

## **Proposal for Creating a Research Action Cluster (RAC)**

### ***Cultivating a National Collaborative for Research on Food, Energy, and Water Education (NC-FEW)***

**Problem to be Addressed:** Worldwide, there has been rapidly growing interest in research, education, and discourse around the Food-Energy-Water-Nexus (FEW-Nexus). The FEW-Nexus serves as a conceptual framework to describe and aid in addressing complex interrelationships associated with coupled human-natural systems at local, regional, and global scales. The inter-linkages between water, energy, and food means that changes in one system can have far-reaching impacts in others, resulting in significant ecological, economic, social, and political consequences. The nexus serves as an analytical tool to understand the interplay between natural systems and their human dimensions. Envisioning their interconnections as a ‘nexus’ aids in decision-making that span particular objectives, production and consumption pathways, and regulatory modes. In short, the nexus idea affords greater ability to represent systems as holistic entities that go beyond a simple sum of their constituent parts. The potential of the FEW-Nexus has been recognized most recently in the U.S. through NSF and USDA-NIFA’s collaborative *Innovations at the Nexus of Food, Energy, & Water (INFEWS)* initiative, which has led to a series of science-focused workshops and funded research projects. However, the education component of these efforts has been underemphasized and under-represented, despite compelling evidence for the very real and pressing global challenges in the FEW-Nexus, the need to foster science literacy in America’s citizenry, and necessity of meeting ever-evolving needs of the STEM workforce. These challenges provide a rationale for sustained, systemic, and interdisciplinary education efforts focused on food, energy, and water issues in a wide array of educational contexts. All students must be actively supported to learn to leverage scientific knowledge and negotiate its intersection with social, cultural, and economic values to make science informed decisions about FEW issues. Institutions of higher education must take a leading role in fostering science literacy as a means of preparing all global citizens for the FEW challenges of today and tomorrow. However, no systematic discipline-based education research (DBER) effort currently exists to study strategies, processes, and outcomes of FEW education efforts. As a result, little research has been conducted to understand teaching and learning in the FEW-Nexus. The opportunities for innovative DBER around the FEW-Nexus are very real but as-yet unrealized. Capitalizing fully on this significant opportunity will require transdisciplinary collaborations that can be greatly facilitated by cultivating a community around FEW education and DBER that is national in scope. NSEC-affiliated centers are uniquely positioned to synergize this effort with an emphasis on STEM. This project affords NSEC the opportunity to be a critical incubator for growth of a targeted, transdisciplinary, timely, and high-impact DBER community through which to cultivate scientific literacy.

**Individuals and Institutions in the RAC:** This proposal builds upon recent and ongoing efforts to address this need by cultivating a national network of DBER faculty focused on education grounded in the FEW-Nexus. In fall of 2016, a Multistate Research Planning Committee – NCDC231, *Collaborative for Research on Food, Energy, and Water Education* – was proposed, approved, and established with support from partner Land Grant institutions, each of which committed a small amount of annual travel funding to the committee’s efforts. The new committee will serve as a nucleus for cultivating a national network of scholars committed to DBER grounded in the FEW-Nexus. It is led out of the University of Nebraska-Lincoln which, over the past five years, has heavily invested in an institutional Science Literacy Initiative and associated faculty cluster hire, as well as more broadly to DBER-focused approaches to STEM education. The 12-member NCDC231 planning committee met in April, 2017 for an initial, full-day meeting as part of the 2017 Water for Food Global Conference in Lincoln, NE and facilitated an invited symposium focused on national FEW education efforts with contributions from 25 projects. Through the present proposal, we seek to leverage these early efforts and investments to advance longer-term capacity-building goals, which include expanding this network to include a broad array of transdisciplinary collaborators as part of a *National Collaborative for Research on Food, Energy, and Water Education (NC-FEW)*. The partner institutions and NSEC member centers in Table 1 reflect this transdisciplinarity and provide evidence of existing institutional buy-in.

Table 1: *NC-FEW Partner Institutions and Institutional Contacts/Project Team Members*

## Proposal for Creating a Research Action Cluster (RAC)

### *Cultivating a National Collaborative for Research on Food, Energy, and Water Education (NC-FEW)*

Institution	NSEC-Affiliated Center	Institutional Contacts
University of Nebraska-Lincoln	Nebraska Collaborative for Food, Energy, & Water Education	Dr. Cory Forbes
	Center for Science, Mathematics and Computer Education	Dr. Leilani Arthurs
Purdue University	Center for Advancing the Teaching and Learning of STEM (CATALYST)	Dr. Hui-Hui Wang
		Dr. Lynn Bryan
University of Missouri	ReSTEM Institute: Reimagining & Researching STEM Education	Dr. Christine Li
		Dr. Troy Sadler
Virginia Tech	Center for Research in SEAD Education at Virginia Tech	Dr. Hannah Scherer
		Dr. Liesl Baum
University of Oregon	Science Literacy Program (SLP)	Dr. Nicola Barber
		Eleanor Vandegrift
Michigan State University	CREATE for STEM Institute	Dr. Kelly Millenbah
		Dr. Joe Krajcik
University of Minnesota	STEM Education Center	Dr. Brad Greiman
		Dr. Gillian Roehrig

The DBER work that defines this group is fundamentally problem-based and multidisciplinary, foregrounding the promotion of science literacy through post-secondary FEW education efforts. Programs in this domain often involve a focus on systems thinking and are typically interdisciplinary in nature, spanning the sciences, social sciences, education, and in some cases, the humanities. Disciplinary homes of current NC-FEW members include departments of agricultural education and communication, colleges/schools of natural resources, science, math, technology, and engineering education faculty from colleges of education, and scientists and engineers. This inherent transdisciplinarity is a significant strength of the FEW education program model and the growing community of DBER faculty who have coalesced around it. Because the FEW-Nexus encompasses large-scale and coupled human-natural systems, it is highly appropriate and beneficial for such a network of scholars to reflect the many disciplinary perspectives that must be brought to bear on challenges facing post-secondary institutions to engage in effective undergraduate education in the FEW-Nexus. The transdisciplinary nature of NC-FEW is one of its core features that position it for systemic long-term impact at multiple levels, including individual partner institutions, as well as nationally.

**Proposed Intervention or Activities:** The multistate and multidisciplinary approach provides an exceptional opportunity to catalyze regional and national collaborative projects that will allow NC-FEW members to develop and implement comprehensive DBER programs that produce empirical findings, delineating baseline data to be used as benchmarks over time to ascertain the effectiveness of new FEW-Nexus education programs, develop innovative tools to aid in educational responsiveness to emergent FEW issues, and to cultivate a network that expand nationally and internationally to address FEW issues worldwide through effective, research-based educational methods and interventions. Toward that end, we propose to convene an invited workshop focused on DBER in the FEW-Nexus. A fundamental assumption underlying the establishment of NCDC231 is that *the FEW-Nexus affords a novel theoretical and analytical lens through which to foster and understand STEM reasoning and decision-making about FEW challenges*. The purpose of this 2-day workshop will be to draw upon expertise from an expanded group of faculty representing partner institution in Table 1, as well as those from other institutions, to contribute to development of an elaborated blueprint for systemic, high-impact DBER in the FEW-Nexus. Upon funding, we will convene a conference planning committee in September of 2017. Project team members from institutions and centers in Table 1 will assume responsibility for planning and facilitating the workshop. The conference planning committee will play a key role in articulating 1) a plan for disseminating information about the conference and 2) the workshop agenda with greatest impact. To define the focus of the proposed invited workshop, we draw upon a couple critical sources of information.

## Proposal for Creating a Research Action Cluster (RAC)

### *Cultivating a National Collaborative for Research on Food, Energy, and Water Education (NC-FEW)*

First, through the NCDC231 meeting in April, 2017, the project team identified a set of core themes driving post-secondary DBER in the FEW-Nexus. These include:

1. Reposition the pursuit of food, energy, water education in context of pressing localized problems with global significance (Learning as Participation)
2. Prioritize efforts that attend to equitable and accessible participation in food, water, energy learning, planning, and problem solving (Equity and Accessibility)
3. Priority for research around the food, water, energy nexus education in context of the relationship between humans, landscapes, and systems (Building New Knowledge)

Second, in advance of the proposed workshop, the planning team will administer a nationwide survey to FEW educators and education researchers on these three priority themes. We anticipate targeting members of an array of professional organizations whose members have an interest in FEW education and education research, and in which NCDC231 committee members are engaged. These include:

- American Association for Agricultural Education (AAAE)
- American Educational Research Association (AERA)
- European Science Education Research Association (ESERA)
- Geological Society of America (GSA)
- International Society of the Learning Sciences (ISLS)
- National Association for Research in Science Teaching (NARST)
- National Association of Geoscience Teachers (NAGT)
- National Science Teachers Association (NSTA)
- North American Association for Environmental Education (NAAEE)
- North American Colleges and Teachers of Agriculture (NACTA)
- National Association of Biology Teachers (NABT)
- Society for the Advancement of Biology Education Research (SABER)

This information, collected before the workshop is held, will provide baseline information for organizing workshop sessions and events that reflect the current state of conversations around these themes at a national level. Workshop planning team members have access through their membership within these organizations and/or have professional relationships with their executive directors who may distribute survey questionnaires. Utilizing the memberships and/or relationships will ensure survey distribution to the majority of relevant FEW educators and education researchers nationwide, thus increasing the validity of the information collected. Overall, this effort will lay the foundation for long-term efforts through which NSEC and affiliated centers can work collaboratively to advance a coherent agenda.

The workshop will be held in conjunction with the 2<sup>nd</sup> annual NCDC231 committee meeting in spring, 2018 at Nebraska Innovation Campus. As lead institution, UNL will assume primary responsibility for organizing and hosting the workshop, as reflected in the project budget match. UNL personnel have extensive expertise planning and organizing large events through IANR Science Literacy and Center for Science, Mathematics, and Computing Education. Dr. Cory Forbes, UNL, will lead this effort through his administrative responsibilities as NCDC231 Committee Chair, Director of the NC-FEW, and IANR Science Literacy Coordinator. We anticipate 40 workshop attendees from the UNL community and other institutions. These attendees include official members of the NCDC231 committee, additional attendees who participated in the 2017 NCDC231 meeting and invited symposium, and others who have expressed interest in the growing network. Participants will register through an online conference portal available through UNL. Correspondence will be coordinated by the workshop organizing committee and UNL personnel. The proposed workshop will focus on activities and interactions that further advancement of NC-FEW goals. A tentative proposed program is shown in Table 2:

Table 2. Proposed Workshop Program

	<b>DAY 1</b>
10:00 AM	Welcome and Opening Session: <i>The Importance of Science Literacy</i>

## Proposal for Creating a Research Action Cluster (RAC)

### *Cultivating a National Collaborative for Research on Food, Energy, and Water Education (NC-FEW)*

	Dr. Ronnie Green, UNL Chancellor
10:30 AM	Conference Overview: <i>Towards a National Collaborative for Food, Energy, &amp; Water Education</i> Dr. Cory Forbes, Associate Professor, Coordinator, IANR Science Literacy, Director, Nebraska Collaborative for Food, Energy, & Water Education, and Chair, NCDC231
11:00 AM	Concurrent Session I: <i>Inventory of existing FEW education programs</i>
12:00 PM	Sharing What We Learned: <i>Recap of Inventory</i>
12:30 PM	Lunch & Networking
1:45 PM	Session II: <i>Brainstorming – What should FEW education programs accomplish?</i>
3:45 PM	Sharing What We Learned: <i>Recap of Brainstorming</i>
4:30 PM	<i>Innovations at the Nexus of Food, Energy and Water Systems</i> Speaker: TBD
5:00 PM	Poster Session & Reception Highlighting FEW Education projects

	<b>DAY 2</b>
8:30 AM	Reflection and Reactions
9:00 AM	Session III: <i>Selection of Overarching Outcomes</i> Identification of 2 to 3 outcomes of FEW education programs
10:00 AM	Session IV: <i>Developing a Strategy</i>
11:30 AM	Working Lunch
12:30 PM	Session V: <i>Mapping the Plan &amp; Determining Next Steps</i> Breakout groups: Crafting new approaches or building off existing programs to address the overarching outcomes
2:30 PM	Session VI: <i>Identification of Next Steps</i>
3:00 PM	Closing Remarks

**Anticipated Outcomes and/or Deliverables:** There is an array of expected outcomes from this RAC. As a whole, these constitute an elaborated blueprint for capacity-building around NC-FEW, including a) growing the participant network and b) enhancing its impact. Each of these outcomes and deliverables is focused on building capacity for the future by growing and nurturing the vision for this transdisciplinary community. Short-term outcomes and deliverables from the workshop include:

- 1) A concrete mission statement and set of objectives for a DBER FEW-Nexus network
- 2) Fully-developed plan for a 5-year Multistate Research project proposal (due May, 2018)
- 3) Replicable model of intra-institutional FEW-Nexus team-building strategy
- 4) Dissemination and recruitment plan (identification of and plan of action for engaging with professional communities spanning FEW-Nexus DBER interests)

These short-term outcomes and deliverables will be compiled in the form of a NC-FEW organizational summary document that provides an overview of NC-FEW's vision, mission, goals and objectives, priorities, and 3- and 5-year workplans. Longer-term outcomes and deliverables of the workshop include:

- 1) Proposal for a 5-year project to support NC-FEW activities through the Enhanced Hatch-Multistate Research Funding Program at UNL (\$500k in potential funding)
- 2) Recruitment of STEM education faculty and development of a national network
- 3) DBER proposal briefs grounded in inter-institutional teams positioned to competitively pursue federal funding for FEW-Nexus DBER. Anticipated proposals include:
  - a. DBER projects focused on postsecondary teaching and learning in the FEW-Nexus
  - b. NC-FEW national conference

**Academic Enhancement:** This entire project revolves around an emphasis on academic enhancement with a specific focus on FEW education efforts at the post-secondary level. By engaging with faculty from post-secondary institutions, as well as other stakeholders, the reach of this workshop, as well as future programming that emerges from it, transcends both UNL, partner institutions, and the funding period.

## **Proposal for Creating a Research Action Cluster (RAC)**

### ***Cultivating a National Collaborative for Research on Food, Energy, and Water Education (NC-FEW)***

The project will contribute to a longer-term, systemic effort to promote science literacy through FEW education programming nationwide. By involving a transdisciplinary group of FEW education faculty in developing a comprehensive plan for FEW education programming and evaluation, we intend to help them develop functional knowledge of a) science literacy outcomes and b) science literacy evaluation methods and measures that will inform secondary and post-secondary instruction at partner institutions. The identification of collaboration-based FEW education programs at the workshop, as well as engagement with DBER faculty, will ultimately help improve and strengthen FEW education efforts at post-secondary institutions. For example, knowledge of FEW-Nexus learning outcomes can help individual instructors find points of connection where existing courses and programs can directly promote science literacy. Knowledge of existing FEW education programs, as well as newly conceived programs, will contribute to instructional innovation among project partners. Knowledge of evaluation methods and measures and DBER will provide instructors models, strategies, and tools for assessing an array of instructional, curricular, and learning outcomes they choose to target through instruction. Each of these elements will contribute to the development of the primary product(s) and deliverables of the workshop. This project will transcend the collaborators' institutions as others participate in the conference.

Continuation and Dissemination: The workshop proposed here will help begin to translate the goals and priorities laid out in association with NCDC231 into a comprehensive, national plan for implementation of outcome-driven FEW education programming and evaluation. NCDC231 members are already actively disseminating information about the growing NC-FEW network through engagement with multiple professional communities. This includes upcoming presentations at the 2017 Earth Educators' Rendezvous, Network of STEM Education Centers (NSEC), NACTA, and NAAEE conferences. We anticipate additional conference proposals submitted to AAEE and NARST. Each of these proposals focuses on the NC-FEW network and is authored by subsets of NCDC231 members with connections to these respective professional communities. These capacity- and network-building proposals focus on dissemination about the growing network, its goals and activities, and opportunities for other faculty and personnel to get involved. After the proposed workshop is held, dissemination will focus on products emerging from the workshop and NCDC231 meeting. One targeted point of dissemination are future workshops focused on cultivating interdisciplinary clusters of FEW educators and education researchers at individual institutions. These efforts would focus on supporting and fostering transdisciplinary team-building around shared FEW education and research priorities at an institutional level. The present proposal represents an early-stage investment in a systemic FEW education effort that has significant, long-term potential to synergize FEW education efforts nationwide. As such, support for NC-FEW at this stage is an investment in ongoing and future innovation in post-secondary FEW education programs and DBER at a national level.

Budget: We request **\$15,000** in funding through the NSEC RAC funding program to support activities outlined in this proposal. Funds will be used to provide a \$1,000 travel allowance to each of 15 invited participants from partner institutions. An estimated \$8,000 in matching travel funding will be provided by partner institutions through the Multistate Research Committee program already supporting NCDC231. These existing resources will support 8 current members of NCDC231 to participate in this workshop. The funding requested through the RAC program will enable an additional 15 DBER faculty to attend and contribute to the annual committee meeting and proposed workshop. With funds available through IANR Science Literacy at UNL, Forbes is able to match an additional \$3000 for costs associated with the workshop (facilities, food, printing and materials, etc.) and an estimated \$5,700 in salary and benefits for 2 weeks of Dr. Forbes' time to lead planning, organizing, and facilitating the workshop. Therefore, **total matching funds total \$16,700**. In addition to this explicit match, we anticipate being able to leverage additional internal funding to maximize the scope and impact of the proposed workshop. Furthermore, the project team submitted a conference funding proposal to the USDA-NIFA Higher Education Challenge Grant program (USDA-NIFA-CGP-006325) in spring, 2017 for additional funding to support the proposed workshop and enhance early impact of NC-FEW. This proposal is currently 'pending'.