- number of STEM students that enter professional schools
- number of STEM students who enter graduate programs in STEM, and where they go
- number of STEM students who get initial post-baccalaureate jobs in STEM fields

5. Board of Regents-Specific Student Performance Data (Appendix E)

The following data was requested by the BOR

- Majors and Schools in which faculty teach
- Courses taught by STEM faculty
- Number of sections taught per semester by STEM faculty
- Total number of students taught in these sections
- Completion rates of these sections
- Grades earned in these courses

We are still in the process of collecting and analyzing outcomes data to demonstrate the efficacy of the 4-yr URE program (student attitudinal surveys and faculty attitudinal surveys) since this involves a longitudinal study. We began analyzing all data (currently 3 years of data) in fall 2013 and will continue to collect data for the duration of the grant. Additional, detailed, outcomes data on the efficacy or effectiveness of mini-grant projects are available in the individual mini-grant final reports.

IV. Future Efforts

A. Please discuss dissemination efforts for best practices or research findings identified through participation in the USG STEM Initiative.

We continue to disseminate the work of STEM Initiative. During FY 13-14, the PI and Co-PIs presented GGC's STEM Initiative and SST's 4-Year URE Initiative at five national and two regional conferences. Our abstracts were accepted for four interactive presentations and five posters. Additionally, we continue to work on publishing our work in a peer-reviewed journal. FY 13-14 presentations are listed below:

Conference Presentations

1. Leader, T., C. Runck, D. Pursell, A. D'Costa, G. Giles, J. Awong-Taylor, and T. Mundie. (2014). Monitoring undergraduate research outcomes: Designing effective assessments. CUR 16th Annual National Conference – Creating the citizens of tomorrow: Undergraduate research for all, June 26-July 1, 2014, Washington D.C. (interactive presentation)

2. Runck, C., D. Pursell, A. D'Costa, G. Giles, J. Awong-Taylor, T. Mundie, and T. Leader. (2014). A course embedded model for integrating undergraduate research experiences throughout the 4-year curriculum. CUR 16th Annual National Conference – Creating the citizens of tomorrow: Undergraduate research for all, June 26-July 1, 2014, Washington D.C. (interactive presentation)

3. Awong-Taylor, J., T. Mundie, D. Pursell, A. D'Costa, G. Giles, and C. Runck. Integrating undergraduate research experiences throughout the 4-yr curriculum: a course-embedded model. (2013). American Association of Colleges and Universities (AACU) *Transforming STEM Education: Innovation, Inquiry, and Evidence* conference, October 31-November 2, 2013, San Diego, CA.

4. Awong-Taylor, J., D. Pursell, C. Runck, A. D'Costa, and G. Giles. 2013. *SST STEM Initiative: An Update*. SST STEM Symposium 2014, Lawrenceville, GA, May 2nd, 2014.

Poster Presentations

1. Giles, G., C. Runck, J. Awong-Taylor, T. Mundie, D. Pursell, A. D'Costa, and T. Leader. (2014). Large scale implementation of undergraduate research projects in lower division STEM courses. CUR 16th Annual National Conference – Creating the citizens of tomorrow: Undergraduate research for all, June 26-July 1, 2014, Washington D.C.

2. Runck, C., A. D'Costa, J. Awong-Taylor, G. Giles, D. Pursell, T. Leader, and T. Mundie. (2014). A 4-year course-embedded research model for enhancing student engagement and learning in STEM fields for all students. CUREnet Conference, March 31-April 2, 2014, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

3. Runck, D., J. Awong-Taylor, A. D'Costa, G. Giles, T. Mundie, D. Pursell, and T. Leader. (2014). Course-embedded research and service learning internships – GGC's high impact practices for enhancing student engagement and learning in STEM fields – an update. Georgia Scholarship of STEM Teaching and Learning Conference, March 7, 2014, Georgia Southern University, Statesboro, GA.

4. Awong-Taylor, J., T. Mundie, C. Runck, A. D'Costa, G. Giles, and D. Pursell. (2014). Implementing vision and change in undergraduate education: an interdisciplinary approach. AAAS conference *Vision and Change in Biology Education: Chronicling Change, Inspiring the Future*. August 28-30, 2013. Washington, D.C.

5. Awong-Taylor, J., D'Costa, A., Runck, C., Pursell, D., Giles, G., Mundie, T. (2013) Course-Embedded Research and Service Learning Internships-GGC's High Impact Practices for Enhancing Student Engagement and Learning in STEM Fields. Poster at the Georgia Scholarship of STEM Teaching and Learning Conference. Statesboro, GA. March 8, 2013.

In addition to the SST's 4-Year URE Imitative, we also continue to disseminate the work of the Service Learning Course. The following presentations were completed at both statewide and national conferences:

1. D'Costa, A., Peiffer, B., Awong-Taylor, J. & Runck, C. (2013, November). Service Learning to Enhance Elementary STEM Education. Paper presented at the National Association of Biology Teachers Annual Conference, Atlanta, GA.

2. Peiffer, B., D'Costa, A., Awong-Taylor, J. & Runck, C. (2014, March) Lessons Learned from Development and Implementation of a STEM Service Learning Project. A paper presented at the 2014 SoTL Commons Conference, Savannah, GA.

3. Runck, C., D'Costa, A., Peiffer, B., Awong-Taylor, J. & Kinard, M. (2014, March). Updates from and Lessons Learned in Delivering a Service Learning Course to Enhance Elementary STEM Education in Gwinnett County. Paper presented at the 3rd Annual Georgia Scholarship of STEM Teaching and Learning Conference, Statesboro, GA.

4. Runck, C., Awong-Taylor, J., D'Costa, A., Giles, G., Mundie, T., Purcell, D. and Leader, T. Course-Embedded Research and Service-Learning Internships – GGC's High Impact Practices for Enhancing Student Engagement and Learning in STEM Fields – an Update. (2014, March). Poster presented at the 3rd Annual Georgia Scholarship of STEM Teaching and Learning Conference, Statesboro, GA.

PIs of mini-grants have also presented their work at various regional and national conferences. A total of 64 presentations/posters were presented FY 2014. Others are in the process of further analyzing data and anticipate presenting their work in FY 2015 or publishing their findings in scholarly journals. Students involved in the research components of the re-designed courses presented 25 different presentations at various venues regionally and nationally. A list of all faculty and student presentations is attached (Appendix F).

We hosted a one-day 2014 SST STEM Symposium that was attended by ***most*** SST faculty and staff. All mini-grants awardees presented their work during this conference. We also used this symposium to disseminate information about the USG STEM Initiative II and our own STEM Initiative. The FY 13-14 symposium focused on developing effective assessment tools and surveys. Sessions for faculty included how to write and develop effective Course-Embedded Research mini-grant proposals and SoTL mini-grant proposals; collaborative ideas for mini-grants; and breakout sessions on assessment and evaluation of the 4-Yr URE. The 2014 SST STEM Symposium agenda is attached (Appendix G)

PI and Co-PI travel to disseminate the work of the initiative was fully funded by the STEM Initiative Grant. Faculty travel to disseminate the work of the mini-grants was covered partially by the STEM Initiative Grant and partially by the School of Science and Technology.

B. Please identify any external grants (e.g. NSF, Department of Education, private/foundation) for which you have applied based on support received for the STEM Initiative. Indicate whether any applications have been successful.

The following external grant (based on support received by STEM Initiative) was submitted in FY13-14.

1. Embedding Research and STEM Core Competencies in Courses Throughout the Four Year Curriculum: A Transformative Model for Undergraduate STEM Education. Submitted to Department of Education's ***First in the World*** rfp. PI: Awong-Taylor, J., Co-PIs: T. Mundie, A. D'Costa, G. Giles, Tirza Leader, D. Pursell, and C. Runck.

C. Will your institution's STEM Initiative program for FY2015 involve any notable changes from your FY2014 program? If so, please explain any changes and the rationale for them.

Our STEM initiative program for FY2015 will not involve any notable changes; however, we will make some slight modifications, additions, and goals as follows:

1. We will continue to include a Peer-Mentoring Program as a component of the 4-Yr URE Program. We will focus our efforts on the introductory biology course, BIOL 1107-Principles of Biology. We will continue to assess and evaluate the Peer-Mentoring Program.

2. The STEM Undergraduate Research Lab (SURL) will continue to be available for undergraduate research use.

3. The Technology Resources Program will provide tablets for faculty in-class use. We will continue to track usage of these resources and assess its impact.