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 NSF BooKS Summer Workshop Summary  
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Anchors Away!

Welcome to the *Boat of Knowledge in the Science Classroom* (BookS), a National Science Foundation GK-12 project to bring high school teachers, their classrooms, graduate Fellows in civil engineering, biology and computer science together with higher education faculty to explore the Ohio River. While the Ohio River is found in the backyards of many school yards in Southeast Ohio, high school teachers and their students seldom have the opportunity to explore this body of water with respect to water quality, river habitats and environmental concerns that are often the result of the coal and farming industries in the area adjacent to their schools.

The *BookS* week of professional development provided high school teachers and graduate Fellows an opportunity to connect their own understanding of biology, chemistry, engineering, teaching and learning to the larger concept of the water quality of the Ohio River. Through a series of hands-on labs involving water chemistry, macroinvertebrates, biological assessment, and guest speakers, teachers and Fellows were challenged to frame questions concerning the water quality in the Ohio River area closest to their school and begin to plan lessons to help their students answer those questions.

Introductions began with an overview of the goals for the *Boat-of-Knowledge* project and the roles of the Fellows, teachers, students and OU faculty in supporting the research and classroom implementation by Dr. Tiao Chang, PI. The Ohio Science Academic Content Standards to be explored during lesson design, research data to be collected, development of teacher-Fellow teams and school environments were discussed in depth with Dr. Teresa Franklin, Co-PI, in preparation for visitation to the *BookS* boat later in the week. Sample lesson plans concerning water quality and environmental issues were explored for future use in the classroom. Pre-testing of teacher and Fellow science knowledge was conducted for comparison to post testing “knowledge gains” for the end of the week.

Dr. Tiao Chang conversation with teachers and Fellows presented an overview of the Ohio Basin, its watershed, and the changes that have occurred over the years. He helped the teachers identify the watershed regions of the Ohio and how this impacts the water quality of the Ohio



Dr. Kelly Johnson, helps the teachers and Fellows in identifying river water specimens.



*Hands-on activities prepare teachers and Fellows for the boat trip.*

River. Dr. Kelly Johnson, Co-PI, challenged teachers on their knowledge of the science of the Ohio River, the human impact on rivers, locks and dams, key pollutant concerns and their sources, and the role scientists play in monitoring and regulating the Ohio River. Several presentations were provided to the teachers and Fellows to support their understanding of the Ohio River and in

particular this region of the river. The hands-on lab activities in the afternoons examined the biological indicators of a health river ecosystem. Teachers used taxonomic charts and field guides to examine specimens and were very surprised to note the large variety of macroinvertebrates that could be identified and used to index water quality. The professional development included a presentation, *Using Fish to Evaluate the Ohio River*, by Peter Thompson, Ohio Environmental Protection Agency, Southeastern District Office. The afternoon concluded with Dr. Suzanne Nichols, project evaluator, sharing evaluation techniques to be used in classrooms and in the field to determine the goals of the *BooKS* project are being met.

As Southeast Ohio is well known for acid mine run-off which eventually reaches the Ohio River, Fellow Ebenezer Aluma presented his research in determining mercury levels from mine run-off and the impact on the region. Ebenezer also shared with the teachers and Fellows the research strategy and hypothesis of his work that will become part of his dissertation. Graduate assistant, Ying Zhang and Fellow Nathan Andre presented information on the virtual boat to be built as part of the project to allow students nationally to participate in the *BooKS* project. Nathan and Ying shared past science games built by Ohio University *STEAM* project as examples of how the virtual world would be used in the classroom.



Teachers, Fellows, faculty, and scientists were welcomed aboard the *NSF GK-12 BooKS* boat docked in Marietta, Ohio, in anticipation of conducting real-world experiments on the Muskingham and Ohio Rivers. After an thorough “safety on-board training session”, Captains Dave Diggle and Tiao Chang pulled away from the dock and the *NSF GK-12 BooKS* began to navigate the Muskingham to a site to examine river habitats, macroinvertebrates, turbidity, water velocity as

well as water chemistry with the datasondes and colorimetric assays. Dr. Chuck Somerville, Marshall University, shared strategies for testing for fecal contamination of water while Dr. Michael Miller, University of Cincinnati, discussed the biodiversity of the river in the region. Ms. Erin Crowley, Northern Kentucky University, provided instruction in the examination of river bank habitats and how those influence the health of the river. Fellows and teachers quickly learned to navigate the array of water-testing equipment found on the boat and collected samples on both the Muskingham and Ohio Rivers over a 3 hour period.

The excitement of Thursday's boat trip carried over into the discussions on Friday concerning how the schools might participate in collecting water samples from the boat in future visits. Teachers and Fellows indicated in their journaling that the boat added a real-world dimension to the study of the water quality of the Ohio River and that the experiments would resonate well with the students and increase their understanding of the impact of the Ohio and Muskingham Rivers upon the areas in which they live. Teachers noted the high quality of the Fellows, the cooperativeness of the faculty and the impressive resources provided by Ohio University for the work of the BookS project.



Fellows collect samples from the Ohio and Muskingham Rivers for analysis with their partner teacher.

Most teachers and Fellows noted that the "Fish Tales" presentation provided the most applicable information for the classroom and the content within the high school science classes. All reflected on the loss of biological diversity as a very serious problem. Reflections from teachers noted that many Appalachian students lived in areas where the effects of acid mine drainage are still being observed. There are several areas where the effects of clear-cutting and logging, etc. have caused problems with soil erosion leading to changes of nearby stream quality and diversity. Taking bio counts upstream, downstream and at the source of pollution and then putting the information into graphs could illustrate such effects and present a real-world view of the ecosystems at work in the region. One teacher noted that losing a species would be like losing a good friend, and losing a habitat would be like losing your home. The species in any ecosystem are very closely entwined, and even if something doesn't affect a species directly, it is sure to affect the species indirectly due to the effects it has on the surrounding species. Teachers found the professional development to be a good mix of speakers, subjects, and hands on activities and the focus on the Ohio River to be an exciting challenge for the school year.