2.6 EARTH SYSTEM SCIENCE EDUCATION FOR TEACHERS IN WESTERN WASHINGTON

Michael R. Witiw*
Eleanor Close
Seattle Pacific University

1. INTRODUCTION

Earth system science takes an integrated approach to the study of the Earth system. It studies interactions between Earth's atmosphere, hydrosphere, biosphere and lithosphere. The effects of events originating outside the Earth system are also considered. These may include the effects of asteroids and fluctuations in solar intensity. The effects of human activity on the Earth system are also included, such as deforestation and ozone depletion. Through sponsorship from NASA and the National Science Foundation (NSF), Earth system science course material has been developed for all educational levels, including materials with an emphasis on teacher preparation and continuing education.

2. BACKGROUND

Earth system science education has a history of support from both NASA and NSF. In the early 1990s, through sponsorship by the Universities Space Research Association (USRA), NASA funded the Earth System Science Education (ESSE) program. Over 75 colleges and universities have participated through the ESSE I, ESSE II, and ESSE 21 programs, which developed ESSE content for Earth system science courses for the undergraduate level (*Earth system science education for the 21st century*, 2007). Through the NASA-sponsored *Classroom of the Future,* modules were designed for students at the K-12 level (*Classroom of the future*, 2007; *Exploring the Environment*, 2007). Professional development for teachers was also provided.

More recently, NASA funded the Earth System Science Education Alliance (ESSEA), which was administered by the Institute for Global Environmental Strategies (IGES) from 2000 to 2005. Since 2005 support has been provided by NSF under continued IGES administration. Currently, a group of about 40 universities participate in providing Earth system science education and professional development courses for K-12 teachers through ESSEA. Courses are modular and "event-based:" a course consists of several modules; in each module, an event which occurs in one of Earth's spheres is examined and how this event may influence events in the remainder of Earth's spheres is explored.

Each summer, training and updates are provided by IGES through a three-day conference for ESSEA course facilitators. Up to two faculty from each participating institution are funded to attend these conferences.

3. ESSEA COURSES

As part of ESSEA, a number of modules are available for courses for high school and middle school teachers. Each module is centered about a particular event or issue that is important to the Earth system. Current modules aimed toward high school and middle school teachers include Brazilian deforestation, coral reefs, Galveston Hurricane of 1900, global climate change, Hurricane Katrina, ice sheets, Mt. Pinatubo, and stratospheric ozone (ESSEA, 2007). New modules under development address the decline in amphibian populations, coal systems analysis, U.S. agriculture, plate tectonics, tsunamis, El Nino, and fog.

In a typical university schedule, each ESSEA module is designed to last three weeks and includes both group work and individual assignments. Each module is divided into three "cycles," with each cycle designed to last for one week; the cycle format, however, allows for compressing the course during summer sessions when teachers may have more time to devote to the course. In the first cycle ("Teacher as Problem Solver"), participants explore their own ideas concerning the event and exchange their ideas with other members of their group. In the second cycle ("Teacher as Scholar"), participants research the issue and become more familiar with the event and the sphere-to-sphere interactions that occur. In the last cycle ("Teacher as Designer"), each participant develops a lesson plan for his or her own classroom.

4. ESSEA AT SEATTLE PACIFIC UNIVERSITY

Seattle Pacific University (SPU) has recently received an ESSEA implementation grant. We will offer four ESSEA courses over the next two years. For the courses offered at SPU, a hybrid format will be used: three to five meetings will take place on the campus of SPU, with the remainder of the course activity conducted online. Teachers who complete an ESSEA course will be awarded either graduate quarter-credits or equivalent Continuing Education Units.

* *Corresponding author address:* Michael R. Witiw, Seattle Pacific University, Department of Physics, 3307 Third Avenue West, Suite 307, Seattle, WA 98119-1957; email: witiwm@spu.edu

The five quarter-credit course will consist of five modules. The first module is an introductory module in which the participants are introduced to Earth system science and the methods of inquiry used in ESSEA courses, become familiar with the ESSEA web site, explore an example module, and complete some pre-assessments (the Group Assessment of Logical Thinking and the Cross-Cutting Concepts in Earth System Science pre-test). Participants will then complete four content modules, each lasting three weeks. Each participant will complete a final individual assignment where they will build an Earth system science model based on the example volcano scenario provided in the first weeks of the course.

During summer of 2008, SPU will offer an intensive three quarter-credit ESSEA course over a two week period. An additional three quarter-credit course is scheduled for summer of 2009. By autumn of 2009, an undergraduate course is planned for pre-service teachers attending SPU.

5. RECRUITING

Through a partnership with the Seattle Public Schools, we advertised through fliers and presentations to individual high school science departments. Fliers were also sent to other school districts in the area. Individual science teachers at various private schools were contacted by e-mail. At this time, our enrollment is 10 students for the course beginning on January 28.

6. SUMMARY

The Earth System Science Education Alliance (ESSEA) provides event-based modules for Earth system science courses for K-12 teachers. Each module is centered on an event, such as the eruption of Mt. Pinatubo or ongoing deforestation in Brazil; course participants study the impact of the event in each of the Earth's spheres (atmosphere, hydrosphere, biosphere, and lithosphere). At Seattle Pacific University, we have three ESSEA courses scheduled between January 2008 and August 2009. By the Fall Quarter, 2009, we plan to have an Earth system science course available for pre-service teachers pursuing their degrees at SPU.

7. REFERENCES

Classroom of the Future, 2007. [Available online at: http://www.cotf.edu.]

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