

**Project** \_ Goal 2 Initiative 2: Applying the Science of Learning to the Learning of Science (SENCER Program)\_\_\_\_\_ **Start Date**\_\_8/15/2012\_\_\_\_\_

**Client** \_\_Indiana State University\_\_\_\_\_ **Program Manager** \_\_Dr. Jim Speer\_\_\_\_\_

**Project Manager** \_\_Dr. Jim Speer\_\_\_\_\_

**Thesis Statement** \_ Applying the Science of Learning to the Learning of Science to improve STEM education at ISU, infuse experiential learning into our curriculum, and make community engagement an integral part of our students' education\_\_\_\_\_

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## **Introduction/Background – What?:**

### **SENCER at ISU**

Indiana State University has adopted the Science Education for New Civic Engagements and Responsibilities (SENCER) Teaching Model, which fits well with our strengths in experiential learning and community engagement. Our committee is working hard to promote the SENCER Teaching Model at ISU and requests the following budget to meet the goal of making our STEM education classes more engaging and to provide students with a deeper learning experience across all disciplines using this interdisciplinary approach.

The SENCER Teaching Model promotes project-based learning and community engagement to engage students in a meaningful education. The funds that we are requesting will provide faculty development workshops (including a regional conference focusing on the sciences), funds to convert classes to this interactive and interdisciplinary model that incorporates community engagement, and to fund a SENCER Student Leadership Team that uses their learned skills from their disparate majors to bring SENCER alive at ISU. Most of the requested funds will go to undergraduate and graduate student wages and provide funds for them to travel to conferences to present the work that they are doing at ISU. These travel funds will also help other students participating in these classes to present their findings at conferences and to gain this professional experience that they can put on their resumes.

### **Previous Achievements of Goal 2 Initiative 2**

Over the past three years , funds for this initiative have enabled us to engage over 70 faculty and staff in professional development workshops at ISU. We have 30 courses listed as SENCER-like courses throughout the University and have provided course development funds for two new courses in the College of Education and one new course in physics. Twenty-six of these faculty, staff, and students traveled to the SENCER Summer Institutes in Chicago Illinois, Asheville North Carolina, and Indianapolis Indiana in the last three years

to learn about this teaching model and to present the work that ISU has done over the past year. This summer we will have six more faculty staff and students attend the SENCER Summer Institute at Santa Clara California including three new faculty in working with the SENCER model. We will be presenting three poster presentations at this conference. The conference in Santa Clara will be August 2-6, 2012 but funds were approved in FY 2012 so that we could plan for this event. We have trained ten students in the SENCER program and have had them use their skills to advance the SENCER program at ISU: Ross Alexander (graduate student), Emily Pugh, Dorothy Rosene, Peter Rosene, Elise Hobbs, Adri Lehman, Chase DuPont, Lauren Adams, Alli Creed, and Andrea Kelley). These students have presented at the Washington DC Symposium in April 2010, 2011, and 2012 and attended the Summer Institutes in Chicago, Asheville, and Indianapolis. At the Washington DC Symposium in 2011, ISU was awarded the William E. Bennett Award for Extraordinary Contributions to Citizen Science for our work with the SENCER Teaching Model and specifically for the development and implementation of the SENCER Student Leadership Team. This was an innovative advancement and has been suggested as a model for other institutions to follow. Also, the SENCER program continues to produce news stories that are featured on local television and radio news broadcasts as well as on ISU's web pages. This program has been successful in bringing much positive media attention to the experiential learning and community engagement that our students have completed.

As the faculty and staff bring this model to campus, the student SENCER team puts the energy into the campus effort to provide this project-based learning around civic issues. Our current student workers are providing the student leadership that is needed to engage the rest of the student community in these engaging classes.

Initiative 2 is working to meet three of the four benchmarks listed under goal 2. These benchmarks are the following:

- by 2014, increase the percentage of students who participate in internships, practicums, and field experiences before graduation to 100 percent;
- by 2014, increase the percentage of degree programs with a required significant experiential learning component to 100 percent;
- increase the participation in experiential learning each year, until 100 percent of ISU students engage in at least one significant field experience within their major before graduation;

We are approaching this from a different direction by incorporating field experiences into the foundational studies classes that have been SENCERized and through major courses using this teaching model.

Furthermore, these classes also emphasize community engagement around civic issues that grab the interest of the students such as global climate change, environmental issues, the Riverscape, and ISU campus life itself.

We met our goals for Fiscal Year 2012 by completing the assessment of the first two years of our SENCER program at ISU which resulted in a peer-reviewed publications with the national SENCER organization (Rosene et al. 2012). We expanded the SENCER Teaching Model into the Physics program and Dr. Joe West is receiving a course development grant from us this summer to convert an introductory physics class to the SENCER Teaching Model. We have given 28 presentations on the ISU SENCER model, which include invited presentations at national and international venues including presentations in England, Scotland, and Ireland.

### **Proposal/Purpose/Justification – Why?:**

Inquiry-based, hands-on learning has been shown to be the most effective means to teach science to all age groups (Haury and Rillero 1994). Kolb (1984) states that “Learning is the process whereby knowledge is created through the transformation of experience.” SENCER classes focus on this process of learning by giving students the opportunity to practice science by developing and testing hypotheses. Through these efforts, they learn the scientific method and learn the specifics of the subject matter deeply, rather than memorizing facts for an exam. The National Research Council has produced multiple studies and publications that support the concept that actively participating in scientific research is the best way to deeply learn the skills of a scientist (NRC 2000, 2002, and 2005). The SENCER Teaching Model engages students (especially through Foundational Studies) and get them excited about STEM courses. ISU is also unique out of the 300 college campuses that use this model in promoting the use of SENCER concepts in the Humanities and over half of our classes are in courses in communications, economics, and education. These techniques have proven to be effective in engaging students across the nation and at ISU. We have been able to demonstrate that our students are having a positive experience in these classes with many students self-reporting an interest in taking more classes like the ones that they have experienced. We were also able to demonstrate a 2% increase in retention of students at ISU specifically from students that have experienced a SENCER course over the first two years of the program.

Haury, David L. and Rillero, Peter. 1994. Perspectives of Hands on Science Teaching. Columbus, Ohio: ERIC Clearinghouse for Science, Mathematics, and Environmental Education. 151 pp.

Kolb, D.A. 1984. Experiential Learning: Experience as the source of learning and development. Prentice Hall. Englewood Cliffs, NJ.

National Research Council. 2000. How People Learn: Brain, Mind, Experience, and School. Bransford, J.D. *et al.* (eds.) Committee on Developments in the Science of Learning and Committee on Learning Research and Education Practice. Commission on Behavioral and Social Sciences and Education. Washington D.C. National Academy Press. 374 pp.

National Research Council. 2002. Science Research in Education. Committee on Scientific Principles for Education Research. Shavelson, R.J., and Towne, L. (eds.) Center for Education. Division of Behavioral and Social Sciences and Education. Washington D.C. National Academy Press. 188 pp.

National Research Council. 2005. How Students Learn: Science in the Classroom. Committee on How People Learn, A Targeted Report for Teachers. M.S. Donovan and Bransford, J.D. (eds.) Behavioral and Social Sciences and Education. Washington D.C. National Academy Press. 615 pp.

Rosene, P.J., Alexander, M.R., and Speer, J.H. 2012. Assessment of the SENCER Teaching Model at Indiana State University After Two Years. Science Education and Civic Engagement: An International Journal 4(1): 92-99.

### **Work Plan – Action Steps – Process – How?**

In May 2012, a group of faculty applied to the NSF TUES grant opportunity for funding to create a cognitive fellowship around sustainability minor. Whether or not we receive those funds, we plan to move forward on a sustainability minor with new classes that are interdisciplinary and use the ideals of the SENCER teaching model. We also hope that these classes will be made into foundational studies classes in the next round of classes that are accepted for that program.

From August 2-6, 2012, ISU will be sending a six person team of faculty, graduate students, and undergraduate students to Santa Clara California to learn more about the SENCER program (these faculty are new to the program) and to present on their own contributions to the SENCER Teaching Model. Dr. Ethan Strigas, Dr. Tina Newsham, and Dr. Joe West will be attending the conference along with graduate student Nicholas Flinner and undergraduate Alli Creed and Adri Lehman.

On September 21<sup>st</sup>, 2012, ISU will host a regional SENCER conference that focuses on Physics, Biology, Chemistry, and Mathematics. ISU has actually been very good at including the humanities into the SENCER Teaching Model and President Bradley has asked that we focus on getting more of the sciences on board. We have been successful in this process by working with Dr. West to convert one of his Physics classes to the SENCER Teaching Model and specifically targeting Elementary Education students to take this course. Through this course, the students will learn physics and Dr. West will model an inquiry-based teaching process.

Fall 2012, two college of technology classes will design, source, and build a deck for the ISU Community Garden. This will be a student and community build project during a week in November, 2012. This project enables the students in the College of Technology to practice their skills on a real-world problem and to build

something that gives back to the community. This project includes classes taught by Dr. Ellingson and Dr. McNabb.

We have started conversations with the Dean Balch and Associate Dean Susan Powers of the College of Education about encouraging more of their students to take SENCER classes to model inquiry-based education. This work will continue with the likely result that students will be advised to take courses and sections of courses that have SENCER components. So far, this collaboration has resulted in Dr. West's physics class where he is collaborating with Dr. Bauserman (a previous SENCER mini-grant recipient) to make this class more useful to Elementary Education majors.

The long-term goal of all of these efforts is to make SENCER classes more accessible to students across campus, to study the impact of these courses, and to encourage more faculty to take on this teaching model in their own courses. We are at the phase where we are collecting hard data from the assessment of our current courses to help convince faculty of the efficacy of these courses. We have conducted more Student Assessment of Learning Gains surveys than most other programs in the United States (according to the person who wrote that tool). We have already started to gather information from Institutional Reporting on student retention numbers for students who take these classes and we will start to collect 991 numbers of students that take these courses. These efforts contribute to the benchmarks of Goal 2 to increase the participation in experiential learning through integration of experiential learning and community engagement into foundational studies and majors courses throughout the university.

## **Reporting and Deliverable Schedule – When?:**

### **Summer 2012**

Presentations at the SENCER Summer Institute in Santa Clara California (August 2-6)

Dr. West and Dr. Bauserman working on modifying the Physics Course to the SENCER Model

Working with the National SENCER organization on publication of the ISU SENCER Student Leadership Team Backgrounder

### **Fall 2012**

Hold our second Regional SENCER symposium. This time with a focus on Physics, Chemistry, Biology, and Mathematics.

Continue to teach multiple SENCER courses at ISU.

Have Drs. Ellingson and McNabb from the College of Technology teach SENCER classes around the Community Garden deck build project.

Work to make the ENVI 110 course more SENCERlike through innovative and original research projects with the students taking this course. Working with the CSRC to provide a more comprehensive field research project for these students and to work on data archiving.

Work on Sustainability Minor classes to include the SENCER Ideals and to gear them towards Foundational Studies so that we can incorporate more SENCER classes in the Foundational Studies Program

### **Spring 2013**

Continue data collection and analysis of our student outcomes through our SENCER classes

Attend the DC Symposium with students to have them report out on their research in their SENCER classes

### **Budget – How Much?:**

Our initiative requested \$173,552 from the strategic plan for the Fiscal Year 2013. In this request, we include funds for the SENCER Summer Institute for Summer 2013 (in Fiscal Year 2014) so that we can plan for the July conference during the Spring semester when abstracts and team rosters are due. The majority of the budget is for student wages for the SENCER Student Leadership Team. This project provides them leadership skills, experiential learning within their major, and an opportunity to improve education at their own institution.

### **Stakeholders and Management Plan – Who?:**

Dr. Jim Speer is the faculty member in charge of Goal 2 Initiative 2. He holds weekly meetings with the SENCER Student Leadership team, almost daily meetings with the graduate student overseeing the team, and monthly meetings with the faculty and staff members of the SENCER team. He will teach one section of ENVI 110: Introduction to Environmental Science in the Fall semester and he will teach ENVI 460: Conservation and Sustainability in the Spring as SENCER classes.

Nick Flinner is the graduate student who oversees the SENCER Student Leadership Team. He will manage the student team and to enter data into Task Stream. He will also help with the organization of the SENCER Regional Conference in the Fall and help to organize talks and promotional events for SENCER.

The SENCER Student Leadership Team will have two students continuing from last year: Adri Lehman (Human and Environmental Systems Major) and Alli Creed (English Major). We will search for four new student members on the Student Leadership Team with skills in public relations, survey development, and assessment.

Dr. Larry Tinnerman, Dr. Kathy Bauserman, and Dr. Susan Berta have converted courses to SENCER courses and continue to teach these classes at ISU. Dr. Feng-Qi Lai conducts research in inquiry-based education and has recently joined the team. Dr. Carolyn Wallace was recently hired to be the new director of the Center for Science Education and is an expert in qualitative assessment. Drs. Tina Newsham and Ethan Strigas are new faculty members on the SENCER team and are converting their classes to the model. Dr. Joe West is just

currently transforming one of his physics courses to the SENCER Teaching Model with the help of Dr. Bauserman.

Jennifer Sicking (ISU Public Relations and Communications), Liz Metzger (Office of Sponsored Programs), and Heather Miklozek (Center for Community Engagement) remain engaged with the SENCER program and bring their skills and expertise from their offices to advance SENCER at ISU.

### **Outcome Assessment & Future Testing – How Well?:**

We are studying the effect of SENCER classes through an innovative assessment tool called the Student Assessment of Learning Gains (SALG). Each SENCER class completes this extra assessment survey of the students' gains and understanding of larger issues such as critical thinking and importance of civic issues. This work is building to the point where we will better understand how our students learn and what engages them in their education, which will result in student retention and success (see benchmarks under **Goal 1** as well). We also are looking at long-term data from the Student Instruction Report (SIR) scores from the past 10 years to examine classes before and after the SENCER model was implemented at ISU. We will know that we are succeeding if we see an increase in SIR scores in SENCER classes and if we see positive responses regarding critical thinking, knowledge of how science is done, interest in science, and interest in the science of civic issues from the SALG assessment. We are now starting the process of collecting student 991 numbers in SENCER classes as well.

## **Budget Narrative for Goal 2 Initiative 2**

**Faculty salary.** Dr. Jim Speer has been overseeing the SENCER program at ISU for more than three years and has received national recognition for his work on this project. We are requesting \$7,333 in summer salary for the time that Dr. Speer puts into overseeing this part of the strategic plan. He also continues to teach multiple SENCER courses each semester, which have been the basis for assessment of the SENCER program at ISU. Furthermore, funds are requested to be awarded to four faculty members as subawards at \$3,000 each (total of \$12,000) to develop new SENCER courses.

**Student Stipends, Wages, and Tuition Waiver.** Indiana State University was nationally recognized for its SENCER Student Leadership Team which is composed of a graduate student and six undergraduate students. Our current graduate student (Nick Flinner, BA in Geography; Current MS Earth and Quaternary Sciences) is new to the SENCER Leadership Team and will be attending the SENCER Summer Institute in Santa Clara to learn more about the model. We are requesting \$15,000 for his salary and \$15,099 for his tuition waiver for fiscal year 2013.

In the last two years, we have been able to build a SENCER Student Leadership team with skills from different majors that they could bring to the program. Besides the science students, we have hired students with majors in public relations, political science, psychology, and construction management. This is another example of experiential learning where students are working on important projects and getting real world experience using the skills that they learn in their majors. The majority of the requested funds are to go to student wages to help this program run and to provide that resume building experience to these students. All of the past students on the team graduated in May, except for two students that will be continuing in the Fall. This gives us the opportunity to hire new students into these positions to bring a new perspective to the SENCER Teaching Model at ISU. We are requesting funds to pay the students \$9/hour for 20 hours a week during the school year and 40 hours a week during the summer.

**Supplies and Expenses.** Many SENCER classes use specific scientific equipment and sampling gear. \$20,000 are requested to be able to purchase this equipment to enhance our SENCER classes and to give students hands-on experiences with scientific tools. We plan to use these funds to purchase supplies needed for those classes to make them more interactive and hands on. Specifically, we are working to bring in new College of Technology courses dealing with the built environment into the SENCER program. Some of these funds will be used for materials and supplies so that students in these technology classes can design and build a deck for the Community Garden. This project will provide invaluable skills to the students, build their resumes, and contribute to the Community Garden and the Gardeners use of this ISU facility.

**Faculty Development Workshops, Guest Speakers, and Promotional Material.** We continue to hold faculty development workshops and to bring in guest speakers to enhance the SENCER programs at ISU. These funds are both to teach our faculty members about the SENCER program and to bring guest speakers into their classes to enhance the educational experience for students. We will also be holding a regional SENCER conference on September 21<sup>st</sup> to bring in nationally recognized SENCER leaders in the areas of physics, chemistry, biology, and mathematics. We have requested \$15,000 to cover the cost of these workshops and the regional conference.



## **Travel Expenses**

The SENCER Summer Institute (SSI) is the main event that is sponsored each year by the National SENCER organization to share knowledge about the SENCER program and for institutions to report out on their efforts in their own institutions. We have been participating for four years (Chicago 2009, Asheville 2010, Indianapolis 2011, and we will be sending a team to Santa Clara California in August 2012 on last fiscal year's funds). We are requesting \$10,000 to pay for a 6-member team to attend the SSI 2013. ISU has been prominent in these conferences since we started to attend and we have received national recognition for the work that we have completed using the SENCER Teaching Model. This venue is the highlight of the year and gives us an opportunity to report out on our good work. This is also a venue where our students can present their work at a national conference.

We have also had the opportunity to support our students presenting at national conferences in Washington DC last April. We request \$8,000, which will specifically be used for our SENCER students and students taking SENCER classes to present at national conferences around the United States.