Project Annual Report

November 30 2009

GK-12: Ocean And Coastal Interdisciplinary Science (OACIS) Program
Proposal Number: DGE-0742559

Location: University of Washington, Seattle and Friday Harbor, Washington

PI: Kenneth P. Sebens, Director UW Friday Harbor Laboratories, Professor of Biology
Co-PIs: Daniel Grunbaum, Associate Professor, UW School of Oceanography
David Armstrong, Director, UW School of Aquatic and Fishery Sciences, Professor SAFS
Evaluator: Loretta Kelley

Part I. Principal Investigator’s Report

A. Participants

Faculty and graduate students from four UW departments and schools, and the staff of many UW programs and facilities, are taking part in the OACIS Program, which has completed one full academic year and is now in its second. On the Seattle campus, the Biology Department (College of Arts and Sciences) includes over 20 faculty conducting research in the marine environment, the College of Ocean and Fishery Sciences (COFS) has over 200 faculty in the School of Aquatic and Fisheries Sciences (SAFS), the School of Marine Affairs (SMA), the School of Oceanography (SO) and the Applied Physics Laboratory (APL). So far, over 20 faculty mentors have agreed to participate, with their graduate students, in this GK-12 program. The University’s Friday Harbor Laboratories (FHL) is the site of marine research for over 200 researchers per year, including UW graduate students who can develop and offer GK-12 activities as fellows in the San Juan Islands. FHL offers easy access to marine habitats and organisms and is an excellent venue for teacher training and student workshops, and for field trips from any of the participating schools; FHL will be a major contributor to this program.

High school science classes, the locus of the OACIS Program, offer exceptional opportunities to integrate ocean and coastal science into the curriculum and also to encourage students to consider science careers and college science programs. The four school districts selected for this collaboration are in Seattle (King County) and in the San Juan Islands (San Juan County). These districts span true inner city to rural conditions, with a substantial diversity of student ethnic, economic and cultural backgrounds (Table 3). The Spring Street School on San Juan Island will also collaborate next year (www.springstreet.org/); this is the only other high school in San Juan County, and has a very active marine science curriculum. Each year 8-9 fellows will work in 4-5 high schools at one time, partnering 8-12 teachers; each fellow will have classroom time with 60-100 students per week. We expect approximately one third of the
fellows to be working in three San Juan County schools, and two thirds to be working in 2-4 Seattle area high schools each year. Graduate students working in San Juan County are usually those who have ongoing research projects there, and thus benefit from being in residence the full academic year. In both 2008-9 and 2009-10, there were two graduate students who chose to work in SJC, and we expect 3 per year in future years.

Table 1. OACIS GK-12 Senior Personnel

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Length of Time with Project</th>
<th>Institutional Affiliation</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ken Sebens</td>
<td>Senior PI</td>
<td>21 months</td>
<td>Friday Harbor Laboratories, UW</td>
<td>Oversee grant and Steering Committee activities</td>
</tr>
<tr>
<td>Daniel Grunbaum</td>
<td>PI</td>
<td>21 months</td>
<td>Oceanography, UW</td>
<td>Work with Faculty Coordinators and Program Manager on grant activities</td>
</tr>
<tr>
<td>David Armstrong</td>
<td>PI</td>
<td>21 months</td>
<td>Aquatic and Fishery Sciences, UW</td>
<td>Provide staff support in preparing promotional materials</td>
</tr>
<tr>
<td>Megan Dethier</td>
<td>Faculty Coordinator</td>
<td>21 months</td>
<td>Friday Harbor Laboratories, UW</td>
<td>Oversee San Juan County fellows/teachers, plan and participate in OACIS workshops and other activities</td>
</tr>
<tr>
<td>Loveday Conquest</td>
<td>Faculty Coordinator</td>
<td>21 months</td>
<td>Aquatic and Fishery Sciences, UW</td>
<td>Oversee Seattle School District fellows/teachers, plan and participate in OACIS workshops and other activities</td>
</tr>
<tr>
<td>Tansy Clay</td>
<td>Program Manager</td>
<td>21 months</td>
<td>Oceanography, UW</td>
<td>Work with fellows, teachers, other senior personnel, plan workshops, logistics for meetings, manage teaching supplies,</td>
</tr>
<tr>
<td>Name</td>
<td>Year in Graduate Program</td>
<td>Major</td>
<td>Research Topic</td>
<td>Statement of graduate location and nature of graduate work</td>
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<tr>
<td>Amanda Bruner</td>
<td>3rd year; 2nd year fellow</td>
<td>Fisheries</td>
<td>Use of the threespine stickleback fish to elucidate effects of the endocrine disrupting toxicant, tributyltin, when exposure occurs during embryonic development</td>
<td>School of Aquatic and Fisheries Science, collecting and analyzing data, thesis work.</td>
</tr>
<tr>
<td>Dan Evans</td>
<td>5th yr; 1st year fellow</td>
<td>Biology</td>
<td>Habitat fragmentation, habitat corridors and plant fitness</td>
<td>College of Arts and Sciences, collecting and analyzing data, PhD candidate</td>
</tr>
<tr>
<td>Andrew Kosydar</td>
<td>5th yr; 1st year fellow</td>
<td>Biology</td>
<td>Effects of hunting and habitat fragmentation on small mammals in Bolivia</td>
<td>College of Arts and Sciences, PhD candidate</td>
</tr>
<tr>
<td>Jessica Lundin</td>
<td>5th year; 1st year fellow</td>
<td>Earth &amp; Space Sciences</td>
<td>Ice-flow dynamics and effects on ice-core paleoclimate records</td>
<td>College of the Environment, data collection and analysis, 3/10 general exam</td>
</tr>
<tr>
<td>Max Maliska</td>
<td>3rd year; 1st year fellow</td>
<td>Biology</td>
<td>Evolution and larval dispersal in intertidal snails</td>
<td>College of Arts and Sciences, data</td>
</tr>
<tr>
<td>Name</td>
<td>Year; Fellow Year</td>
<td>Department</td>
<td>Research Focus</td>
<td>College/Academic Unit</td>
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<tr>
<td>Siri Nelson</td>
<td>6th year; 1st year fellow</td>
<td>Biology</td>
<td>Evolutionary biology of the major histocompatibility complex in African elephants</td>
<td>College of Arts and Sciences, data analysis and writeup; PhD candidate</td>
</tr>
<tr>
<td>Elizabeth Tobin</td>
<td>3rd year; 2nd year fellow</td>
<td>Biological Oceanography</td>
<td>Investigating how changes in cell motility during life cycle transitions affect bloom dynamics in harmful algal species using modeling and molecular approaches.</td>
<td>School of Oceanography, data collection and analysis, defended M.S. 12/09</td>
</tr>
<tr>
<td>Kevin Turner</td>
<td>4th year; 2nd year fellow</td>
<td>Biology (Marine Ecology)</td>
<td>Food web interactions in the subtidal zone of the San Juan Islands, and how those interactions change in areas open and closed to fishing</td>
<td>College of Arts and Sciences, gathering and analyzing data and preparing for general exam</td>
</tr>
<tr>
<td>Robin Elahi</td>
<td>2008-09 fellow</td>
<td>Biology</td>
<td>The effects of local and regional processes on marine epifaunal communities</td>
<td>College of Arts and Sciences, PhD candidate</td>
</tr>
<tr>
<td>Alex Hart</td>
<td>2008-09 fellow</td>
<td>Biology</td>
<td>Algae-herbivore interactions in the rocky intertidal</td>
<td>College of Arts and Sciences, PhD candidate</td>
</tr>
<tr>
<td>Colleen Kellogg</td>
<td>2008-09 fellow</td>
<td>Biological Oceanography</td>
<td>The community structure and degradative capacity of particle-</td>
<td>School of Oceanography, PhD candidate</td>
</tr>
<tr>
<td>Name</td>
<td>Year</td>
<td>Major</td>
<td>Research Area</td>
<td>Department</td>
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<tr>
<td>Jonathan Kellogg</td>
<td>2008-09 fellow</td>
<td>Oceanography (Marine Geology and Geophysics)</td>
<td>Quantifying the heat and salt fluxes from hydrothermal vent systems on the Endeavour Segment of the Juan de Fuca ridge</td>
<td>School of Oceanography, PhD candidate</td>
</tr>
<tr>
<td>Christina Maranto</td>
<td>2008-09 fellow</td>
<td>Biology</td>
<td>Impact of seabirds on juvenile salmon in the mid-Columbia River</td>
<td>College of Arts and Sciences, defended PhD 12/09</td>
</tr>
<tr>
<td>Name</td>
<td>Characteristics</td>
<td>Description of Activities</td>
<td>Number of fellows and teachers</td>
<td>Name of fellow and teacher teams for 2009-10</td>
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<tr>
<td>Seattle Public School District</td>
<td>Urban, 21.6% African-American, 22.2% Asian-American, 11.7% Hispanic, 2.1% Native American, 42.5% White, 39% low-income, 14% special-education, 23.3% ESL. Percentage of 10th grade students that met WASL standards in 2007-2008: Reading – 80.1% Math – 50.3% Writing – 85.2% Science – 37.4%</td>
<td>Participating teachers participate in two 1-week summer workshops, and in quarterly meetings with program personnel and graduate fellows. Teachers also meet weekly with their fellow-partner for planning, and host the fellow for 10 hours per week in their classroom.</td>
<td>6 fellows, 6 teachers</td>
<td>Amanda Bruner (fellow) and Kevin Barth (teacher)</td>
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<td></td>
<td>Dan Evans (fellow) and Wendy Lane (teacher)</td>
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<td>Siri Nelson (fellow) and Maggie Rose (teacher)</td>
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<td>Elizabeth Tobin (fellow) and W.P. Spangenberg (teacher)</td>
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<td>Jessica Lundin (fellow) and Susan Brierly (teacher)</td>
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<td>Andrew Kosydar (fellow) and Heather Snookal (teacher)</td>
</tr>
<tr>
<td>Orcas Island School District</td>
<td>Rural, 0.8% African-American, 1.9% Asian-American,</td>
<td>Participating teachers participate in two 1-week summer</td>
<td>0 fellows, 0 teachers</td>
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<tr>
<td>San Juan Island School District</td>
<td>Rural, 1.1% African-American, 2.4% Asian-American, 8.8% Hispanic, 1.2% Native American, 85.4% White, 24.9% low-income, 11.2% special-education, 4.1% ESL. Percentage of 10th grade students that met WASL standards in 2007-2008: Reading - 81.7% Math - 60.9% Writing - 90.9% Science - 47.6%</td>
<td>Participating teachers participate in two 1-week summer workshops, and in quarterly meetings with program personnel and graduate fellows. Teachers also meet weekly with their fellow-partner for planning, and host the fellow for 10 hours per week in their classroom.</td>
<td>2 teachers, 2 fellows</td>
<td>Max Maliska (fellow) and Nick Frazee (teacher)</td>
</tr>
<tr>
<td>Lopez Island School District</td>
<td>Rural, 5.5% African-American, 7.9% Asian-American,</td>
<td>Participating teachers participate in two 1-week summer</td>
<td>1 fellow, 1 teacher</td>
<td>Kevin Turner (fellow) and Marc Vermeire</td>
</tr>
</tbody>
</table>
15.3% Hispanic, 2.6% Native American, 64.8% White, 40.4% low-income, 12.7% special-education, 8.0% ESL. Percentage of 10th grade students that met WASL standards in 2008-2009: Reading - 81.2%, Math - 45.4%, Writing - 86.7%, Science - 38.8% workshops, and in quarterly meetings with program personnel and graduate fellows. Teachers also meet weekly with their fellow-partner for planning, and host the fellow for 10 hours per week in their classroom.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description of Activities</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Seattle Aquarium, John Braden, Director</td>
<td>Host field trips for high school classes</td>
<td>Personnel time and access to aquarium</td>
</tr>
<tr>
<td>The San Juan Nature Institute, Fiona Norris, Director</td>
<td>Host field trips for high school classes</td>
<td>Personnel time and access to research sites</td>
</tr>
<tr>
<td>The Whale Museum, San Juan Island, Jenny Atkinson, Director</td>
<td>Host field trips for teachers, fellows, high school classes</td>
<td>Personnel time and access to museum</td>
</tr>
<tr>
<td>Centers for Ocean Sciences Education Excellence-Ocean Learning Communities, Philip Bell, Director</td>
<td>Speakers, course materials for science learning course for fellows</td>
<td>Personnel time and course materials for science learning</td>
</tr>
<tr>
<td>Ocean Inquiry Project, Fritz Stahr, President</td>
<td>Host field trips in Puget Sound for teachers, fellows, high school classes</td>
<td>Ship time, personnel time, materials for activities</td>
</tr>
<tr>
<td>SoundCitizen, Richard Keil, Director</td>
<td>Speakers, water sampling kits and analysis, high school level curricular materials</td>
<td>Personnel time, curricular materials, sampling kits, sample analysis.</td>
</tr>
</tbody>
</table>
Table 5.  External Advisory Committee

This committee was formed to review progress of the program and to provide suggestions for modifications annually. The committee met in February 2009, and will meet again in winter 2010. This committee comprises:

M. Patricia Morse (Chair), former Program Officer at NSF in the Elementary, Secondary and Informal Science Division, Directorate for Education and Human Resources,
Loyce Adams (UW, PI, GK-12 Program in Mathematics),
Robert Chen (University of Massachusetts, WISP (NSF GK-12) PI and Program Director, NE COSEE Co-PI),
Craig M. MacGowan (Seattle Schools, Science instructor and co-developer of the Environmental Academy at West Seattle High School),
Philip Bell (UW College of Education, COSEE-OLC Director) and
Véronique Robigou (UW School of Oceanography, COSEE-OLC Director Emerita)

Philip Bell directs the Everyday Science and Technology Group at UW, a research team in the Learning in Informal and Formal Environments (LIFE) Center, funded via NSF’s "Science of Learning" initiative (http://depts.washington.edu/cogstudy/everydaycognition/). He also brings expertise from his involvement in a previous GK-12 (PRIME) program at UW (Engineering, D. Denton PI). Véronique Robigou brings COSEE national ocean sciences education experience and expertise from teaching the COSEE “Communicating Ocean Sciences” course. Chen has been PI and Director of the GK-12 WISP Program (middle schools) through two rounds of funding, and provides valuable guidance to our efforts. Loyce Adams has directed the UW GK-12 Program in Mathematics through two funding cycles (ending 2009), and brings current expertise, contacts and experience to the OACIS program.

Participating Graduate Faculty: Mentors, Coordinators (in addition to PI, Co-PIs):

Kenneth P. Sebens (Prof. Biology, PI),
Daniel Grunbaum (Assoc. Prof., SO, Co-PI),
Terrie Klinger (Assoc. Prof., SMA),
Emily Carrington (Assoc. Prof., Biology),
Horacio de la Iglesia (Asst. Prof., Biology),
Loveday Conquest (Prof., SAFS),
P. Dee Boersma (Prof., Biology),
Josh Tewksbury (Assoc. Prof., Biology),
Deborah S. Kelley (Assoc. Prof., SO),
Robert Waaland (Prof., Biology),
David Armstrong (Prof. SAFS, Co-PI),
Billie Swalla (Assoc. Prof., Biology),
Jennifer Ruesink (Assoc. Prof., Biology),
Tim Essington (Asst. Prof. SAFS),
Russell McDuff (Prof., SO),
Carolyn Friedman (Assoc. Prof., SAFS),
Patrick Christie (Asst. Prof., SMA),
Lorenz Hauser (Asst. Prof., SAFS),
Thomas Daniel (Prof., Biology),
Megan Dethier (Res. Prof., Biology)

SMA – U.W. School of Marine Affairs
SAFS – U. W. School of Aquatic and Fisheries Science, SO – U. W. School of Oceanography

University of Washington’s OACIS GK-12 Program
Evaluation Report
November 2008
B1. Goals and Activities

Goals for the OACIS GK-12 include training of future researchers in communicating marine and environmental science concepts to high school students and to general audiences; to bring current scientific research into the high school classroom; to get high school students thinking about science-related careers and science majors in college; to provide role models of science researchers for the students; to assist high school teachers in their professional development; to develop curricular materials that will stay with the teachers and the high schools on a permanent basis.

1) To provide graduate students with an opportunity to acquire additional skills that will broadly prepare them for diverse professional and scientific careers in the 21st century. We are supporting highly qualified graduate students, in NSF-supported STEM disciplines, through fellowships in this GK-12 program. The Biology Department at UW is well known for its research in marine ecology, physiology, evolutionary biology, developmental biology as well as cellular and molecular biology of marine organisms and has a highly competitive graduate program. COFS has some of the nation’s top graduate programs in the ocean sciences, covering oceanography, fisheries, applied physics and marine affairs. Students in these programs have already been through an intense selection process, and we make certain that the students chosen for OACIS are well qualified and highly motivated to participate.

2) To improve STEM instruction in K-12 schools. Interdisciplinary aspects of marine science can be applied to instruction in biology, chemistry, physics and environmental science. Some schools already have classes in marine biology, environmental science or marine science to which graduate students can contribute effectively. Other schools do not yet include marine science in their curriculum, and thus OACIS offers new ocean and coastal inquiry-based learning activities that can be integrated into existing science courses. Graduate students in the marine sciences have broad scientific backgrounds and apply basic sciences and mathematics throughout their research careers. They are also very familiar with scientific instrumentation and computer analysis of data and can assist teachers in those sometimes difficult areas.

3) To provide institutions of higher education with an opportunity to make a permanent change in their graduate programs by incorporating GK-12 like activities in the training of their STEM graduate students. Involvement of graduate students and faculty with K-12 education is an important and integral part of our programs and is expanding. FHL currently has two half time staff educators working closely with science teachers in elementary and middle schools and three faculty volunteering their time to assist this effort. A new course has been developed in COFS, to specifically address K-12 teaching skills for graduate students (COSEE-OLC, 2007). An adapted version of this course is now a primary training vehicle for graduate students in the OACIS GK-12 Program.

Expected project outcomes and benefits include:

1) Improved team building, communication and teaching skills for fellows. Fellows participate,
with teachers, in workshops held annually. They are also required to enroll in the course designed specifically to improve teaching skills at the K-12 level, and to take part in regular biweekly seminar meetings of the K-12 coordinators and fellows. These meetings focus on challenges and successes that come to light as the program progresses. They include presentations by invited faculty and teachers, discussion of publications dealing with ocean and coastal issues relevant to the curricula, and relevant pedagogical methods.

2) **Content gain and professional development opportunities for K-12 teachers.** Teachers take part in workshops each year during which lectures, discussions, research cruises, and both field and laboratory experiences (Seattle, Friday Harbor) focus on developing content for the ocean and coastal curriculum. Teachers are able to use these personal research experiences in their own classrooms. Graduate students taking part in these workshops assist teachers in creating presentations (Powerpoint, DVD etc.) to use in class, featuring the teachers’ own field and laboratory activities. Teachers receive credit and hours for these activities and are also given opportunities to take university classes and to pursue advanced degrees through existing UW programs such as the M.S. in Biology Teaching (MSBT). The MSBT is directed by Dr. Helen Buttemer, who also serves on the OACIS Steering Committee. Dr. Loveday Conquest, Seattle Faculty Coordinator for OACIS, has recently joined the MSBT Steering Committee.

3) **Enriched learning by K-12 students and increased interest in STEM by K-12 students.** GK-12 fellows bring science content to the schools in the form of student-centered visual and hands-on experiences with technology, live organisms, and examples of current research findings. Fellows also take part in expanded inquiry-based learning, including field activities at local coastal sites, at the Seattle Aquarium, the Whale Museum (Friday Harbor) and Friday Harbor Laboratories. Exciting demonstration materials developed at the university are adapted for use in high school classes or labs. Furthermore, both graduate students and participating advanced undergraduates can act as role models for high school students considering STEM careers and investigating college science programs. Contacts made through OACIS will enable high school students to find research opportunities at UW and FHL.

4) **Incorporation of GK-12 like activities as an integral part of the institution's graduate programs in STEM.** UW has already had GK-12 programs in Mathematics and Engineering. The Applied Mathematics Department had a successful GK-12 program, and put forth a substantial effort to make the program sustainable through internal and external funding sources (Loyce Adams, PI). The Biology Department has one full time faculty member overseeing teacher education (Helen Buttemer), and COFS has one full time staff person with assigned projects in K-12 outreach, along with several faculty volunteers from all departments.

5) **Strengthened partnerships between higher education institutions and local school districts.** A number of successful partnerships are already in operation. Examples include projects between the San Juan Island School District and FHL, and between several Seattle schools, the Biology Department, and COFS. None of these partnerships, however, previously had graduate students working cooperatively with teachers in ongoing classroom projects. The OACIS Program has established this valuable additional conduit for the exchange of information, ideas and analysis.

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6) Reporting of project activities and outcomes to promote best practices in STEM graduate education. Project activities and outcomes are evaluated professionally through both formative and summative procedures, providing reports that assist our ongoing efforts. We have established a web site to inform other GK-12 programs, teachers, and administrators of our activities. We are also presenting our findings at national meetings of GK-12 programs, and marine science organizations (Table 5).

Table 5. OACIS Conference Presentations

<table>
<thead>
<tr>
<th>Authors of Presentation</th>
<th>Title of Presentation</th>
<th>Name of Conference</th>
<th>Date</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amanda Bruner, Kevin Barth [teacher], Tansy Clay</td>
<td>Integrating Marine and Environmental Research into a Classroom Curriculum</td>
<td>National GK-12 Conference</td>
<td>3/27/09-3/29/09</td>
<td>Washington DC</td>
</tr>
<tr>
<td>Jonathan Kellogg, Wendy Lane [teacher], Colleen Kellogg</td>
<td>Using Real-Time Data to Teach the Complex Story of the Hood Canal, WA Fish Kills</td>
<td>National Marine Educators Association</td>
<td>6/29/09 – 7/3/09</td>
<td>Monterey CA</td>
</tr>
</tbody>
</table>

B1a. Training, workshops, seminars and/or professional development for fellows and teachers.

Two summer workshops were held for the 2008-09 and 2009-10 cohorts of teachers and graduate fellows. In June, “old” and “new” teachers and fellows (plus Steering Committee
members) met together in Seattle for a 3-day workshop, followed by a 1-day research cruise on Puget Sound. During the workshop, fellows and their teachers presented favorite lesson plans from the previous year’s activities to the entire group. We had panel discussions on “lessons learned” from both teachers and fellows, and discussed “what defines GK-12 success” in terms of individual teacher-fellow pairings, on a day-to-day basis, and for the grant and for NSF. New fellows also presented the nature of their graduate research projects to the group. The Puget Sound research cruise allowed teachers and fellows to get better acquainted with each other and with the local non-profit the Ocean Inquiry Project. The Ocean Inquiry Project (www.oceaninquiryproject.org), takes groups of students/teachers out into the Sound to learn about local marine life and the research techniques used to study it. Participating in the cruise provided an opportunity to participate in collecting oceanographic data, providing a common marine science learning experience for teachers and fellows that they could then draw on throughout their partnership.

In August, the OACIS program hosted a week-long workshop, “Learning to Be Partners and Getting to Work” (August 17-21) to prepare participants for the upcoming academic year. The group first met for two days at the UW Friday Harbor Labs in the San Juan Islands. There, participants heard a variety of lectures on marine science, using technology in the classroom; took a field trip to a local beach (low tide marine life); and spent time in their pairs discussing syllabi and lesson plans (including content from the lectures). After a mid-week travel day, the group reconvened at UW’s Seattle campus. Fellows began drafting teaching statements, and identified specific areas of communication that they would like to focus on with their teachers. We also discussed ways to get fellows’ faculty advisors involved in OACIS, including observing their fellows in the classroom. We had presentations on cultural diversity and on students with disabilities. In terms of resources for high school teachers, we had demonstrations on “cool stuff to do in the classroom”, a presentation from SoundCitizen, a local non-profit that engages citizens and students in collecting water quality data (http://soundcitizen.org/), and we explored the Department of Biology’s teaching resources room, available to both teachers and fellows. Responding to evaluations from the previous year, the workshop content was cut back from 2008 so that teachers and fellows had more time together for planning lessons.

**September 2009 Course for Fellows**

Fellows are required to register for a 2 credit intensive 5-day (all day) course offered through the School of Oceanography in September. This GK-12 course is based on the COSEE-OLC “Communicating Ocean Sciences” course, a course designed to teach best science teaching methods to marine science graduate students. The GK-12 course has been adapted to serve the needs of fellows, emphasizing high school level teaching and learning that is most relevant to our GK-12 fellows. A lecturer provided by OACIS (Dr. Tansy Clay, OACIS Program Manager, and COSEE-OLC), with expertise in ocean sciences education and outreach, was selected to develop the course (advised by Véronique Robigou, COSEE-OLC); she also teaches the course. This course introduces fellows to inquiry-based teaching methods and science education theory, research and practice that support teachers and fellows in creating student-centered learning environments and descriptions and practice of effective science curricula.
Content pedagogy includes concepts such as 1) formulating pre-test and post-test assessments that include analysis of misconceptions students bring to the classroom; 2) planning inquiry-based activities that relate to the national and state standards; 3) developing a protocol for creating instructional materials that are engaging, inquiry-based, and incorporate a variety of assessments such as student journals and discussion leading and questioning strategies; 4) developing a protocol for GK-12 fellows to present their research to the teachers and students they work with early on, as a model that clearly illustrates and demonstrates what their goals for student performance are. Activities for fellows are based on inquiry science teaching and learning strategies used in the COSEE-OLC “Communicating Ocean Sciences” course in spring quarter 2007, 2008, 2009. Fellows are also encouraged to attend the spring quarter course in the year before they start the program. All indications, from the fellows’ comments, are that this course achieved its goals and that they felt much more prepared to enter the classroom after having taken it. A syllabus for the course is included with this report (Appendix I).

OACIS fellows were asked to observe in the high school classrooms they would be working in prior to the course to provide relevancy to the course topics and to ensure that the course covered any questions the fellows had about working in their classes. Course topics included the learning cycle, promoting discussion, learning strategies, creating an inclusive learning environment, the process of science, the nature of inquiry, considering the whole student, preconceptions, and assessment. An exercise in curriculum topic study was also included, providing fellows with first hand experience grappling with the challenges of aligning current educational research and theory, local and state standards, and district curricula. Students were also introduced to the Reformed Teaching Observation Protocol as a tool that could be used to assess their teaching. The culminating piece of this course was the development of a lesson and assessment to be delivered in the high school classroom. Each OACIS fellow developed a lesson, tested their lesson on their classmates, improved the lesson, delivered the lesson to their high school classes, reflected on the lesson and assessment, and revised the lesson based on that reflection. These lessons are being shared with other GK12 fellows, will be made available to future fellows, and have been provided to the teachers to incorporate into their classes if they wish.

The October 2009 “All Hands” meetings were held in two groups: Seattle and San Juan County. We dispensed with the use of videoconferencing between the two groups in response to evaluation comments about hindrances to free-flowing discussions, due to difficulties involved in videoconferencing with a group this size. During the “teachers only” portion of the meeting, the first hour, teachers discussed successful and challenging aspects of the GK-12 experience. It was clear that we had learned a lot from the 2008-09 experiences, that the teacher-fellow pairings seems to be better matched for 2009-10, and that the additional time allotted in the August workshop for working on lessons had paid off. Teachers described their collaboration with their fellow-partner as occasionally feeling like “team teaching”. Several commented on the value of the fellows as a content resource for both themselves and their students, and that the graduate fellows had quickly become an integral part of the high school classes. Challenges teachers mentioned included integrating graduate student expertise in marine science into their usual high
school biology curriculum, and helping graduate students grasp the full range of abilities of high school students within a single class.

Fellows take a required OACIS seminar each quarter (FSH 507), where curricular issues along with “classroom challenges” are brought up and discussed. In mid-November, fellows presented a specific classroom activity that they had done in their respective schools as part of the culminating project for the required September course for graduate fellows. Fellows plan to share their hands-on activities so that all will have access to each other’s expertise, and can use these activities in the future, and teachers will have them for use in future classes.

**B1b. Curriculum materials adopted or developed.**

Through their classroom presentations and activities, the fellows are developing curriculum materials that will stay with the various teachers (and the materials are to be shared within and between schools). These are listed in Appendix II. Specific examples are highlighted below in the paragraphs about the San Juan County and Seattle School District fellows. These curricular materials are initially developed or acquired by individual fellows, then shared with the rest of the group via a password-protected webpage. (The materials are in varying stages of development; many are not yet ready to be made public. Also, intellectual property issues must be cleared before publication.) These materials, when published, will address the “sustainability” portion of the grant by leaving a legacy of lesson plans and classroom activities that may be used by all teachers.
San Juan County Fellows

Two fellows are working this year in San Juan County schools (we expect three next year). Both are graduate students in Biology, one working on a dissertation project in subtidal marine ecology, the other on development and genetics of marine snails. For both, their dissertations field work is concentrated in the San Juan Islands. Kevin Turner is paired with teacher Marc Vermeire at the Lopez High School on Lopez Island. Kevin is working in a Biology class (a mix of grades 10 and 11), interacting weekly (usually 3 days per week) with about 21 students, and in an Oceanography class (grades 11 and 12), interacting 3 days a week with 16 students. Max Maliska is paired with physical science teacher Nick Frazee in the Friday Harbor High School on San Juan Island. He is working in an Oceanography class (grades 11 and 12), which has 15 students, and in both Physics I (9th-10th grade: 30 students) and AP Physics classes (10-12th grade, 15 students). The Oceanography course being taught by both teacher-fellow partnerships is a new and exciting one within the school district; it is part of the “UW in the High School” outreach program, following an undergraduate-level curriculum and textbook written by University of Washington Oceanography faculty; high school students can opt to take the course for college credit (Oceanography 101). The Friday Harbor class has already made use of the research vessel of the UW’s marine lab to show students how oceanographic data are gathered, and the Lopez class has a program to regularly collect water samples for analysis by Dr. Rick Keil’s SoundCitizen water testing program (http://soundcitizen.org/). As with most fellows, during some weeks, each prepares an independent marine science unit that he brings into his classes, and in other weeks he helps his teacher-partner with ‘regular’ activities. Max made a “larval dispersal” board game incorporating the concepts of currents, gene flow, and larval biology. Kevin made up taste tests of salinities simulating different ocean basins, to get students thinking about sources and importance of salts in the ocean.

Seattle School District Fellows

The remaining six fellows are partnered with teachers in the Seattle School District (see Table 3 for a list of fellows, their teacher partners, and their high schools). The fellows spend anywhere from 3-5 days a week at their respective schools, assisting with classes that are sometimes specific marine science classes, and other times more general environmental science, chemistry, or biology classes. Their activities include doing class presentations or leading discussions, acting as a marine or other science research “expert” to be called on, doing hands-on classroom science activities, and working with their teachers on lesson plans (including field trips) and curriculum development. Fellows have arranged field trips to the extensive UW fish collection, a local wastewater treatment sewage plant, the Seattle Aquarium, and UW’s Botany Greenhouse. A teacher/fellow pair is endeavoring to put together an overnight trip for students to the UW’s marine research laboratories at Friday Harbor. A fellow and his teacher also took their class on a Puget Sound research cruise with the Ocean Inquiry Project. The “Map the Mystery Sea Floor” bathymetry activity has been used successfully more than once. One fellow had her students count the number of species on different sized rocks from the marine intertidal zone, to illustrate the concepts of island biogeography. Another fellow has helped her students overcome
“environmental burnout” with different assignments from David Helvarg’s book, *50 Ways to Save the Ocean*. Students have investigated the relationship between unusually high sea surface temperatures and coral bleaching using satellite data. An activity as simple as comparing how one’s hands feel in cold, hot, and room temperature water is being used to teach students about heat transference. Fellows also invite their graduate colleagues into the classroom for special activities (e.g., spawning sea urchins), thus broadening the areas of expertise available to the high school classes.
University of Washington’s
Ocean and Coastal Interdisciplinary Science GK-12 Program
Evaluation Report - December 2009

Loretta Kelley, External Evaluator

Project Goals and Methods

Goals and Objectives

The University of Washington’s GK-12 program is currently in its second year of funding. A major goal of this project is to infuse research in marine science into the science curriculum in rural and urban high schools in Washington state by pairing graduate students in the Department of Biology at the UW with high school science teachers. The graduate fellows assist their teacher partners with their science instruction by conducting inquiry-based learning activities and bringing current research in marine science into the classroom. The graduate fellows also constitute role models for pursuing both a college education and careers in science. Through their classroom activities the graduate fellows improve their teaching and communication skills and become more aware of the high school teaching environment and issues in public school education. To measure progress toward this goal, data has been and will continue to be collected on the effect of participating in the project on the graduate fellows and their teacher partners.

The evaluation questions based on project’s objectives and activities are:

1. How does participation in the project affect the educational progress and professional growth of the graduate fellows?

2. What is the effect of the program on science content knowledge of participating teachers?

3. How are project results being disseminated both locally and nationally?

4. How are the teachers benefiting from the project’s workshops and other professional development activities?

5. How are the fellows supporting teachers in implementing more inquiry-based science?

6. What do the fellows’ research advisors and other stakeholders at UW know about GK-12, the OACIS program, and their advisee’s role in the program?
7. What are student outcomes in content knowledge and attitude toward/interest in STEM?

Questions 3 and 6 are not addressed directly in this report.

Evaluation Methods and Data Sources

The data for this report was collected in a variety of ways. The evaluator conducted a three day site visit to Seattle in March 2009 and attended a week-long workshop for graduate fellows and teachers at the University of Washington in June 2009. Both face-to-face and telephone interviews were conducted with most fellows and teachers and all fellows and teachers completed a variety of surveys. The project staff’s cooperation was indispensible in the administration and collection of these surveys. Since the inception of the project, the evaluator and project staff have maintained contact in person, when possible, and electronically.

A site visit to Friday Harbor Laboratories was not conducted this year but is being planned for 2010. The fellows’ research advisors will be interviewed or surveyed in 2010 also.

The data sources for this report include:

- Visits to five classrooms in four schools (seven classes observed) in March 2009;
- A focus group with six graduate fellows in March 2009;
- Telephone interview with one graduate fellow in March 2009;
- Interviews with five teachers in spring 2009;
- Attendance at the project’s June 2009 workshop;
- Baseline surveys of new graduate fellows (n = 4) and teachers (n = 4) in June 2009;
- Surveys of first year graduate fellows (n = 8) in June 2009;
- Surveys of first year teachers (n = 8) in June 2009;
- Participants’ assessments of August 2009 workshop (n = 14);
- Ongoing communication with project staff.

A summary of the baseline data collected in August 2008 was included in the 2008 Evaluation Report. The baseline data was compared to data collected this past year to measure the effect participation in the project had on the graduate fellows and teachers. The results of this comparison will be included in the following section.

Results of the Evaluation

The data collected was primarily to assess the benefit of participating in the project to its participants, most notably the graduate fellows and teachers, but also the students in the teachers’ classrooms. The fellows and teachers were also surveyed and interviewed to allow them to give constructive (and anonymous) feedback to the project staff on how the project could better benefit them and other participants in the future.
Effect on the Participants

At the June 2009 workshop both the teachers and fellows completed surveys consisting of four multi-part questions which had been part of the baseline surveys they completed in August 2008. These surveys contained questions about the importance of and their confidence in their ability to perform a variety of pedagogical tasks, their preparation to develop student learning in some domains and to teach scientific topics, and their teaching context. Comparing the results of these two surveys measures how the participants assessed growth in their science teaching during the 2008 – 2009 academic year. The data indicate that both the teachers and fellows believe that they are now better prepared to use a variety of teaching strategies which support inquiry-based science instruction and to teach specific topics and domains in science.

The Graduate Fellows:

The graduate fellows exhibited growth both in their classroom roles as GK-12 fellows and in ways that will benefit them professionally in the future. They learned a lot about teaching and pedagogy. One fellow said the GK-12 classroom experience “made me realize just how much joy I get out of educating people.”

Based on feedback from the fellows, one of the major lessons they learned about being in a high school classroom is that flexibility is key to collaborating with a teacher in a public school with a culture so different from that of a university. All agreed that being in a high school classroom is very different from being a TA. The fellows also mentioned that preparing for a high school class is different from preparing for a presentation at a conference; they have far less time to prepare for each class. They learned the value of using materials that have already been created and sharing ideas with others. One fellow said, “I have learned so much about how to teach that I can’t even verbalize it. The kind of reactions I got from the students allowed me to find exactly the kind of instruction they could learn from.”

A comparison of the fellows’ baseline data with similar data collected in June 2009 revealed positive changes in their thinking about issues in science education, including the importance of a variety of pedagogical tasks, their confidence in their ability to perform these tasks, and their preparedness to develop student learning in science.

- The fellows were asked about thirteen activities relevant to science instruction (e.g., developing students’ conceptual understanding of science, connecting science to students’ experiences, engaging students in inquiry-oriented activities) and asked to rate the importance of these activities in the classroom and how prepared they are to conduct these activities. In 2009 the fellows considered these activities to be more important and believed themselves better prepared to conduct these activities.
- The fellows felt more supported by their department to try out new ideas in 2009 than they had in 2008.
- The fellows reported an increase in their preparation to develop student learning in six domains (e.g., problem solving, critical thinking, developing multiple strategies).
• The fellows felt slightly better prepared to teach five science topics (e.g., the scientific process, data analysis and interpretation). In 2008 they had already felt well-prepared to teach these topics.

The fellows all reported having grown personally and professionally in ways that they expect to be valuable to them in the future. The two areas in which the fellows report the most growth are in forming opinions and attitudes about teaching and in gaining specific pedagogical and more general skills. They gained a sense of how important it is to be able to communicate about science in general and their research in particular to non-scientists. They also learned how to communicate to a more general audience. Specific skills they mentioned improving were collaboration, time management/multi-tasking, communication and presentation, and becoming more comfortable and confident in front of an audience.

The Teachers:

All the teachers were enthusiastic about their participation in the project. When asked if they would recommend participating in the project to other teachers, all responded affirmatively. One teacher said, “Absolutely. It’s great for the teacher, the graduate student, and the students. It’s a win-win-win situation.”

All teachers reported that activities or labs had taken place in their classrooms that would not have happened without the fellows’ assistance. Several of these activities required materials that the fellows had provided which the teachers lacked the time or connections to obtain, such as live animal specimens and aquatic plants. Some specific labs/lessons the teachers mentioned were:

• dissections of clams and annelids;
• using a pan of water, dye, and straws to demonstrate westerly and trade winds;
• a field trip to UW to see fish specimens;
• a lesson on the differences between fresh and salt water ice and the organisms that live in them; and
• a multiple-day presentation on marine birds.

The teachers completed surveys in 2008 and 2009 similar to the ones described above for the fellows. A comparison of the teachers’ baseline data with similar data collected in June 2009 revealed growth in their thinking about issues in science education, including the importance of a variety of pedagogical tasks, their confidence in their ability to perform these tasks, and their preparedness to develop student learning in science.

• The teachers were asked about thirteen activities relevant to science instruction (e.g., developing students’ conceptual understanding of science, connecting science to students’ experiences, engaging students in inquiry-oriented activities) and were asked to rate the importance of these activities in the classroom and how prepared they are to conduct these activities. From 2008 to 2009 the teachers reported little change in the
importance they attached to these activities. They did, however, consider themselves better prepared to conduct these activities.

- The teachers were asked to agree or disagree with seven statements about the supportiveness of their teaching context. In general, there was more agreement with statements that indicated a supportive context (e.g., teachers planning together and enjoying teaching science).
- Like the fellows, the teachers reported an increase in their preparation to develop student learning in six domains (e.g., problem solving, critical thinking, developing multiple strategies).
- The teachers felt better prepared to teach five science topics (e.g., the scientific process, data analysis and interpretation) in 2009 than they had in 2008.

The students: The impact on student learning and attitudes was not measured directly. However, the teachers were asked about the effect of having a GK-12 fellow in their classrooms. All teachers agreed that their students have benefited from the fellows’ presence in their classrooms. The particular advantages the fellows brought to their classrooms were:

- having a real scientist in the classroom;
- bringing in new and innovative ideas, as well as enthusiasm and energy;
- being a role model for the students;
- supplementing the curriculum;
- having more than one person to answer their questions; and
- knowledge about recent research and current events “livens up the class”.

The teachers also agreed that their students like their fellow and that the fellows work well with the students. One teacher described her fellow partner as bringing the “Oh wow! factor” into the classroom that helps the students understand that science is a dynamic discipline.

The fellows also noted the students’ reactions to their presence in the classroom. One said, “It was rewarding to see them get excited about marine science.”

June 2009 Workshop

The OACIS June 2009 workshop was very productive. It allowed the new fellow-teacher partnerships to get to know one another so that they could begin their collaboration during the August workshop. The agenda items were relevant and appropriate amounts of time were allocated for them. The discussions among the participants were lively and honest. Many ideas and issues came out during these discussions. It seems likely that there will be more collaboration both within and between partner pairs in the coming year.

The particular sessions held were

- Panel Discussion: Lessons learned by Fellows
• Panel Discussion: Lessons learned by Teachers
• Open Discussion: What does GK12 success look like to you?
• Developing teaching statements and portfolios
• Sharing of favorite lesson plans by teacher-fellow partnerships
• Sharing of Fellows’ research interests/focus
• Sharing of Teachers’ courses and philosophies

The workshop also included opportunities for socializing and networking, as well as the informal exchange of ideas and concerns. The fellows’ research advisors were invited to attend a celebration one evening. Informal conversations with the research advisors indicated that they are knowledgeable about the UW GK-12 project and support their advisees’ participation in it.

The last day of the workshop was a full-day cruise on a warm and sunny day on Puget Sound provided by the Ocean Inquiry Project. The participants (working in teacher-fellow pairs) performed a variety of activities to measure the conductivity, temperature, quality, and depth of the water and collected and observed samples of phytoplankton and zooplankton. The participants were also able to examine marine specimens collected by divers. This cruise allowed the participants to learn some methods of research in marine science, participate in team building activities, and learn about OIP resources.

Assessment of August 2009 Workshop

This week-long summer workshop included a variety of activities such as research presentations, lectures on several topics in marine science and pedagogy, and field trips. There was also time for the fellow and teacher partners to plan collaboratively. The participants rated each activity on a scale of 1 to 5, with 5 signifying “do it again next year for sure” and 1 being “drop it next year for sure”. Participants were also given an opportunity to make comments on each presentation and on the workshop as a whole.

Overall, the ratings were high, with 4’s and 5’s predominating. The most highly rated sessions overall were the planning times. Even the activities that were rated lower overall received some high ratings so every activity was valuable to some participants. Some participants seemed to appreciate effective lectures or demos; others wanted or expected content more directly applicable to their classrooms. Comments indicated that the attendees appreciated the discussions following lectures.

A detailed summary of the workshop assessment data was presented to the project in September. This data will be used by the project staff in planning future workshops.

Conclusions and Recommendations

The project appears to be running very well. All parties involved appear committed to the success of the project and work together toward that end. Project staff did a good job of selecting University of Washington’s OACIS GK-12 Program Evaluation Report November 2008
participants, the summer workshops were successful, and the project is providing activities and supplies to science classrooms. All involved appear happy to be part of the project and the feedback provided during the site visit was mostly positive.

Positive changes have been made in the second year of the project. Most notably, there were two summer workshops in 2009 which provided opportunities for the graduate fellows and teachers to become better acquainted with one another and to begin their collaboration prior to the beginning of the academic year.

The data collected indicate that both the teachers and fellows believe that they are now better prepared to use a variety of teaching strategies which support inquiry-based science instruction and to teach specific topics and domains in science.

There are a few recommendations for improving the project.

1. The teachers and fellows may not be “on the same page” about certain aspects of the partnership. Communicate more explicitly in the following areas
   • The process for graduate fellows to present in classrooms other than their own.
   • The collaborative aspect of the partnership. All teachers may not understand that they and the graduate fellow are equal partners with different areas of expertise.

2. The project staff should maintain a greater presence in the classroom and provide feedback to the graduate fellows about their teaching and the partnership. Feedback and suggestions for improving classroom performance can also be addressed at the fellows’ meetings. Teachers should be encouraged to provide feedback to the fellows.

3. Consider other ways for graduate fellows to receive feedback about their classroom performance. Two suggestions are
   • Reciprocal observations: Two fellows would observe each others’ teaching and debrief. This provides each fellow with feedback on his or her teaching style plus an opportunity to observe another fellow’s teaching style and pedagogy.
   • Videotaping: The fellows’ lessons would be videotaped and each would have an opportunity to review it (and have it critiqued if they wish). [Note: There may be legal issues with videotaping a classroom in which students are present, even if the students themselves are not taped.]

4. Provide some time at bi-weekly meetings for the fellows to brainstorm and share with each other. There may be a formal mechanism (such as a web-based repository) for sharing lesson plans/activities/labs.

5. Offer next year’s incoming graduate fellows an opportunity to visit this year’s classrooms.
6. Include the fellows’ research advisors in the project to a greater extent. Survey or interview them to determine their knowledge of the UW OACIS project and their advisee’s role in it.
Collaborative Response Report

The project seems to be running very well. All parties involved appear committed to the success of the project and work together toward that end. Project staff did a good job of selecting participants, the summer workshops were successful, and the project is providing activities and supplies to science classrooms. All involved appear happy to be part of the project and the feedback provided during the site visit was mostly positive.

Positive changes have been made in the second year of the project. Most notably, there were two summer workshops in 2009 which provided opportunities for the graduate fellows and teachers to become better acquainted with one another and to begin their collaboration prior to the beginning of the academic year.

There are a few recommendations for improving the project.

1. The teachers and fellows may not be “on the same page” about certain aspects of the partnership. Communicate more explicitly in the following areas
   • The process for graduate fellows to present in classrooms other than their own.
   • The collaborative aspect of the partnership. Teachers are accustomed to the cooperating teacher-student teacher model and relationship and may not understand that they and the graduate fellow are equal partners with different areas of expertise.
   
   **PI Response:** These topics are brought up at each of the summer workshops, though it still takes some adjustment because it is a new concept for the teachers (and fellows). First, we encourage fellows to give presentations in any classes at the schools in our program, but this is hard to organize centrally. So far, it has worked best when fellows from two schools arrange an exchange – nonetheless, our coordinators will facilitate this process, and will communicate with both teachers and fellows regarding mechanisms to foster exchange. In 2009-2010 we have already seen an increase in the frequency of fellows presenting in other classrooms. Second, we emphasize the equal partner model in all workshops and information provided to teachers and fellows, but it is different than what the teachers have done in the past – it seems they evolve into it over the first semester, and then it usually works fine. We continue to emphasize the collaborative aspect of the partnership during our all-hands meeting, when we meet with the teachers only to emphasize the value we place on the teacher’s expertise, and again when the graduate fellows join the meeting. Revisiting this topic over time helps to facilitate the change we see over the 1st semester.

2. The project staff should maintain a greater presence in the classroom and provide feedback to the graduate fellows about their teaching and the partnership. Feedback and suggestions for improving classroom performance can also be addressed at the fellows’ meetings.

   **RESPONSE:**
The coordinators have increased the frequency with which classrooms are visited in 2009-2010, assuring that each classroom is visited at least once, and in most cases multiple times per semester.

3. Consider other ways for graduate fellows to receive feedback about their classroom performance. Two suggestions are

- Reciprocal observations: Two fellows would observe each others’ teaching and debrief. This provides each fellow with feedback on his or her teaching plus an opportunity to observe another fellow’s teaching style and pedagogy.
- Videotaping: The fellows’ lessons would be videotaped and each would have an opportunity to review it (and have it critiqued if they wish). [Note: There may be legal issues with videotaping a classroom in which students are present, even if the students themselves are not taped.]

RESPONSE: In the 2009 fall workshop we emphasized these methods for fellows to receive feedback about their classroom performance. A session introducing the Reformed Teaching Observation Protocol (RTOP) was included in the fall workshop for teachers and fellows, and in the fall course for fellows the fellows were trained in RTOP evaluation protocols to ensure that fellows had the proper training to comment on each other’s teaching. At the fall 2009 workshop we encouraged the use of videotape, offered supplies for fellows to carry this out, and offered to watch the videotape and debrief with fellows. We have revisited these options during the seminar for fellows throughout the fall.

4. Provide some time at bi-weekly meetings for the fellows to brainstorm and share with each other. There may be a formal mechanism (such as a web-based repository) for sharing lesson plans/activities/labs.

PI Response: The biweekly meetings continue to be a great forum for general support and sharing of information and useful tips. Fellows who are struggling more with the program have been getting individual attention from the coordinators and from Program Manager Tansy Clay. One-on-one conversations with some of the teacher mentors have also helped smooth out some initial difficulties. Visits to each of the classrooms will be continuing over the next 2 months to observe each partnership in action.

A non-public web-based shared space is available to all OACIS fellows and teachers, and fellows are encouraged to post their lesson plans/activities/labs. The non-public nature of this shared space allows fellows to share materials that are ‘in progress’ facilitating collaboration on teaching materials. Time is occasionally allowed during the biweekly meeting for fellows to post materials to this shared space, encouraging fellows to stay up to date on the materials they are posting. Materials created in 2008-2009 are also posted, making the work of previous fellows available. Teachers who participated in
the OACIS GK12 program in 2008-2009 are also able to access this shared space, and in this way continue to benefit from the work of the OACIS graduate fellows.

5. Offer next year’s incoming graduate fellows an opportunity to visit this year’s classrooms. For our next round we intend to make our fellow selections earlier in the year, which will allow time/opportunity for incoming fellows to observe current fellows before the end of the school year.

6. Include the fellows’ research advisors in the project to a greater extent. Survey or interview them to determine their knowledge of the UW OACIS project and their advisee’s role in it.

   **PI Response:** Project staff have been frequently checking in with fellows about how much time they are committing to the GK12 program, and whether they are managing to balance this with their academic progress. This is an ongoing issue that all are very aware of, and it is taking time for each fellow to find a reasonable balance. The PI is contacting research advisors to keep them informed and to give them the opportunity to take part in GK-12 seminars and workshops. In August, two of the research advisors for current fellows gave presentations at the workshop. The research advisors are required to visit the classroom their student is working in to see first-hand the OACIS program and their student’s contribution.
Appendix I

Best Practices in Science Teaching: High School Marine Science
UW Ocean 509A, Autumn Quarter 2009

Instructor: Tansy Clay
tansy@u.washington.edu
Meeting Times: Sept 21-23, 28-29, 9am-5pm
Meeting Location: OTB 211
Credits: 2 credits

*All information on this syllabus is subject to change*

Course Description

This course is for graduate student fellows in the OACIS GK-12 program. The course is designed to teach best science teaching methods to marine science graduate students who are interested in a) improving their ability to teach science, and b) gaining experience in collaborating with members of the K-12 community. This course is focused on inquiry-based teaching methods and science education theory. Course content includes concepts such as:

- The learning cycle
- Misconceptions students bring to the classroom
- Assessment
- How to create an inclusive learning environment
- How to develop instructional materials that are engaging, inquiry-based, emphasize the nature of science, and relate to state and national standards.

Course participants will apply course content to the development, delivery, and revision of a high-school level science lesson they create as a part of this course.

Requirements

- Assigned readings and participation in class discussion and activities
- Development of an original hands-on science lesson
- Delivery of your lesson to your peers
- Participation in peer review of presentations
- Delivery of your lesson to a high school class
- Reflection on delivery of your lesson to high school students
- Revision of lesson
## Grading

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<th>Participation (25)</th>
<th>Points</th>
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<td>- Quickwrites</td>
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<td>- Participation in class discussions and attendance</td>
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<td>- Lesson Idea Proposal</td>
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<td>- Written Lesson Plan</td>
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<td>- Assessment task designed for you for your students</td>
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<th>Presentation (20%)</th>
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<td>- Delivery of your lesson to peers</td>
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<td>- Your review of your peer’s lessons</td>
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<td>- Reflection on delivery of lesson in the high school classroom</td>
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<tr>
<td>- Revised lesson plan</td>
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TOTAL 1000

## Course Requirements

1. Attend class, participate in discussions.
2. Complete assigned readings, be prepared to do “Quick Writes” at start of class.
3. Develop a lesson of your own design. The lesson plan has three parts:
   a. Lesson Idea Proposal: An outline of your idea for a lesson. Please map your lesson to the learning cycle. Please bring 5 copies so you can receive feedback on your idea from your peers. This is Due On Wed Sept 23rd.
   b. Draft of Lesson Plan: A 1-2 page description of the goal and key concepts of your lesson and a description of the activity you plan to do. Be sure to clearly label how you will be using the learning cycle and questioning strategies. Include a question map. This is Due on Monday Sept 28th.
   c. Written Lesson Plan: A 1-2 page description of the goal and key concepts of your lesson and a description of the activity you plan to do. Be sure to clearly label how you will be using the learning cycle and questioning strategies. Include a question map. This is Due On Tuesday Sept 29.
   d. A written description of the assessment you plan to use with your assignment, what this assessment is designed to assess, and at which point in the lesson you intend to use this assessment. Please note that you will need to turn in student
work on this assessment with your lesson reflection at the end of October – make sure you have an assessment you can collect! This is Due On Tuesday Sept 29.

4. Present the lesson you developed to your peers (in class) on Tuesday Sept 29.
   a. You will have 30 minutes to complete the activity.
   b. Deliver the activity as though you were presenting it to your high school students so your peers can provide useful feedback.
   c. This is an opportunity to demonstrate/model what you have learned in the class!

5. Culminating experience: AFTER this week has ended, but BEFORE the end of October:
   a. Deliver your lesson to a high school class.
   b. Create a (~5 page) written reflection of how your activity worked with the high school students (Due by end of October)
      - Be sure to focus both on parts that worked well and those that did not.
      - Include notes on how you were/were not able to apply concepts addressed in the course and how this affected the outcome.
      - Include an analysis of your assessment piece (~2 of the 5 pages).
         a. What was the goal of your assessment
         b. What did you find out about student learning?
         c. After seeing responses, how would you modify the assessment or the instruction?
         d. Attach the assessment and student responses.
   c. Revise your lesson and assessment based on your experience. (Due by end of October)
      i. Be sure to clearly label how you would use the learning cycle and questioning strategies. Include a question map.

SCHEDULE

Monday Sept 21
Morning: Course Intro
Discussion: Classroom observations
Process of Science

Afternoon: Process of Science (continued)
Comparing Teaching Approaches

Homework:
• Assigned reading
• Lesson outline (5 copies due on Wed.)

Tuesday Sept 22
Morning: Quick Write
Discussion: Last night’s reading.
Blank Slates/Clever Minds
Afternoon:  Curriculum Topic Study and Probing Student Understanding: Jen Fox
    Questioning Strategies
    Discussion: Use of the material covered today in your classroom

Homework:
    • Assigned reading
    • Lesson outline (5 copies due on Wed.)

Wed Sept 23
Morning:  Quick Write
    Discussion: Last night’s reading
    Promoting Discussion
Afternoon:  Assessment
    Lesson outline feedback

Homework:
    • RTOP reading
    • Work on draft lesson (Due Monday)

Monday Sept 28
Morning:  Creating an Inclusive Learning Environment
    RTOP
Afternoon:  RTOP (Cont)
    Feedback on draft lessons

Homework:
    • Assigned reading
    • Work on Lesson (Due Tuesday)

Tuesday Sept 29
Morning:  Quick Write
    Discussion: Last night’s reading
    3 Student lesson presentations
Afternoon:  5 Student lesson presentations
Appendix II

Topics of Lessons Developed by OACIS GK-12 Fellows

- Current marine events
- Human impacts on the Puget Sound
- Sustainable seafood
- Things high school students and their friends/families can do to save the ocean
- Transport of chemicals into Puget Sound via wastewater and run-off
- The use of kelps in everyday products
- Carrageenan extraction from red algae
- Hydrothermal vents
- Impacts of light on marine life
- How marine mammals dive
- Sea floor mapping
- Tidal zonation
- What is science
- Glaciers
- Sea ice
- Characteristics of arthropods
- Characteristics of fish
- Characteristics of cnidarians
- Characteristics of mollusks
- Characteristics of porifera
- Characteristics of platyhelminthes
- Characteristics of echinoderms
- Chordates
- Fish anatomy
- Marine mammals of the Salish sea
- Marine plankton
- Marine bacteria
- Sea turtles
- Sharks
- Squid dissection
- Protists
- Annelids
- Cells
- Sea urchin fertilization
- Bioaccumulation
- Trophic interactions
- Evolution
- DNA structure and replication
- Spartina: an estuarine plant
- Succession
• Dichotomous keys
• Aquatic nuisance species
• Extremophiles
• Food calorimetry
• Marine food webs
• Larval dispersal
• Atmospheric circulation
• Global climate change
• Ocean currents
• Tides
• Upwelling and downwelling
• Waves
• Oceans and climate
• Water Chemistry
• Hypoxia in the Hood Canal
• The Nitrogen cycle
• The Carbon cycle
• Salinity
• Ocean acidification
• Heat
• Dimensional analysis
• Dissolved gasses
• Bathymetry
• Plate techtonics