Training graduate students to work across disciplines

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Preparing scientists and educators to create and promote practical science-based agricultural approaches to climate change adaptation and mitigation is a main focus of REACCH. Social, political, and environmental complexities and interactions require that future scientists work across disciplines rather than having isolated knowledge of one specific subject area. Additionally, it is important for graduate students earning M.S. or Ph.D. degrees in agriculture and climate sciences to be able to communicate scientific findings effectively to non-scientific audiences.

IMPACT

Social, political, and environmental complexities and interactions require that future scientists work across disciplines rather than having isolated knowledge of one specific subject area. Tomorrow's scientists will be well trained to address difficult and intricate agricultural and climatic issues.

Unfortunately, university graduate curricula rarely adequately prepare students with these important skills. REACCH recognizes the need for graduate students to have thorough exposure to other disciplines and to be able to communicate information for outreach and education purposes. These priorities have been incorporated into graduate training within the REACCH project. The interdisciplinary nature of the project and its sophisticated digital infrastructure provide graduate students multiple opportunities to gain these experiences.

Currently, REACCH has 24 graduate students (15 Ph.D. and 9 M.S.) and 6 post-doctoral researchers participating in the project. Students have diverse interests in approximately 20 disciplines, and their research foci include: agronomy, carbon and nitrogen cycling, crop residue and carbon analyses, soil quality management, no-till and precision agriculture, hydrologic and greenhouse gas fluctuations, pest and beneficial organism dynamics, economics, communication, surveys and public participation modeling, modeling biogeochemical processes, remote sensing, science education and ethnography, and climate change. This diversity of disciplines reflects the breadth of the REACCH project. The REACCH infrastructure allows students to interact through distance collaboration tools, at in-person annual meetings and retreats, and, in some cases, shared research sites and data sets.

Creating a sense of community is challenging because REACCH graduate students and post-doctoral scientists are working at three academic institutions across a large geographical region. To address this, REACCH hosts annual graduate student retreats. The meetings are typically 2 to 3 days long and include both structured time for learning new skills and unstructured time to allow students, post-doctoral scientists, and faculty to get to know each other (Figure 1). The 2013 (year 3) retreat was held at the University of Idaho and included sessions on interdisciplinary data analysis and cross-disciplinary communication, in addition to time set aside for students to explore interdisciplinary collaborative projects (Figure 2). Highlights of this year's retreat, based on student feedback, were the seminar "Climate Change in the Interior Pacific Northwest," delivered by REACCH principal investigator Dr. John Abatzoglou, and opportunities for students to collaborate with one another. Annual graduate student retreats will continue during each year of the REACCH project. The goals and activities, however, likely will morph to meet student needs as they progress in their programs.

Figure 1. *Graduate students, post-docs and faculty gather during a REACCH retreat. Retreats are designed to encourage integration and a sense of community among graduate students working at different campuses. Photo by Erin Corwin.*

A second form of interdisciplinary training within REACCH is use of the Toolbox survey and workshop, an approach designed to help collaborative teams achieve effective communication. The Toolbox instruments and workshop facilitate discussion of research assumptions and how they differ across a collaborative team. Based on more than 100 Toolbox workshops conducted nationally and internationally, these workshops are proven to improve mutual

Table 1. *Part of the rubric developed to help graduate students meet the requirements of REACCH extension and education products.*

Extension or education product rubric	Does not meet expectation	Meets expectation	Exceeds expectation
Multidisciplinary teams	Works alone or with team members within same objective and discipline	Collaborates with an additional student outside of discipline	Collaborates with students and faculty from several disciplines and objectives
Product addresses a need in the Pacific Northwest community	Product does not directly address an identified community need or REACCH objective	Product relates to a perceived need within the stakeholder community and is directly related to at least one REACCH objective	Product relates to a documented need within the stakeholder community as assessed (formally or informally) by students
Ability to translate scientific data to multiple stakeholder communities	Product is written with scientific jargon and content-specific language that is not accessible to a lay audience	Product is written or presented with lay language and visuals; some expert interpretation may be necessary	Product is written or presented with lay language and visuals and can be utilized without the support or expertise of students or faculty

Figure 2. *Graduate students Nevin Lawrence, Taylor Beard, and Isaac Madsen discuss the farming program AgTools™ with senior Matt Miller. Photo by Laurie Houston.*

understanding and self awareness in ways that may significantly enhance collaboration efforts. REACCH students participated in a workshop at our student retreat in 2012 and completed a follow-up online survey in 2013. Results were explored to help students learn about the diversity of views within the project. Student views were compared with faculty views based on a separate faculty survey conducted during spring 2013. Additional follow-ups using the Toolbox are planned as part of our 2014 annual meeting.

To help REACCH students develop their interdisciplinary collaboration skills, each is required to work as part of a team to develop interdisciplinary projects that address the goals of REACCH. These projects must include two or more students from different disciplines working on an extension or education product that can be used by farmers, teachers, students, or other stakeholder groups. A rubric developed to help students meet the project requirements is shown in Table 1.

Eight projects are underway, five focusing on secondary education and three focusing on extension. Extension projects include: video demonstrations of environmental and management effects on crop development; fact sheets describing plant pathogen, soil, and host plant interactions; and interpretation of climatic model outputs. Examples of education projects include: lectures and demonstrations for using GIS and other modeling tools, as well as classroom demonstrations of water infiltration and erosion (Figure 3) for use in a secondary science classroom. All of these projects are described in more detail on the graduate education page of the REACCH website.

Figure 3. *As part of their interdisciplinary education product, REACCH graduate students Chelsea Walsh (soil science) and Hilary Donlon (agricultural economics) demonstrate to teachers a method to model soil infiltration and erosion using inexpensive materials. Materials were distributed to teachers attending the 2013 REACCH teacher workshop and will be available on the REACCH website for others to download. The teacher materials include information on soils, water, erosion, and the economic costs of soil loss. Photo by Brad Stokes.*