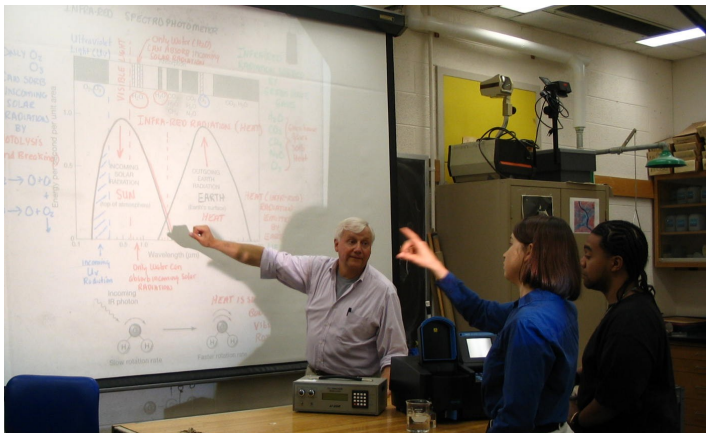

Prof. Curtis Olsen discusses global warming data with two students in the Teaching Weather and Water course.

NECOSEE Case Study: Ocean Educational Linkages with the Boston Science Partnership

Professor Curtis Olsen of the University of Massachusetts Boston Department of Environmental, Earth and Ocean Sciences (EEOS), has participated in a variety of planning, education, and outreach activities as a Steering Committee Member of the New England Center for Ocean Science Education Excellence (NECOSEE) and as an active participant in the NECOSEE Ocean Science Education Institute (OSEI). As part of the OSEI –II Carbon Cycle Project, Professor Olsen and Dr. Dan Repeta (a research scientist at Woods Hole Oceanographic Institution) worked with teachers and science coordinators in the Fairhaven School District to help design a carbon cycle curriculum that spans and links the 6th to 8th grades. As conceived by the Fairhaven teachers, Larry and Louise Carbon would be followed by Fairhaven students from their birth in the 6th Grade Earth/Space curriculum, beginning with their formation during a Star Supernova in space and moving through the Earth's long-term geologic rock cycle; then following them into the short-term carbon cycle of photosynthesis and respiration in the 7th Grade Life Sciences curriculum; and finally, exploring their consumption and ultimate rebirth in the 8th Grade Physics and Energy curriculum, as they are buried and transformed in swamp and ocean sediments into fossil fuels, and ultimately re-released back into the atmosphere by combustion for energy production. More information on this project can be found at the NECOSEE website. (http://necosee.net/edu_project_1/CarbonCycleProject.php).

More recently, Professor Olsen has been participating in, and linking his NECOSEE experiences with, the Boston Science Partnership (BSP) which is also funded by the National Science Foundation under a five year Math Science Partnership grant (EHR 0412390). The BSP, a partnership between UMass Boston, Northeastern University, and the Boston Public Schools consists of a series of evidence-based, innovative, integrated programs designed to improve Boston students' achievement in science courses in grades 6 through college level. Within the

BSP, Dr. Olsen worked with a UMass Boston graduate student and two science teacher leaders from the Boston Public Schools to design an intensive, rigorous Earth science summer course, entitled Teaching Weather and Water, for Boston-area middle and high school teachers. This course is an integral part of the BSP's comprehensive, multifaceted science reform initiative. The course design process required five day-long curriculum design meetings before the course began. During these meetings, Dr. Olsen and his team reviewed and discussed current science education research, including the 7E Learning Cycle model[1] and the importance of inquiry in learning[2,3]. In addition, the team reviewed Boston Public Schools curriculum materials relevant to the science content of the course, FOSS *Weather and Water* at the middle school level and *Living by Chemistry* at the high school level, and state[4] and national standards[5] for science learning in grades 6-12. Dr. Olsen's group then used the information gathered from the science education research sources, curriculum materials, and learning standards and the course theme, Teaching Weather and Water, to determine the specific science content of the course, which included concepts such as matter, gravity, density, pressure, humidity, chemical reactions, photosynthesis, and respiration; and how those concepts relate to environmental phenomena like everyday weather, ozone holes, global warming, hurricanes, tsunamis, El Nino, ocean currents and climate.

The course was designed based on evidence about effective professional development for teachers of science, and the course was anchored to the science curriculum in Boston to provide the best context to meet the needs of the teachers. This design represents a seamless integration of science and pedagogy. Dr. Olsen's curriculum design group created a course syllabus, daily instruction plans, and assessments founded in science education best practices, as described in the literature they had read. All direct instruction and hands-on activities were tightly correlated to specific lessons and units in the Boston Public Schools curricula as well as specific elements of the state and national standards. These lessons, activities, and assessments gave teachers both deep content knowledge and the pedagogical skills to apply that knowledge to the specific materials available in their classroom and the content needs of their own students.

This course was approved as a regular graduate-level course in the Environmental, Earth and Ocean Sciences department. The teachers who took the course met for eight full eight-hour days over a two week period; 15 teachers began the course and all completed it successfully. Dr. Olsen served as the primary instructional source on science content, while his co-teachers focused on the relevant Boston Public Schools curriculum materials and instructional strategies. A significant portion of each class session was devoted to lab work. Activities included water quality analysis, examination of global carbon dioxide level data, and determination of the humidity level of air, among others. Students kept a detailed lab notebook and created a portfolio of their work throughout the course. Nightly homework and reading was assigned and frequent

informal quizzes checked for student understanding. The course grade was based on students' notebooks, their portfolios, daily attendance, and a rigorous final exam on science content. Students earned UMass Boston graduate credit that fulfills a science content requirement in teacher education graduate programs.

Dr. Olsen, his co-instructors, and the teacher participants in the course all considered it a success. Participants' comments indicated that the course format, the use of curriculum materials from their curricula and the co-teaching model emphasizing both content and pedagogy helped them to see exactly how they could apply the knowledge they acquired in their classroom. Several reported that they felt much more confident about teaching the subject matter now that their own knowledge had expanded. Dr. Olsen greatly enjoyed this opportunity to interact with teachers, learn about their needs, and help them to improve their understanding of science. He himself learned new things during the course design and preparation phase, when he read about and applied the 7E Learning Cycle model of instruction to his lessons for the course. He plans to participate in multiple Boston Science Partnership activities during the 2005-2006 academic year and to teach the Teaching Weather and Water course for teachers again in summer 2006.

[1] Eisenkraft, Arthur. *The Science Teacher*. **2003** *70* 56.

[2] Bybee, Rodger. Teaching science as inquiry. *Inquiring into Inquiry Learning and Teaching in Science*, Minstrell, J. and van Zee, E. H. (Eds.) Washington, DC: AAAS, 2000.

[3] Donovan, M. Suzanne and Bransford, John D., Eds. *How Students Learn Science in the Classroom*, National Research Council Committee on How People Learn, Washington, DC: National Academies Press, 2005

[4] Massachusetts Department of Education, *Massachusetts Science and Engineering/Technology Curriculum Framework*, Malden, MA: Massachusetts Department of Education, 2001

[5] National Academy of Science, *National Science Education Standards*, Washington, DC: National Academies Press, 1996