

Annual Report for Period:07/2008 - 06/2009

Submitted on: 04/07/2009

Principal Investigator: Stepien, Carol A.

Award ID: 0742395

Organization: University of Toledo

Submitted By:

Stepien, Carol - Principal Investigator

Title:

Graduate Teaching Fellows in STEM High School Education: An Environmental Science Learning Community at the Land-Lake Ecosystem Interface

Project Participants

Senior Personnel

Name: Stepien, Carol

Worked for more than 160 Hours: Yes

Contribution to Project:

Principal Investigator, Director of the Lake Erie Center and Professor of Ecology in the Department of Environmental Sciences. Dr. Stepien is in charge of the overall plan, coordination, and output for the project. She led teaching of the 2 unit courses each Thursday for the fellows during the academic year, which has focused on teamwork skills, developing lesson plans, coordinating output, helping the fellows in mentoring high school student science fair projects, coordinating our presentations at the regional Purdue conference and at the Washington D.C. national conference, and planning our own research poster show for all of our high schools to be held on April 30, 2009. She also has coordinated the Environmental Science Learning Community monthly seminar seminars at the Lake Erie Center, and its associated dinner that Gk-12 teachers and fellows and faculty attend. The teachers, fellows, and Co-PIs attend a monthly session for Gk-12 at the Lake Erie Center; which is coordinated by Dr. Stepien. Dr. Stepien has been working on team building with the entire group, including the other co-PIS and the Environmental Science Learning Community. She has two Ph.D. students in the Gk-12 program, Amanda Haponski and Osvaldo Sepulveda-Villet.

Name: Moorhead, Daryl

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Moorhead is a professor of Ecology in the Department of Environmental Sciences, and is the lead co-PI for our Gk-12 program. He participated in the initial, two, one-week summer courses for teachers and graduate fellows. He assisted in the organization and conduct of the first week, which emphasized basic knowledge of aquatic ecosystem and laboratory methods, and included trips to local field sites. He organized and led the second week of class, which focused on field methods for stream quality assessment, within a team-building format. Teachers also gained certification as EPA qualified level-one macroinvertebrate data collectors. Data collected were collated for use in subsequent training in analysis and interpretation.

During the academic year, Moorhead help expand the learning community of this program by integrating the public lecture series at the Lake Erie Center with the colloquium series of the Department of Environmental Sciences, UT, and organized a van-pool of graduate and undergraduate students to participate. He also led a team of teachers and fellows that attended the midwest GK12 meeting in Illinois, where he presented an overview of this program.

These efforts were aided by contributions of supplies, equipment and vehicles by the Department of Environmental Sciences, University of Toledo.

Name: Fisher, Timothy

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Fisher is a co-Pi who is a glacial geologist, and is a Professor in the Department of Environmental Sciences. He is helping to co-lead the summer 09 course for fellows and teachers with Dr. Cyndee Gruden. His master's student Melinda Campbell is an 08-09 Gk-12 fellow at Bowsher High School. Dr. Fisher assists his graduate student, Ms. Campbell as her thesis adviser and offering advice on her GK-12 project. Melinda's GK-12 project was successful as she and her students were able to locate unmarked graves with ground penetrating radar with her high school students enthusiastically supporting all aspects of the research.

Name: Gruden, Cyndee

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Gruden is an Associate Professor of Civil Engineering who has been coordinating the Environmental Engineering interface for our program. She helped with the summer training session for the fellows, and gave a guest lecture in the course. Dr. Gruden has regularly attended and helped at many of the weekly course sessions for the fellows, and led sessions on how to engage high school students in the classroom. Dr. Gruden went to the national Gk-12 conference weekend in Washington D.C. One of her Ph.D. students has been a Gk-12 fellow during the 2008-9 year. She is co-teaching the 2009 summer training session with Dr. Tim Fisher, and will serve as the lead co-PI for the 2009-2010 academic year.

Name: Bridgeman, Thomas

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Bridgeman is a co-PI and an Assistant Professor of Ecology in the Department of Environmental Sciences, whose research speciality is limnology and aquatic ecology. He designed, prepared, and led the initial five-day intensive summer course for teachers and graduate fellows. This course taught the theory and practice of water quality including daily lectures and laboratory and field exercises. Topics included the physics, chemistry, and biology of rivers and lakes and methods for their evaluation. He selected and purchased equipment and supplies for both the first and second summer course. He participated as an assistant instructor in the second five-day course that was led by Dr. Moorhead, which focused on field methods for stream quality assessment, within a team-building format. During the academic year, Bridgeman served as a mentor to one of the Fellows (Bodamer), visiting her classroom and teaching partner, participating in their annual field day for the county-wide Student Watershed Watch, and giving a talk on careers in aquatic ecology. He also participated in the Student Watershed Summit meeting held in the fall. Bridgeman attended many weekly meetings of the fellow-teacher group and monthly evening seminars held at the Lake Erie Center.

Post-doc

Graduate Student

Name: DeVanna, Kristen

Worked for more than 160 Hours: Yes

Contribution to Project:

Kristen is a year 2 Ph.D. student of Aquatic Ecology in the Department of Environmental Sciences, whose research focuses on the interaction of mayflies and dreissenid mussels in the Great Lakes. She is a teaching fellow at Ottawa Hills High School in 4 freshman biology classes (1 honors) and a zoology class. Twenty-two students in her honors biology class conducted full research projects and participated in the Northwest Ohio District Science Day, where 3 projects qualified for the state competition. Kristen attended the Purdue University regional Gk-12 conference.

Name: Gorey, Colleen

Worked for more than 160 Hours: Yes

Contribution to Project:

Colleen is a year 3 Civil Engineering Ph.D. student who worked with students at Clay high school and worked with 3 types of classes of varying age groups. With Biology of Ecosystems, she educated students about the importance of their local Wolf Creek and its impact on Lake Erie. With the Physical Science and Principles of technology courses, basic science and engineering principles were brought life with fun activities and real world examples. She gave a mentoring presentation with Dr. Stepien to the Bowling Green State University SETGO program.

Name: Crail, Todd

Worked for more than 160 Hours: Yes

Contribution to Project:

Todd Crail is an Environmental Science year 2 Ph.D. student, who is at Scott High School with Jahnine Blosser and is working specifically with the Environmental Science classes and assisting with lessons in the Biology classes. The Scott team is designing extra curricular work doing temporal sampling at their Student Watershed Watch site, at a local city park, and interpreting the stream to the public through an Earth Day Festival at the park. They are also building a native plant garden at the school as a means to teach local natural history, biodiversity, and interactions such as pollination paired with an organic food plant garden already in place. Todd also developed the field guide 'A Guide to the Common Fishes of the Toledo Area' and the 'Travellin' Fish Show'. Todd went to the national Gk-12 Conference in Washington D.C. and gave a poster presentation on his research. He also helped to lead the 'River of Shame' classroom demonstration.

Name: Sepulveda-Villet, Osvaldo

Worked for more than 160 Hours: Yes

Contribution to Project:

Osvaldo is a year 4 Ph.D. student in Fisheries Molecular Ecology in the Department of Environmental Sciences, advised by Dr. Carol Stepien. His research is on the molecular population genetics of yellow perch. Osvaldo is the GK-12 fellow assigned to Roy C. Start High School, part of the Toledo Public Schools system. Osvaldo is working with Mrs. Wendy Wilson on two sophomore Honors Biology sections. Osvaldo and Wendy have actively involved their classes in the Toledo Student Watershed watch, as well as organizing a field trip and classroom exercises at the University of Toledo's Lake Erie Center, where high schools interacted with graduate and faculty researchers, and performed taxonomic classification, environmental interpretation and conceptualization. Osvaldo is working towards increasing enthusiasm among urban students into science-based matriculation. Osvaldo and Wendy have also reinforced the students' understanding of curriculum necessary for the Ohio Graduation Test (OGT).

Name: Haponski, Amanda

Worked for more than 160 Hours: Yes

Contribution to Project:

Amanda Haponski is a year 2 Ph.D. student in Aquatic Ecology in the Department of Environmental Sciences, whose research focuses on the molecular genetics of temporal stock structure of yellow perch and walleye in the Great Lakes. She is co-instructing a science research class with Mr. Timothy Bollin at the Toledo Early College High School (TECHS). Amanda's role at TECHS is to guide students through the scientific method using independent research projects. The class focuses on water quality issues in the Toledo area. TECHS is a primarily minority high school. Amanda went to the Purdue University regional Gk-12 conference in November 2008. Her advisor is Dr. Carol Stepien, the PI.

Name: Milejeva-Biebesheime, Olga

Worked for more than 160 Hours: Yes

Contribution to Project:

Olga is a year 4 Ph.D. student in the Department of Civil Engineering, who plans to graduate at the end of 2009 and is advised by Gk-12 co-PI Dr. Cyndee Gruden. Olga's contribution to Northview High school research class includes methodology of the scientific research, guidance students in their research projects and introduction of data analysis methodology, involving and preparing students to Ohio District 2 Science day. Olga's contributions to the environmental science class include invitation of the guest speaker from University of Toledo, providing video 'Watershed mentality' assisting students in water analysis for student watershed watch event.

Name: Bodamer, Betsy

Worked for more than 160 Hours: Yes

Contribution to Project:

is a year 2 Ph.D. student of Aquatic Ecology in the Department of Environmental Sciences, whose research is on yellow perch response to aquatic anoxia, i.e., 'the dead zone' of Lake Erie. Betsy is paired with Mrs. Paulette Cole at Toledo Early College High School, part of the Toledo Public School system. Betsy has worked with two general biology classes this year, comprising students in grades 9-10. She has initiated student involvement in watershed monitoring with the TMACOG Student watershed watch, as well as guided students through the scientific process by means of a small research project. Betsy hopes to increase environmental awareness among urban high school students, as well as strengthen student interest in the natural sciences and other STEM sciences. She attended the annual Gk-12 conference in Washington D.C. in March 2009, and helped lead the 'River of Shame' classroom demonstration.

Name: Campbell, Melinda

Worked for more than 160 Hours: Yes

Contribution to Project:

Melinda Campbell is a Master's student in Geology in the Department of Environmental Sciences, who is advised by co-PI Dr. Tim Fisher and will graduate in spring 2009. She is a fellow at Bowsher High School with Dave Bourland, and has been working with a senior internship class focused on research methods. Most recently they completed a project using ground penetrating radar to locate unmarked graves in a local cemetery. Melinda's students entered the Northwest Regional Science fair competition and are entered as an IAGLR09 conference poster presentation. Melinda attended the Gk-12 Regional conference at Purdue University in November 2008, and also presented with Dr. Stepien in a mentoring session at Bowling Green State University's SETGO program in February 2009.

Undergraduate Student

Technician, Programmer

Name: Gray, Meredith

Worked for more than 160 Hours: Yes

Contribution to Project:

Meredith Gray is the Lake Erie Center's Technology and Communications Specialist, who holds an MS degree in Geographic Information Systems. She has been working with the Gk-12 program on developing our websites, posters, presentations, brochures, etc. She has also been working on press relations and helping us to build the Environmental Science Learning Community at the Land-Lake Ecosystem Interface. She has been of tremendous help to Dr. Stepien and Ms. Rachel Lohner, our Education Program Manager. She also is helping us to coordinate the Gk-12 student poster show at the Lake Erie Center and the high school student poster show at the IAGLR09 Conference (May 2009).

Other Participant

Name: Lohner, Rachel

Worked for more than 160 Hours: Yes

Contribution to Project:

Rachel has an M.S. in Biology, and serves as a mediator between graduate fellows, teachers, and the principal investigators of the project. She also aids in mentoring high school students. She handles many of the logistics of the program including the processing of paperwork as well as the ordering and inventory of supplies. Rachel plans travel, organizes meetings, and tracks the grant spending. She coordinates the dissemination of project information as well as maintains the project website. She helps lead the weekly class with the fellows. Rachel is planning the Lake Erie Center Student Poster show on April 30th and the IAGLR student poster show as well.

Name: Mentzer, Gale

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Mentzer is a professional education program evaluator, based at the University of Toledo's College of Education. She helped write our proposal and has been actively involved in all phases of our project; including making field site visits during our summer course, observing Student Watershed Watch at the field sites and the SWW conference at the Zoo where high school groups gave presentations on their results, made site visits to all the fellow-teacher classrooms, attended the March 2009 National GK-12 Conference, and conducted surveys and all evaluations. In addition, she has helped the fellows learn educational methods, by coming to our Thursday course.

Research Experience for Undergraduates

Organizational Partners

Toledo Metro Area Council of Governments

A major component of our project is built upon the 'Student Watershed Watch' (SWW) framework created by the Toledo Metropolitan Area Council of Governments (TMACOG) and Ohio EPA. For the past 16 years, the SWW program has been contributing to the awareness of high school student of the quality of the water that flows in their local stream. We have assisted the SWW program by improving the knowledge and techniques employed by HS teachers in examining local streams, by supplying teachers with improved equipment, and by providing advanced training to TMACOG personnel involved in the SWW program. Likewise, the TMACOG staff has assisted our project by providing contacts with their local network of HS teachers, their knowledge of local stream sites located near participating schools, and facilitating our participation in the annual Student Watershed Summit meeting.

Ohio EPA

The Ohio EPA has been helping with our program by participating in the Environmental Science Learning Community, and as a likely end user for our stream monitoring program.

Toledo Public Schools

Our fellow-teacher teams are at 4 Toledo Public high schools, including Toledo Early College High School (TECHs; 2 teams), Bowsher High School, Scott High School, Start High School. These are all inner city schools, with Scott being almost 100% African American, and the 3 others having high minority student enrollments.

Oregon Public Schools

One of our teacher-fellow teams is at Clay High School in rural Oregon, Ohio; near the Lake Erie Center.

Sylvania Public Schools

One of our fellow-teacher teams is at Sylvania Northview High School in the Sylvania Public School system, a suburban school.

Partners for Clean Streams & Maumee RAP

PCS and Maumee RAP (Remedial Action Program) are members of our Environmental Science Learning Community and end-users of our data.

<http://www.partnersforcleanstreams.org/>Partners for Clean Streams, Inc. (PCS) was formed in early 2007 as a 501(c)3 non-profit community organization with an interest in supporting local and regional water quality improvements in the metro-Toledo area. Partners for Clean Streams is striving for abundant open space and a high quality natural environment;

adequate floodwater storage capacities and flourishing wildlife; stakeholders who take local ownership in their resources; and rivers, streams, and lakes that are clean, clear and safe.

American Rivers and Joyce Foundation

Non-profit environmental organizations American Rivers and the Joyce Foundation are participating in our Gk-12 Environmental Science Learning Community, helping to restore the Maumee River. <http://act.americanrivers.org/site/News2?page=NewsArticle&id=9839>

Ottawa Hills Public Schools

One of our teacher-fellow teams is at Ottawa Hills High School located in the suburban Village of Ottawa Hills, Ohio, near the University of Toledo.

Other Collaborators or Contacts

Our Environmental Science Learning Community involves a monthly public lecture series by a professor or agency professional, who interacts with our Gk-12 teachers and fellows in a special dinner before the lecture. The next talk is, 'Criminal Enforcement of Federal Environmental Laws (Or the Lack of It),' Dr. Frank Merritt, Professor of Law, University of Toledo College of Law. Thursday, April 16th, 2009, 7:00 pm.'

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Please see attached file for our project research and education activities.

Findings: (See PDF version submitted by PI at the end of the report)

Please see attached file for our project findings.

Training and Development:

A two week summer course for fellows and teachers was implemented in 2008 as part of the GK-12 program requirements for participation. The purpose of this course was to impart basic knowledge of aquatic ecosystem and laboratory methods to participants. In addition, team building skills were developed through activities in pairs of prospective fellow and teacher teams.

The second week of the 2008 summer course focused on field methods for stream quality assessment and involved hands on activities. The result of this activity was certification as EPA qualified level-one macroinvertebrate data collectors.

Several members of the GK-12 community attended a summer day trip to Stone Lab for Great Lakes Aquatic Ecosystem Research Consortium. Participants included Gk-12 faculty, several fellows, and 2 teachers.

Since GK-12 inception in August of 2008, an environmental learning community has been developed. The community is supported by a monthly public lecture series at the Lake Erie Center. Attendance is required for all GK-12 participants (fellows, teachers, faculty) and includes many other researchers, graduate students, and community members. All of our Gk-12 team has a dinner with the speaker, facilitating interaction.

Graduate fellows participate in a weekly seminar course (two hours of contact and course time) focused on GK-12 coordination, training, products, and development. During this course, fellows generally share their experiences with other fellows, work on classroom skills such as lesson plan development, and coordinate schedules and activities for the upcoming week(s). One week of each month, the participating teachers and faculty also

attend one hour of the seminar course. This time is allotted for opportunities for feedback from the participating teachers and any announcements or activities that require participation from the larger group.

In 2008-2009, both teachers and fellows attended the GK12 regional meeting held at Purdue University in Indiana, and the annual conference held in Washington DC.

Outreach Activities:

Student Watershed Watch program, including the annual student summit held at the Toledo Zoo where all participating high school classes meet to discuss the results of their studies. Our 8 teams participated, along with many other high schools in the Toledo area.

Science fairs - Northwest Ohio Regional of the State of Ohio, our Gk-12 fellows sponsored 15 projects. Several students won and will be competing at the State level.

Student poster presentation evening and reception at the Lake Erie Center to be held April 30, 2009 (50 posters anticipated), invited will be high school superintendents, principals, teachers, students, their parents, university administrators, mayors, etc.

Environmental Science Learning Community monthly public lecture series, as follows:

June 19, 2008, "Sustainable Engineering: A Paradigm Shift for the 21st Century?"

Dr. Defne Apul

University of Toledo, College of Engineering, Civil Engineering Department

August 28, 2008, "Inland Seas: Understanding and Protecting the Waters of the Great Lakes?", a film by Matthew Radcliff and Rebecca Klaper followed by a discussion of the Great Lakes Compact led by Kenneth Kilbert, UT College of Law

September 18, 2008, "Hypoxia in Lake Erie:

Dr. Gerald Matisoff

Department of Geological Sciences, Case Western Reserve University

October 16, 2008, "Food, Fertilizer, Fish, and Fouled Beaches: Water Quality in the Maumee River and the Western Basin of Lake Erie?"

Dr. Pete Richards

National Center for Water Quality Research, Heidelberg University

November 6, 2008, "Lake Erie's Dead Zone?"

Dr. Robert Heath

Water Resources Research Institute, Kent State University

January 22, 2009, "Viral Hemorrhagic Septicemia in Ohio's Fish?"

Eugene Braig

Assistant Director, Ohio Sea Grant College Program, The Ohio State University

February 19, 2009, "What's in Your Water?"

Dr. Isabel Escobar

Chemical & Environmental Engineering Department, University of Toledo

March 5, 2009, "Lake Erie Yellow Perch: Numbers, Catchability, and Management?"

Dr. Patrick Kocovski

USGS Great Lakes Science Center, Lake Erie Biological Station, Sandusky, Ohio

April 16, 2009, "Criminal Enforcement of Federal Environmental Laws (Or the Lack of It)?"

Dr. Frank Merritt
College of Law, University of Toledo

Dr. Stepien and fellows Colleen Gorey and Melinda Campbell gave presentations on their career beginnings and inspiration in science at Bowling Green State University's NSF-sponsored SETGO program in February 2009, attended by community college students in STEM fields.

<http://www.bgsu.edu/setgo/>

Journal Publications

Haponski, AE; Stepien, CA, "Molecular, morphological, and biogeographic resolution of cryptic taxa in the Greenside Darter *Etheostoma blennioides* complex", *MOLECULAR PHYLOGENETICS AND EVOLUTION*, p. 69, vol. 49, (2008). Published, 10.1016/j.ympev.2008.07.01

Cai, G. C. Gorey, A. Zaky, I. Escobar, and C. Gruden, "Thermally responsive membrane based microbiological sensors.", *Water Research*, p. , vol. , (2009). Submitted,

DeVanna, K.L., B.L. Bodamer, C.G. Wellington, E. Hammer, C.M. Mayer, and J.M. Bossenbroek, "An alternative hypothesis to invasional meltdown in the Great Lakes: general facilitation by *Dreissena*", *Biological Invasions*, p. , vol. , (2009). Submitted,

Gorey, C., I. Escobar, C. Gruden, M. Coleman, O. Mileyeva-Bibesheimer, "Development of Smart Membrane Filters for Microbial Sensing", *Separation Science & Technology*, p. 4056, vol. 43, (2009). Published,

Gorey, C., I. Escobar, C. Gruden, G. Cai., "Development of microbial sensing nanostructured membranes", *Desalination*, p. , vol. , (2009). Accepted,

Grzybowski, M., O.J. Sepulveda-Villet, C.A. Stepien, D. Rosauer, F. Binkowski, R. Klaper, B. Sheperd, and F. Goetz, "Genetic variation of 17 wild yellow perch populations from the Midwest and East coastal United States using microsatellites", *Transactions of the American Fisheries Society*, p. , vol. , (2009). Submitted,

Haponski, A.E., T.L. Bollin, M.A. Jedicka, and C.A. Stepien, "Landscape genetic patterns of the rainbow darter: A watershed analysis of mitochondrial DNA sequences and nuclear microsatellites", *Journal of Fish Biology*, p. , vol. , (2009). Accepted,

Parker, A.D., D.G. Uzarski, O.J. Sepulveda-Villet, C.A. Stepien, C.B. Ruehl, and T.M. Burton, "The interplay of phenotypic plasticity, ecological habitat, and population genetics in young yellow perch", *Transactions of the American Fisheries Society*, p. , vol. , (2009). Submitted,

Sepulveda-Villet, O.J., A.M. Ford, J.D. Williams, and C.A. Stepien, "Population genetic diversity and phylogeographic divergence patterns of yellow perch (*Perca flavescens*)", *Journal of Great Lakes Research*, p. , vol. 35, (2009). Published, 10.1016/j.jglr.2008.11.009

Stepien, C.A., D.J. Murphy, O.J. Sepulveda-Villet, and R.N. Lohner, "Population genetics and biogeography of the walleye *Sander vitreus*: Signatures of vicariance, postglacial dispersal, and spawning philopatry", *Molecular Ecology*, p. , vol. , (2009). Accepted,

Stepien, C.A., D.M. Murphy, and R.N. Lohner, "Status and delineation of walleye genetic stocks across the Great Lakes", *Great Lakes Fishery Commission Special Publication*, p. , vol. , (2009). Accepted,

Stepien, C.A., R.N. Lohner, and D.M. Murphy, "Genetic patterns among walleye (*Sander vitreus*) populations across the Laurentian Great Lakes", *Journal of Great Lakes Research*, p. , vol. , (2009). Submitted,

Books or Other One-time Publications

Web/Internet Site

URL(s):

http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html

Description:

This site is the homepage of our GK-12 program. This website includes information on each PI, fellow, teacher, and High School involved in our program. We also use this site as a place to post and share documents and photos.

Other Specific Products

Product Type:

Research Presentations

Product Description:

Research Presentations at professional meetings (* indicates GK-12 Participants)

Armenio P.M., K.M. DeVanna*, and C.M. Mayer. (2009) Do zebra mussels and low oxygen affect the behavior and predation risk of *Hexagenia*. University of Toledo chapter of Sigma Xi annual conference, Toledo, OH. November 2008.

Banda, J., A.E. Haponski*, and C.A. Stepien*. (2009) Fine-scale genetic structure of Lake Erie walleye. Great Lakes Fishery Commission Walleye and Yellow Perch Task Groups annual meeting, Pickerel Creek, OH, February, 2009.

Bodamer, B. *, T. Crail*, C.A. Stepien*, J. Blosser*, C. Kolinski*, G. Mentzer*, and W. Penamon*. (2009) River of Shame Lesson Plan. GK-12 National Conference, Washington, D.C., March 27-29, 2009.

Bollin, T. *, A.E. Haponski*, and C.A. Stepien*. (2008) Genetic divergence patterns of the Rainbow Darter *Etheostoma caeruleum*: A watershed analysis using mitochondrial DNA sequences and nuclear microsatellites, International Association for Great Lakes Research, Trent University, Peterborough, ON, May 2008.

Campbell M.* (2008) Change Through Time. Sylvan Elementary School, Sylvania, Ohio, October 23, 2008.

Campbell M.* (2008) Using Ground Penetrating Radar in the Oak Openings Region. Sigma Xi Student Research Symposium, Toledo, Ohio, November 1, 2008.

Campbell M.* (2009) Color and Creativity: A Geologist's View of Careers in Science. SETGO, Bowling Green State University, Bowling Green OH, February 5, 2009.

Campbell, M.* (2009) A Day in the Life of a Geologist. Lapeer West High School, Lapeer, Michigan, March 13, 2009.

Campbell, M.* , D. Bourland* , D. Stierman. (2009) History, high schoolers, and geophysics: using ground penetrating radar to locate unmarked graves in Toledo, Ohio, USA. Geological Society of America Abstracts with Programs, 42nd annual meeting North-Central Section, Rockford IL, April 2-3, 2009.

Crail, T.* and J.F. Gottgens. (2009) Testing the impact of vegetative colonization on fish community in the headwaters of the Ottawa River, northwest Ohio. GK-12 National Conference, Washington, D.C., March 27-29, 2009.

Crail T.D.* and J.F. Gottgens. (2008) Testing the impact of vegetative colonization on fish community in the headwaters of the Ottawa River, northwest Ohio. Ecological Society of America Annual Meeting, Milwaukee, WI, August 3-8, 2008.

DeVanna K.M.* and C.M. Mayer. (2008) Hexagenia habitat choice: Effects of hypoxia and fish foraging. International Association for Great Lakes Research, Trent University, Peterborough, ON, May 2008.

Escobar, I. and C. Gruden*. (2008) Development of nanostructured temperature activated membranes, 2008 IWA North American Membrane Research Conference, Amherst, MA , August 10-12, 2008.

Gorey, C.* (2009) Growing up to be an engineer in Northwest Ohio, SETGO, Bowling Green State University, Bowling Green OH, February 5, 2009.

Gorey C.* , I. Escobar, A. Zaky, G. Cai and C. Gruden*. (2008) Cellulose acetate ultrafiltration membranes modified with temperature-sensitive polymers for fouling resistance, 2008 AIChE Annual Meeting, Philadelphia , PA , November 16-21, 2008.

Gorey C.* , I. Escobar, and C. Gruden*. (2008) Development of smart membrane with microbial monitoring capabilities, Water and Sanitation in International Development and Disaster Relief Workshop, Edinburgh , UK , May 28-30, 2008.

Gorey, C.* , A. Zaky, I. Escobar, C. Gruden*. (2008) Microbial-sensing membranes functionalized with a temperature sensitive polymer brushes, Sigma Xi, the University of Toledo, Toledo, OH, November 1, 2008.

Gorey, C.* , I. Escobar, and C. Gruden*. (2008) Microbial-sensing membranes functionalized with a temperature sensitive polymer film, 2008 International Conference on Membranes (ICOM), Honolulu, Hawaii, July 12-18, 2008.

Gorey, C.* , I. Escobar, and C. Gruden*. (2008) Microbial-sensing ultrafiltration membranes functionalized with temperature sensitive polymer brushes, American Water Works Association Annual Conference and Exposition (ACE08), Atlanta, GA, June 8-12, 2008.

Gruden, C.L.* and O. Mileyeva-Biebesheimer*. (2009) Microbiological fate of nanoparticles commonly found in personal care products. American Chemical Society Annual Conference, Salt Lake City, UT, March 23-26, 2009.

Haponski, A.E.* and T.E. Bollin*. (2008) College-High School collaborations: conducting science research in the high school classroom. Annual conference of KnowledgeWorks Foundation, Columbus, OH. October 2008.

Haponski, A.E.* and C.A. Stepien.* (2008) Molecular and biogeographic resolution of cryptic taxa in the Greenside Darter *Etheostoma blennioides* complex, International Association for Great Lakes Research, Trent University, Peterborough, ON, May 2008

Haponski, A.E.* and C.A.Stepien.* (2008) Walleye and yellow perch: 50 years of genetic history across Lake Erie. Lake Erie Fishery Genetics Managers Workshop, Lake Erie Center, University of Toledo, Toledo, OH. November 2008.

Haponski, A.E.*, T.E. Bollin*, and C.A. Stepien.* (2008) Genetic divergence patterns of the rainbow darter *Etheostoma caeruleum*: A watershed analysis using mitochondrial DNA sequences and nuclear microsatellites. Annual conference of Sigma Xi, the Scientific Honor Society, University chapter, University of Toledo, Toledo, OH. November 2008.

Haponski, A.E.*, O.J. Sepulveda-Villet*, and C.A. Stepien.* (2009) Temporal comparisons of Lake Erie yellow perch. Great Lakes Fishery Commission Walleye and Yellow Perch Task Groups annual meeting, Pickerel Creek, OH, February, 2009.

Haponski, A. E.*, O. J. Sepulveda-Villet*, and C.A. Stepien.* (2008) Walleye and yellow perch genetic history across the Great Lakes. Midwest Fish and Wildlife Annual Conference, Columbus, OH. December 2008.

Mileyeva-Biebesheimer O.*, and C.L. Gruden.* (2008) The impact of nanoparticles in personal care products on bacterial viability. Sigma Xi Student Research Symposium, Toledo, Ohio, November 2008.

Moorhead, D.*, M. Campbell*, K.M. DeVanna*, A.E. Haponski*, and W. Penamon*. (2008) Building a science learning community and enhancing student research opportunities through GK-12. GK-12 regional conference. Purdue University, Lafayette, IN. November 2008.

Sepulveda Villet, O.J.* and C.A. Stepien*. (2009) Population genetic basis for Lake Erie yellow perch stock structure and management units. Ohio Fish and Wildlife Manager's Association (OFWMA) Annual meeting 2009, Columbus, OH. February 6, 2009.

Sepulveda Villet, O.J.* and C.A. Stepien*. (2008) Population genetic basis for Lake Erie yellow perch stock structure and management units. 2008 Lake Erie Fisheries Genetic Workshop for Managers. Lake Erie Center, University of Toledo, Toledo OH. November 21, 2008.

Sepulveda Villet, O.J.* and C.A. Stepien*. (2008) Assessing genetic diversity and divergence levels of wild Yellow Perch and Walleye populations and applications to improving broodstock. AFS Fisheries Genetics Symposium, Ottawa, Canada. August 19, 2008

Stepien, C.A.* (2009) Career Insights of a Marine Biologist: Perspectives for Mentoring and insights from our NSF Gk-12 program. Seminar presentation to NSF SETGO program at Bowling Green State University. February 5, 2009.

Stepien, C.A.*, B. Bodamer*, T. Crail*, J. Blosser*, C. Kolinski*, G. Mentzer*, and W. Penamon*. (2009) Establishing an Environmental Science Learning Community at the Land-Lake Ecosystem Interface. Poster presentation at NSF National Gk-12 conference. Washington, D.C. March 27-29, 2009.

Zaky, A., G. Cai, C. Gruden*, C. Gorey*, and I. Escobar (2008) Biosensors incorporated into a fouling resistant ultrafiltration membrane for water treatment, 2008 AIChE Annual Meeting, Philadelphia, PA, November 16-21, 2008.

Sharing Information:

These presentations, including any associated published abstracts, were used to disseminate research and education findings with the academic and/or scientific community.

Contributions

Contributions within Discipline:

Please review the list of publications and presentations

In addition, we have been contributing to the Student Watershed Watch database, an 18 year program started by the late University of Toledo Professor Dr. Peter Fraleigh, around which we have built our Gk-12 program. In the SWW, high schools sample water quality and the macroinvertebrate community at schoolyard stream sites on a given autumn day. In November, student participants present the results at a summit meeting, this year held at the Toledo Zoo. Our Gk-12 program has extended this experience in classroom exercises and student projects throughout the school year, including science fair projects. We are currently revising the background material, instructions, and formulating a database entry form.

Contributions to Other Disciplines:

We are extending our research and education program to local high schools and the research and education communities as a whole by interfacing with other Gk-12 groups, sponsoring a high school student and educator poster show at the International Assoc. for Great Lakes Research annual conference to be held May 18-22, 2009, and through participating in Science Fair competitions.

Contributions to Human Resource Development:

As most of the fellows are women, we have placed female scientists and engineers in the classrooms to dispel the notion that only men are scientists and engineers.

As part of the involvement in the classroom, fellows mentor science fair projects that allow students to practice the research skills that have been taught on a one-on-one basis.

As most high school teachers have not been formally trained as scientists or engineers, the placement of fellows with advanced degrees provides insight for students who have minimal knowledge of what it takes to enter into these fields. This is of particular importance in schools of low-income areas whose exposure to continuing educational pathways is limited. These low-income schools often feature a high minority population that allows the fellows to reach a broad spectrum of ethnic groups. Combinations of teaching skills from the high school teachers and research and scientific skills from the fellows allow for the designing of new lesson plans that engage the students in relevant and rigorous science activities.

Contributions to Resources for Research and Education:

Lesson plans are available on-line and the graduate student educational paradigm has been changed to involve mentoring and engagement of high school students in STEM activities and research.

Around 500 students have been impacted from the involvement of the eight fellows and many have participated in a local research organization called Student Watershed Watch.

Local environmental organizations have sent speakers to interface with the grant participants about environmental topics and regulations.

Contributions Beyond Science and Engineering:

We have contributed through our learning community to engage the public in environmental and aesthetic experiences, including sponsoring a junior high school group to install a rain garden at the Lake Erie Research Center, and a high school senior eagle scout to plant native plants and supervise his troop in removing invasive species. We installed educational signage around both projects

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Book



NSF GK-12 Program

DGE-0742395



Establishing a GK-12 Environmental Science learning community at the land-lake ecosystem interface

PI: Carol Stepien Lead Co-PI: Daryl Moorhead

Co-PIs: Thomas Bridgeman, Timothy Fisher, and Cyndee Gruden

http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html



Our program partners eight advanced graduate students at the University of Toledo with eight teachers and their students at seven high schools, to build an Environmental Science Learning Community at the land-lake ecosystem interface. The objectives are to: 1) Generate student enthusiasm for science careers by engaging them in hands-on research into environmental problems, 2) Exchange knowledge and pedagogies between graduate students and high school teachers resulting in cutting-edge environmental science content and increased teaching and communication skills, and 3) Develop hands-on solutions to environmental problems along schoolyard stream ecosystems feeding the Great Lakes.

Graduate fellows in our program encompass the fields of aquatic ecology, hydrology, and environmental engineering. Our schools encompass an urban-suburban-rural gradient, and projects focus on augmenting an existing Student Watershed Watch (SWW) program; to which the fellows bring varied and synergistic research experience. SWW has been in place for 18 years, was formulated by a former University of Toledo professor (Dr. Peter Fraleigh, now deceased) and is coordinated by the Toledo Metropolitan Area Council of Governments (http://www.tmacog.org/Environment/SWW_08/SWW_08.htm). The SWW annual program features water quality and macroinvertebrate data collection on a designated fall collection date from schoolyard stream sites, and the high school students then present their findings at an annual conference. We are enhancing this program by increasing the quality of the student presentations, sampling, and data analysis; as well as providing additional classroom activities and sponsoring science fair projects.

Another novel aspect of our program is that we are planning a high school student poster show at the International Association for Great Lakes Research annual conference (which University of Toledo is hosting) in May 2009, which features posters by high school students across the Great Lakes Region of the U.S. and Canada. This is preceded by our own high school student poster show with 50+ posters on April 30 for students, parents, teachers, superintendents, and university administrators. Graduate fellows, teachers, and high school students are gaining hands-on experience in the role of urban and agricultural influences on watersheds in the history, social development, and future vitality of the Great Lakes region; disseminated through the project website, presentations, and publications. Our GK-12 program not only teaches students about water quality assessments and interests them in science careers, but more importantly it creates citizens who are informed about the environment.



For more information please visit our website http://www.utoledo.edu/as/lec/gk12_grant/gk12_main.html or contact our Program Manager: Rachel Lohner rachel.lohner@utoledo.edu or 419.530.8364.

University of Toledo Gk-12 Report April 2009-04-06
“An Environmental Science Learning Community at the Land-Lake Ecosystem Interface”

PROJECT ACTIVITIES

Two-week summer introduction course

- Teachers and Fellows spent 2 weeks working with UT Faculty working to better understand water quality, ecosystem health and faunal communities in their local streams and Lake Erie
- Obtained Ohio EPA Level 1 Macroinvertebrate certification for all Fellows and Teachers and PI-Co-PI team
- Led to teacher and fellow preparedness for the Student Watershed Watch and quantitative analysis of stream and lake
- Team building, self-reliance, and who within the team could answer the questions among the team
- We developed team work in sampling and characterized the schoolyard streams
- All groups made a macroinvertebrate collection and we made a joint fish collection that classes can borrow to check out

Produced Local Field Guide - “A Guide to the Common Fishes of the Toledo Area”
By Fellow Todd Crail

Student Watershed Watch

- 263 students and 8 teachers participated with their fellows from our group
- 4 teachers participated for the first time, all students participated for the first time
- Working to improve data collection, entry and interpretation for entire program
- Worked with teachers and students at GK-12 participating schools to do the SWW 2008
- Working on collating data of Toledo Area water quality from all participating schools.

Participated in U.S.A. Biology Olympiad

- One student has qualified for the semi-final exam

Aquarium design & setup in classrooms

NSF Meeting with NSF Dr. Arden Bement- our NSF Gk-12 fellows and 2 teachers attended his lecture and presented a poster in November 2008. All talked with Dr. Bement and had a photo opportunity.

NSF Regional GK-12 Conference at Purdue in November 2008

- Presented Program Poster – *“Building a Science Learning Community and Enhancing Student Research Opportunities Through GK-12”*

Participating in Northwest Ohio District 2 Regional Science Fair in March 2009

- (31) students participated under the direction of student fellows
- (3) teachers sent students for the first time
- (5) projects qualified for State Competition
- (4) sponsored awards
- (1) \$1,000 scholarship to the University of Toledo (renewable for 4 years)

Public Talks in the Environmental Science Learning Community

- Dr. Defne Apul, Assistant Professor, Dept. of Civil Engineering, University of Toledo - "Sustainability revolution in its infancy: What scientific and engineering resources and analysis approaches are currently available?"
- Rebecca Klaper and Matt Radcliff, "Inland Seas: Understanding and Protecting the Waters of the Great Lakes," funded by Wisconsin Coastal Management, UWM Great Lakes WATER Institute, and Paignton Pictures.
- Dr. Gerald Matisoff, Case Western Reserve University – “Hypoxia in Lake Erie”
- Dr. Peter Richards, Heidelberg College Water Quality Laboratory – “Food, Fertilizer, & Fouled Beaches: Water Quality in the Maumee River & the Western Basin of Lake Erie, 1975-Present”
- Dr. Robert Heath, Kent State University – “Lake Erie’s Dead Zone: Who Killed It?”
- Dr. Eugene Braig, Assistant Director, Ohio Sea Grant – “VHS, Beaches”.
- Dr. Isabel Escobar, Associate Professor, Dept. of Civil Engineering, University of Toledo- “What’s in Your Water?”
- Dr. Patrick Kocovsky, US Geological Survey – “Yellow Perch Numbers, Catchability & Management in Lake Erie”
- Dr. Frank Merritt, Professor of Law, University of Toledo- “Criminal Enforcement of Federal Environmental Laws (Or the Lack of It)”

NSF National GK-12 Conference in Washington D.C. March 2009

- Presented Program Poster – *“Establishing a GK-12 Environmental Science learning community at the land-lake ecosystem interface”*
- Classroom Activity – *“The River of Shame”*
- Fellow Research Poster – *“Testing the impact of vegetative colonization on the fish community in the headwaters of the Ottawa River, northwest Ohio”*

Hosting poster session at IAGLR09 (International Assoc. for Great Lakes Research) annual conference to be held at University of Toledo for an anticipated 650-700 scientists May 18-22, 2009

- 17 Posters Submitted (11 contributed by GK-12 participants) to a GK-12 Sponsored Session “High School Educators - Great Lakes Watershed Science”
- Some other GK-12 programs are participating

Hosting GK-12 High School student poster GALA for students at LEC

We are having a programmic student research poster show at the Lake Erie Center Thursday April 30, 2009 for high school superintendents, principals, teachers, students, parents, our graduate fellows, faculty, university administrators, and public officials

Invited talks in classrooms from University Faculty and Students

- Hans Gottgens – “The Ottawa River and Raingardens”
- Travellin’ Fish Show – Watershed and fish poster developed by fellow Todd Crail
- Tom Bridgeman – “Limnology in the Great Lakes and Beyond”
- Jill Shalabi – “Sustainability”
- Cyndee Gruden – “Pollution in your watershed”
- Daryl Moorhead – “Ecology in Antarctica”
- Isabel Escobar – “What it takes to be an engineer”
- Carol Stepien – “Fishes of the Great Lakes”

Lesson Plans – 8 contributed by teacher/fellow pairs + 1 group plan

- “The River of Shame” – Group lesson plan originated by teacher Michelle Bogue, and then refined by our group and presented at the annual Gk-12 conference in Washington, D.C. Illustrates the origin and fate of pollutants through student design of businesses and services along a watershed.
- “Macropoloy” – Student designed game to teach macroinvertebrate identification and roles in the watershed environment.
- Visualizing Solar Energy and the Ozone Layer – Illustrates the concepts of solar energy and the electromagnetic spectrum, and the function of the ozone layer.
- Life in a Lake: Modeling the effects of phosphorus on aquatic insects – Utilizes ecobeaker simulation software to demonstrate the effects of phosphorus on aquatic insects.
- Race to the Drains: How your school returns rainwater to the soil – Shows students how physical and abiotic features affect water infiltration into the soil using an interactive website.
- An Introduction to Water Quality – Students are asked to examine where their drinking water comes from, and learn about different water contaminates and pollution and quality and stuff and poop.
- Water to Land Lab – Creates basic model of how fossils are related to transgressive and regressive sequences.
- Introduction of Experimental p-value Utilizing Basics of Probability Theory – Students develop hypotheses and create and evaluate a variety of conclusions.
- Invasion! – Game demonstrates the effects of an invasive species on local aquatic life.

Individual Fellow Research

- **Betsy Bodamer** - My dissertation is examining how Lake Erie hypoxia (a.k.a. the “dead zone”) affects (physiologically and behaviorally) benthic foraging fish (e.g. Yellow Perch) and benthic dwelling invertebrates (e.g. *Hexagenia* mayfly larvae).
- **Melinda Campbell** - My thesis involves mapping the surficial geology of the Oak Openings Region and working towards reconstructing the geologic chronology of the region.
- **Todd Crail** – My doctoral research involves assemblage, niche and interspecific interactions in North American lotic aquatic systems.
- **Kristen DeVanna** - I am currently working on ecological interactions between an important native species in the Great Lakes, burrowing mayflies (*Hexagenia limbata* and *H. rigida*), and invasive zebra and quagga mussels (*Dreissena polymorpha* and *D. bugensis* respectively).
- **Colleen Gorey** - My research involves post-synthesis modification of water filtration membranes.
- **Amanda Haponski** - My dissertation research focuses on two important commercial fishery species walleye (*Sander vitreus*) and yellow perch (*Perca flavescens*). I am using archived scale samples to compare their genetic variation over the past 50 years in the Great Lakes.
- **Olga Milejeva-Biebesheimer** - I am working on several environmental problems including developing a membrane-based sensor for selected bacteria in drinking water, monitoring levels of the algal toxin microcystin in Lake Erie, and determining the fate and toxicity of nanoparticles commonly found in personal care products in the environment.
- **Jhonatan Sepulveda Villet** – I am working on the population genetic patterns of yellow perch (*Perca flavescens*) across their native range with a fine scale focus in Lake Erie.

University of Toledo Gk-12 Report April 2009-04-06
“An Environmental Science Learning Community at the Land-Lake Ecosystem Interface”

PROJECT FINDINGS

Evaluation Findings to Date by Evaluator Dr. Gale Mentzer:

The evaluation plan examines seven outcomes:

1) Participants will value content of summer course: Teachers felt the first week provided an appropriate balance between lecture and field/lab activities. They also agreed that they had a clear understanding of what to expect that first week. Teachers were asked if they might transfer their learning about specific topics to their classrooms. For every topic, a majority of the teachers felt the learning might be useful. In general, fellows learned new content on each of the topics covered during the summer. Eight of the nine felt that the field trip to the Sewage Treatment Plant provided them with new content. All participants completed a pretest/posttest of content covered over the summer. A dependent sample t test was performed and results showed a statistically significant gain in content knowledge ($t = 3.99$; $p < 0.001$; $n = 15$).

2) Participant knowledge gain of teaching inquiry-based lessons: Direct observation was made of six of the eight fellows. In each instance, fellows were engaged with students in gathering, analyzing, or synthesizing data. It was not clear from the observations how much collaboration between teacher and fellow occurs. It appeared in several cases that while the fellow interacted with students, the teacher was not providing guidance in areas like engaging the class, classroom management, and developing teamwork. Interviews with teachers provided more information. Seven teachers believed that their fellow has a better understanding of how to teach to high school students—how to break down a complex topic into chunks that the student can understand. Five of the teachers compared their approach to teaching in the fall with current methods and all noted that their fellows now are more effective in their teaching practices and interactions with students (communicate better, provide more hands on opportunities rather than lectures). Fellows completed a monthly reflection log based upon the Ohio State University GK-12 Fellow lesson report. Findings from a qualitative assessment of emerging themes shows growth in fellow teaching self-efficacy as well as in their ability to engage and relate to the high school students.

3) Application of knowledge and skills: See outcome 2.

4) Best practices followed by fellows working with students: See outcome 2.

5) Student science mastery: This will be measured using the 2009 scores of the Ohio Achievement Test. These scores will not be available until May or June 2009.

6) Student science fair participation: It was expected that interaction with the fellows would inspire students to engage in science extracurricular activities. Teachers indicated that last year none of their students participated in the science fair. This year, 26 students from five high schools entered the science fair. Six students received superior ratings, 15 were rated excellent and two earned a rating of good. Four students also received Governor's awards and one earned a

geology award. Interaction with the fellows has had a positive effect on student participation in the science fair.

7) Student knowledge of and interest in pursuing career opportunities in science: This outcome will be measured mid-April using a student survey adapted from “Creation of an Interdisciplinary Earth Materials Testing Laboratory to Enhance Undergraduate Science Education” (University of Wisconsin - Stevens Point, NSF Gk-12 project).

Other findings: Feedback from teachers and fellows and direct observation of the evaluator indicate there are some minor communication problems. Specifically, among and between teachers and fellows, the understanding of the purpose of the project and the way in which fellows were to interface with students varied. Some teachers integrated the fellows into regular classes and others only used them in small (less than 5 students), research-based classes. In some classes the fellows team-taught concepts with the teacher providing content and the fellow providing practical applications to illustrate concepts. In other classes the fellows integration was nothing more than what a pre-service science teacher might provide (a mirror of the teacher rather than a scientist adding substance to topics). To correct this, our faculty will meet to clearly determine how fellows will be used in the classrooms next year. These expectations will be compiled into a guide and shared with both fellows and teachers during our summer program. Returning teachers will assist in the development of this guide and even provide examples of successful ways in which they have incorporated the fellows into their classes this past year.

Results of 2008-09 LEC GK-12 Fellow Direct Observations

Direct observation was made of six of the eight fellows. In each instance, fellows were engaged with students in gathering, analyzing, or synthesizing data. The degree to which the fellow was involved with students varied, however, depending upon the class visited. In one case, the fellow was limited to interaction with an inappropriately small number of students and in other cases fellows either led instruction/labs or roamed through a lab session providing assistance and advice when asked. The fellows provided students with the opportunity to interact with a scientist and students in all of the classes visited appeared to have positive and respectful relationships with the fellows.

It was not clear from the observations how much collaboration between teacher and fellow occurs. It appeared in several cases that while the fellow interacted with students, the teacher was not providing guidance in areas like engaging the class, classroom management, and developing teamwork. In several of the classes visited, group activities were occurring but students were not provided with specific roles within their groups so often one or two students did most or all of the work. As a scientist, it is important that the fellow provide students with the model of collaborative teamwork. This is an efficient model that makes the most of everyone's talents. Interestingly, the teachers and fellows both experienced this type of teamwork during the summer program; and while designated duties were part of the Student Watershed Watch sampling observed, some regular classroom lab activities did not show this same evidence.

Of most concern was whether the fellows were providing students with more exposure to science topics, scientists, and scientific method than what might be provided by a pre-service science

teacher during field experience (student teaching). During two visits this appeared to be the case as the fellows worked with students on science research projects. However, during the other visits, the fellows appeared to be integrated into existing lessons rather than providing something beyond basic science instruction or providing a perspective beyond what the science teacher provided.

Recommendations: In general the observations showed that fellows interact well with the students and both teachers and fellows believe the experience to be positive. During the summer session teachers and fellows should plan activities that will showcase the fellow’s expertise and will interest students in pursuing science beyond required coursework. While assisting students in labs is helpful, it is not clear that it actually interests students in science or whether the students are just appreciative of someone helping them do their assignments.

A Summary of UT LEC Fellow Responses to Monthly Student Interaction Survey 2008-09

Eight fellows participated in the UT LEC GK-12 project representing various scientific and engineering content areas. Fellows spent approximately 10 hours per week in their partner teacher’s high school science classroom. According to NSF GK-12 guidelines, “As the graduate students bring their cutting-edge research and practice into the K-12 classroom, they gain these skills which enable them to explain science to people of all ages, ranging from students to teachers. The graduate students also inspire transformation in the K-12 formal and informal learning environments and stimulate interest in science and engineering among students and teachers.” The Monthly Student Interaction Survey measures fellows’ perceptions of the quality of their interactions with teachers and students. This survey included several statements that fellows were asked to rate their level of agreement with and several open-ended items to gather qualitative information to elaborate on the rating scale.

Because quantitative data collected on this survey was ordinal (ranked level of agreement with statements), modes, medians, and frequencies will be provided.

1) Overall my interaction with students went well (mode=strongly agree; median=strongly agree)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	18	56.3	64.3	64.3
	agree	10	31.3	35.7	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

2) I used inquiry-based instructional approach when working with students (mode=agree; median= agree).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	9	28.1	32.1	32.1
	agree	13	40.6	46.4	78.6
	no opinion	3	9.4	10.7	89.3
	not sure or don't know	3	9.4	10.7	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

3) My interaction with students built on their prior knowledge (mode & median=strongly agree)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	14	43.8	50.0	50.0
	agree	12	37.5	42.9	92.9
	no opinion	2	6.3	7.1	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

4) My interaction with students increased their content knowledge (mode & median=strongly agree)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	14	43.8	50.0	50.0
	agree	11	34.4	39.3	89.3
	no opinion	2	6.3	7.1	96.4
	not sure or don't know	1	3.1	3.6	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

5) Future interaction with students will build on what they learned during the past month (mode 7 median=agree)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	12	37.5	42.9	42.9
	agree	14	43.8	50.0	92.9
	no opinion	2	6.3	7.1	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

6) My work with the students is linked to the Ohio Science Content Standards (mode & median=agree)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	12	37.5	42.9	42.9
	agree	14	43.8	50.0	92.9
	no opinion	2	6.3	7.1	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

7) I feel I have worked with students for an appropriate amount of time over the past month (mode & median=strongly agree)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	14	43.8	50.0	50.0
	agree	13	40.6	46.4	96.4
	disagree	1	3.1	3.6	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

8) The students were appropriately engaged when I worked with them (mode & median=agree)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	10	31.3	35.7	35.7
	agree	15	46.9	53.6	89.3
	no opinion	2	6.3	7.1	96.4
	disagree	1	3.1	3.6	100.0
	Total	28	87.5	100.0	
Missing	System	4	12.5		
Total		32	100.0		

The fellows consistently felt that their interaction with students was positive and helpful. Initially some of the fellows did not understand what was meant by inquiry-based instruction (#2). The monthly report assisted in identifying areas that needed more explanation. Once the fellows understood what inquiry-based instruction entailed, their agreement level that inquiry-based instruction was utilized increased. Because each fellow’s experience was unique, it is not appropriate to generalize about trends or changes in responses over time. However, it appears that in general the level of agreement consistently varied between “strongly agree” and “agree” indicating that the fellows thought their experience with the students to be beneficial.

Open-ended items allowed the fellows to elaborate upon their experiences. Each month fellows were asked to report on the topics they covered over the past four weeks. Initially most were working with water quality and sampling procedures for the Student Watershed Watch. During this time, both students and some teachers viewed fellows as the experts new to the event. Eventually some of the fellows moved to mentoring students on the development of science fair and/or research projects (5). Fellows also interacted in the classroom as lab assistants for teacher led activities. For three fellows classroom and lab assistance appeared to be the only way in

which they worked with students. In these instances, students may not have been exposed to advanced scientific content or cutting edge research techniques.

When asked what evidence the fellows had to support their impressions of their interaction with the students, all indicated that students appeared interested in the topics, asked questions, and for those involved in projects, the students were eager to share progress with the fellow. Students were showing both an interest in doing science and mastery of science topics.

The fellows appeared to be gaining the ability to explain science to a variety of audiences. When asked what types of problems they encountered each month, the most frequent response was that no problems occurred. However, at some point most of the fellows admitted that they have had communication problems and have adjusted their teaching or mentoring methods to adapt to the high school student's level. For example, one fellow learned to be more careful about the way in which instructions were given because students tended to take them literally. Another mentioned that for PowerPoint demonstrations it was more effective to cut back on text and include more pictures (wise advice for everyone!). Three fellows mentioned student behavior as something they had not anticipated (not staying on task or not contributing to group work) and another was surprised at the students' somewhat limited writing skills. All of these examples illustrate that the fellows have been learning more about ability levels of the high school students and have adapted their methods of interaction to better communicate with the students.

In general, the fellows wished they had more time with the students. They felt that complex concepts were not allotted enough time and also the fellows felt spread thin amongst the students. Two fellows would have like to develop more interactive activities for their students and one felt that a lesson could have gone better if the information had been compartmentalized or chunked into smaller units of information so that the students could better grasp concepts. One fellow was unsure how to inspire some students to become more interested in the subject. All of these comments indicate that the fellows have developed a thoughtful, reflective teaching practice.

Conclusions/Recommendations: Overall it appears that, based upon the fellows' perceptions, the GK-12 classroom experience has contributed to the attainment of project goals. Some fellows had a collaborative experience with their teachers. Others, however, indicated that they felt they were not in a position to operate independently of their partner teacher. In other words, the teacher assigned the duties of the fellow and there was little discussion about how the fellow might better be incorporated into the class in general or into specific topics. With this in mind, it is recommended that the fellows and teachers spend more time planning activities or getting to know one another over the summer. Teachers need to be aware of the special talents their fellow can contribute to the classes and they also need to understand that the fellows will not inspire students if they only serve as lab assistants. A candid discussion prior to the next academic year should clarify expectations. A debriefing among just teachers as to how fellows contributed to their classes might be a way to inspire some teachers to make better use of their fellows. It may also be helpful to share project goals with both the fellows and the teachers.

Because some fellows will be new next year and some may be assigned to a different teacher, it is recommended an orientation be given to these fellows. A clear understanding of the expected

roles and responsibilities of the fellows would be helpful. A fellow buddy system or mentor may help the new fellows to acclimate to the program.

Results of 2008-09 LEC GK-12 Teacher Year-End Reflections

In March 2009, the eight participating teachers were asked to complete a report that coincides with the monthly fellow activity and reflection reports. Teachers were asked to rank their fellows on the same items the fellows completed on a monthly basis. These items and the frequency of teacher responses are listed below:

1. Please indicate the degree to which you agree or disagree with each of the following statements. Type an "X" for your response to each item.	Strongly Agree					Don't Know
	Agree				No Opinion/Not Sure	
	Disagree			Strongly Disagree		
a) Overall, my fellow's interaction with students went well.	4	3			1	
b) My fellow used inquiry-based instructional approach when working with students.	4	2	1	1		
c) My fellow's interaction with students built on their prior knowledge.	4	4				
d) My fellow's interaction with students increased their content knowledge.	5	2		1		
e) My fellow's work with the students is linked to the Ohio Science Content Standards.	3	5				
f) I am satisfied with the amount of time my fellow works with students	5	2		1		
g) The students were appropriately engaged when my fellow worked with them.	5	1		2		

Following this rating, teachers were asked open-ended questions in order to elaborate on the scale above. A summary of their responses follows:

1) *What evidence can you provide to support your impression of your fellow's interaction with students over the past six months?*

Four of the teachers indicated that students developed a genuine interest in the fellow over time. They observed that not only did the students come to identify the fellow as a teacher or mentor but also the fellows themselves took on more responsibilities for instruction and student interaction often by-passing the teacher. These teachers all noted that early in the program, the fellows were hesitant to take the initiative but after a few months real growth as a mentor became evident. Two other teachers also mentioned that interaction between the fellow and students increased and another felt the fellow was a positive person who was willing to help out in class. One teacher did not provide a response that satisfied the request for evidence of their assessment of the fellow.

2) *Describe how you used the fellow to enhance instruction.*

All of the teachers used the fellow to enhance science content. Four teachers indicated that the research skills of the fellow were used to help students in preparation for the Science Fair and three indicated that they and their fellow often team taught topics with the teacher providing the basic content and the fellow providing real life applications. Two teachers used their fellows to assist in lab sessions and one specifically mentioned that the fellow provided "personal

mentoring”. Finally, one teacher also asked the fellow for feedback on how well lessons went. In each case, the teacher identified and made use of the strengths and expertise the fellow brought to their classroom.

3) *Do you believe your fellow has a better understanding of pedagogy?*

Seven teachers believe that their fellow has a better understanding of how to teach to high school students—how to break down a complex topic into chunks that the student can understand. Five of the teachers compared their approach to teaching in the fall with current methods and all noted that their fellows now are more effective in their teaching practices and interactions with students (communicate better, provide more hands on opportunities rather than lectures). One teacher provided an extended explanation of the fellow’s growth:

When my fellow began with our class, the fellow was somewhat hesitant to engage students and did have many general questions regarding how to approach topics, deliver information, conduct assignments, etc. Initially, when conducting class, I would do much of the instruction and management of the class as the fellow observed. As time passed (very little time), the fellow became more and more comfortable in the classroom and became more and more active in everything that happened in the class. Where the fellow would initially wait or ask what to do next, now it seems to be second nature. Where the fellow initially would reserve adding information or answering student questions, now the fellow interacts with students just as I do. Today, as we plan how we will be approaching topics in class, there is little hesitancy in taking on tasks, discussions, labs, presentations, etc. The fellow has much experience in conducting research and following scientific methodology. In class, we try to use these methods to instruct and the fellow’s experiences have been a tremendous asset.

One of the teachers was not sure if the fellow’s understanding of pedagogy improved because the teacher did not use the fellow in a teaching role.

4) *In retrospect, how might you change the fellow’s experience or the way in which you utilized the fellow? Would you include any training?*

Two teachers felt nothing needed to be changed although one did mention that more time for planning would be helpful. Three teachers indicated that some time was wasted early on because other than the Student Watershed Watch, they were unsure of how to make use of the fellow. A strong theme emerged that focused on understanding the roles and responsibilities of both the teachers and the fellows. Three teachers specifically mentioned that clear guidelines as to what to expect from both teachers and fellows should be provided prior to the summer program. One teacher felt somewhat cheated in that the fellow assigned did not have mastery of content appropriate for the class the fellow was assigned to. Three teachers felt that some type of teacher training should be provided to the fellows prior to entering the classrooms so that they could more easily assimilate.

5) *Other comments.*

Five teachers provided additional comments. Two teachers reiterated the positive experience they had. Two teachers indicated that because they were unclear about the role of the fellow in

the classroom beyond Student Watershed Watch, they probably did not utilize the fellow as much as they could. One also assumed that the fellow had a better grasp of what it is like to work with high school students than was true. Finally, one teacher regretted that the fellow did not interact with students as much as had been anticipated. These last two teachers both indicated that next year they would do things differently having learned much about the dynamics of teacher-fellow-student this year.

Recommendations: Prior to the 2009 summer program, UT faculty involved in this project should meet to clearly determine how fellows will be used in the classrooms. These expectations should be compiled into a guide that is shared with both fellows and teachers prior to fellows working in the classroom. Returning teachers might assist with this guide and even provide examples of successful ways in which they have incorporated the fellows into their classes this past year. It is also recommended that the selection of fellows take these expectations into account. Additionally, teachers must be aware of their obligation to encourage fellows to interact with students on a regular basis and to gain knowledge in areas in which they may be weak in order to provide a contribution to the classes.

Other than comments concerning lack of clarity as to the roles of teachers and fellows this experience has been positive for the teachers. Many indicated spinning their wheels early on but once they understood how the fellow could be utilized they saw value in having a fellow assigned to their classes. While fellows meet regularly without teachers present, it is not clear whether the teachers ever meet without the fellows. If not, it is recommended that at least twice a year a teacher debriefing session be held so that teachers can air concerns, share ideas, and ensure they are making the most of their fellows.

COMMENTS BY P.I. DR. CAROL STEPIEN:

The teachers and fellows seemed to initially want a P.I.-specified direct agenda, which was not in their best interest or in the spirit of creativity that is the goal of the Gk-12 program. Over the course of our weekly meetings, the program successfully evolved and the fellows and teachers worked this out. One fellow was difficult to work with, despite being paired with a very successful, creative, and experienced teacher. This fellow is the student of a co-PI and, although she is a US citizen, she was educated in another country in an educational system very different from ours. She also had some ESL difficulties and tends to be rigid. She is graduating from our program and thus will not be continuing on. The teacher is being paired with another continuing student, with whom she should be happier.

One of our Greatest Successes has been in mentoring High School Research and Science Fair Projects (next page):

High School Student Presentations sponsored by our Gk-12 Fellows at the Northwest Ohio District 2 Regional Science Fair March 28, 2009

Student(s)	Grade	Project Title	Score	Awards
E. Serna & A. Murray	9	Identifying Changes in Gene Expression when Melanocytes are exposed to UVB Light	Superior	
M. Kime	9	Do Cars Blow?	Superior	2nd Place Governor's Award for Excellence in Energy Research
M. Hileman	9	Which Insulation is Better: Natural or Man-Made?	Superior	1st Place Governor's Award for Excellence in Energy Research
A. Hylant	9	Is it Worth it?	Excellent	2nd Place Governor's Award for Litter Prevention and Recycling Research
J. Walter	9	Store Bought vs. Homemade Bread	Excellent	
Y. Gore	9	Which Candles Produce More Heat: Soy or Wax?	Excellent	
N. Denner & V. Burchinow	9	Recalled to Life: Bringing Plants Back from the Dead	Excellent	
C. Liu	9	Are Luxury Moisturizers Worth the Money?	Excellent	
K. Young	9	Vitamin Phenomenon: Natural vs. Synthetic	Excellent	
E. Brochin & A. Moreau	9	The Super Stroop Effect	Excellent	
L. Buckey & K. Shollenberger	9	Can I Have Your Number?	Excellent	
P. Joseph & D. Stockton	9	Sports Drink Phenomenon	Excellent	
N. Fisher & B. Day	9	I-Rate	Excellent	
J. Saddemi & M. Spetka	9	Aquatic Emissions	Good	
B. Gan	9	The Decaying Apple	Good	
B. Hauri	11	The Effects of Ibuprofen on Crayfish	Superior	
S. Bollinger	12	Survival Rates of Crayfish in Alkalinity and Acidic Water Conditions	Excellent	
E. Harris	12	Teaching Styles: Lessons on Macroinvertebrates	Excellent	
I. Hickman	12	Bacteria	Excellent	
K. Gibbons & P. Fink	12	Using Ground Penetrating Radar to Locate Unmarked Graves	Excellent	Geology Award
S. Karsiotis	12	Salinity Tolerance of the Exotic Round Goby: Experimental Implications for Seawater Ballast Exchange	Superior	1st Place Governor's Award for Excellence in Environmental Science and Tillotson UT District Science Day Scholarship
D. Tung	11	The Strength of Different Properties of Wooden Construction Materials for Building Houses	Excellent	
L. Wendt	12	The Effects of Music Tempo on Acceleration and Deceleration of Heart Rate	Superior	

Quotations of some of our GK-12 Program Personnel:

“I like to think of myself as having provided the students with a pretty good cake in the past (in terms of science knowledge, experience, etc.), but having my GK-12 Fellow, Jhonatan, in the classroom this year has provided the most incredibly rich and tasty frosting to that cake. I have loved the experience and I KNOW my students have benefited.”

Wendy Wilson, Teacher Start High School

"I was walking down the crowded halls of the high school and noticed a student in one of the classes I work with stop talking to her friends and run up to me showing me a new set of data she had collected for a science fair project. It was that moment I knew that I had engaged students in the scientific process."

Kristen DeVanna, Graduate Fellow

“The GK-12 program gave me both insight to the perspectives of K-12 science teachers and an appreciation of their impressive mastery of functional knowledge. I say ‘functional’ because every tidbit of new information was immediately integrated within their teaching repertoire; they transform their learning experiences into potential teaching experiences with a facility that left me floundering. I have much to learn from them.”

Daryl Moorhead, Co-Principal Investigator

“The GK-12 program has given me the unique opportunity to work in an urban school, in a classroom situation controlled by professional educator, where my time is spent enhancing the curriculum and individual students' experiences who otherwise would not get the extra attention. I think that is just fantastic!”

Todd Crail, Graduate Fellow

“I love having the expertise of my PhD fellow. He adds ideas and examples that I have never even heard of, it makes the topic fuller to discuss things outside of the textbook. Also, he doesn't just talk about the ideas, but brings visual aids to give kids a fuller experience.”

Jahnine Blosser, Teacher, Scott High School

“There is many a topic that sparked my interest while visiting the Lake Erie Center. Questions such as ‘does the dominant population of zebra mussels ever balance the possible infestation of mayflies?’ or do they always pose a threat to the mayfly population? Also, is there any way to reverse the dominant effect the round gobies have by balancing the ecosystem? These are some questions that I thought while at the Lake Erie Center. Overall, I feel that as a student, I have learned a lot from this field trip.”

Miranda Paredes, Start High School Student

“What I liked best about the field trip was when I got to classify the fish. Wearing the gloves and being able to touch the fish made me feel like a real scientist making a discovery because all these things were new to me.”

Cassie Dreslinski, Start High School Student

“I’d like to know more about the pollution of the lake. That subject has always interested me. I’ve never seen naturally clear water (I’ve never been to a beach either so I don’t know). Every time I see the Maumee River so muddy with cans and whatnot floating in it makes me sad.”
Alicia Calvin-McNeal, Start High School Student