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Teaching STEM for the Public Good

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On 24 March 2018, Science Education for New Civic Engagements and Responsibilities (SENCER), the “signature initiative” of the National Center for Science and Civic Engagement, hosted the Kentucky SENCER Inaugural Workshop at the University of Louisville. The workshop asked its participants—hailing from postsecondary institutions across the state—how they might incorporate civic engagement in STEM course design. Eliza Reilly, the Executive Director of SENCER, explained that undergraduate students are increasingly interested in hands-on, practical projects; assignments that link them directly to local community leaders; and, most importantly, socially relevant jobs after graduation. Participants were encouraged to offer more interdisciplinary classes and to include civic engagement in STEM courses so that students can engage with the public before graduating and better prepare themselves for applying their learning at work and in civic life.
Definitions of civic engagement divide the activity into two parts. First, we identify issues of public concern and, then, we make a difference in the community. During one of the day's sessions, Glenn Odenbrett described civic engagement as a four-tiered pyramid.\(^1\)

For the bottom tier, conversation, instructors can easily teach or discuss civic engagement through socially relevant articles from current news or magazine sources (e.g., why did local officials switch drinking water sources in Flint? how does one measure lead in water? what are the effects of lead on the human body?). For the second tier, contact, an instructor may invite guests for in-class discussions or take students on field trips (e.g., a physician visits class to describe the diagnosis and treatment of lead poisoning). For the third tier, collaboration, students may engage in projects, service learning, and community-based research (e.g., Lora Haynes described taking her students to Flint where they applied research to help local residents).\(^2\) For the fourth and top tier, community leadership, classes can partner with local NGOs, engage in advocacy work, and share resources with local civic groups (e.g., Marc Edwards first identified lead levels in the Flint water supply, became one of the first whistleblowers, and joined the Michigan Governor’s project to alleviate water contamination issues).\(^3\) The bottom tiers prepare students for more active work in the top tiers. Odenbrett indicated that as the level of civic engagement increases, so do levels of complexity, risk, and community interaction, while, inversely, faculty control decreases.
The workshop provided an opportunity to learn about current civic projects in STEM education.

1. Martin Brock teaches in the SEEing Science in Appalachia course sequence for the Eastern Kentucky University honors program, which involves service learning experiences related to bee sustainability, the Tates Creek watershed, and Moore’s Branch Creek. Brock also teaches courses on coal, bourbon, and pot; chemistry and art; myths and science of the sun; and chemistry and waste management. His greatest success, however, is working with students and colleagues to enrich science education in elementary and middle schools.4

2. Eliza Riley, as Executive Director of SENCER, has overseen the development of over 55 peer-reviewed and field-tested model courses intended to assist instructors in the development of STEM curricula at postsecondary institutions.5 One course involves soil conservation, worms, and soil toxicity; another involves the chemistry of beer, e.g., fermentation, germination, and yeast.

3. Glenn Odenbrett specializes in water conservation in the Great Lakes region. He has earned a national reputation for integrating community service in his course design by embedding students with conservationists.

4. Alice Jones worked with community leaders in eastern Kentucky to identify important issues and opportunities for partnership. Her students worked with local residents to assess and identify issues with the quality of drinking water. Jones believes that her students’ work with local children inspired the latter to consider higher education.6

5. Lorna Hayes arranges for her students to work with community counseling agencies that help women and children. Research and reflection enhance their experiences.

6. David Simpson’s urban development program offers interdisciplinary bachelor’s and master’s degrees in sustainability. Among other projects, his students have shown tailgaters at sporting events how and why to recycle.7
At the University of Kentucky, I teach full-semester honors courses and seven-week courses that start late during the regular semester (these offer students a second chance to maintain full-time status if they need to withdraw from other courses). I also teach courses at Jilin University, in Changchun, China, during the early summer. By way of Odenbrett’s civic engagement pyramid, my students engage in conversation, contact, and collaboration (tiers one through three).

1. As examples of the first tier, conversation, I engage students with content and discussion relating to the effects of lead on the human body, the importance of nutritional fact labels on food packaging, and the ethical, legal, and emotional costs of assisted reproduction in courses focusing on the science of what we drink, the science of what we eat, and sex after 1978.

2. As examples of the second tier, contact, my honors students work with original archival material held at the University of Kentucky to consider how to collect, analyze, present, and conduct research on primary sources. We interpret notes made by researchers in the margins of documents (e.g., why a mother-in-law did not want her daughter-in-law to take part in a particular research project at the time), as well as demographic information (e.g., a research participant in Appalachia, age 20, with four or five children).

3. As an example of the third tier, collaboration, students in my food and drink courses visit FoodChain, a nonprofit organization in Lexington, Kentucky that provides resources and education relating to fresh food and sustainable food systems. We examine FoodChain’s fermentation waste recycling system, which uses pellets made from spent beer grains to feed fish grown in closed-circuit aquaponics systems. Students investigate why the fish don’t suffer from a buildup of their own waste by observing the water circulation through growing salad greens, which absorb nitrogen and clean the water before it returns to the fish. All of this supports a local restaurant in a food desert. Students learn about food, fermentation, recycling, food deserts, microgreens, and sustainability.

Time constraints have prevented me from engaging in the fourth tier, community leadership. As a reflection on the workshop proceedings, interdisciplinary programs (such as MIT’s doctoral program in history, anthropology, and science, technology, and society) represent promising ways of fostering civic engagement in higher education. Regardless of program, we all would do well to reflect on how we might incorporate any level of civic engagement in our STEM courses.
NOTES

1. Dr. Glenn Odenbrett is Director of the Great Lakes Innovative Stewardship Through Education Network.

2. Dr. Lorna Haynes is an Assistant Professor in the Department of Psychological and Brain Sciences at the University of Louisville.

3. Dr. Marc Edwards is a University Distinguished Professor in the The Charles E. Via, Jr. Department of Civil & Environmental Engineering at Virginia Tech University.

4. Dr. Martin Brock is an Associate Professor in the Department of Chemistry at Eastern Kentucky University.

5. To access the model courses, go to sencer.net/model-courses/.

6. Dr. Alice Jones is a Professor in the Department of Geosciences at Eastern Kentucky University.

7. Dr. David Simpson is the Fifth Third Bank Professor in Community Development, and serves as the Chair of the Department of Urban and Public Affairs at the University of Louisville.

8. For more on FoodChain, go to foodchainlex.org/.

9. For a full program of the day’s workshop, go to ncsce.net/wp-content/uploads/2018/03/KYSENCER-2018-Program-final.pdf. I am grateful to Katherine Rogers-Carpenter and Sumit Das for their assistance in editing and proofreading this manuscript.

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Vlad Tchompalov, Untitled, Unsplash, Public Domain (Title).
Glenn Odenbrett, “Typology of Civic Engagement in Higher Education,” National Center for Science and Civic Engagement, 2010, All Rights Reserved, used w/ permission (Figure 1).

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AUTHOR

Dr. Rita Basuray directed human in vitro fertilization labs for 18 years. After moving to Lexington, she started to teach elective, late-semester courses at the University of Kentucky. Her courses are general in nature, but encourage students to make connections between science, history, geography, and social sciences.