



# Time to close the knowledge–practice gap in field teaching

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The stakes are high in nature's classrooms. When field-based teaching is successfully implemented, students benefit from knowledge gains and hands-on experiences while deepening a sense of connection to the outdoors. Our education research has shown that field-based undergraduate courses are also a powerful tool for recruiting and retaining diverse students in science. But not all field courses are equally effective. Barriers to participation and a lack of perceived value can discourage students from engaging in field courses. Poor course design or implementation can also cause detrimental student experiences and outcomes in the field. Although education research provides loose guidelines for how to best design field courses to attain desired enrollment and outcomes, formal training on how to teach field-based ecology courses remains rare. It is time to close the gap between what we know about effective field teaching and how it is practiced.

The burden on field course instructors in attaining desired outcomes and navigating teaching challenges is enormous. Field course instructors must go above and beyond typical class content curation to develop inclusive outreach materials and safety plans, drive large vans (often for extensive periods and over long distances in remote locations), build community and cultural norms, administer first aid, attend to mental health, supervise overnight camps and shared meals, navigate drug and alcohol policies, teach students with vastly different levels of preparation, and make impromptu adjustments in response to unexpected events. Instead of being formally trained in how to address these challenges, field course instructors often learn about logistical preparation and implementation through trial-by-fire, repeating mistakes made by previous instructors because of limited knowledge transfer. Likewise, graduate students who are awarded teaching assistantships often glean how to field-teach informally by mirroring instructors, similar to an apprenticeship. A lack of training in field teaching can limit student learning outcomes and experiences, even from the most well-intentioned instructors.

The proliferation of teaching and learning centers at universities has led to transformative training programs for faculty,

lecturers, graduate students, and postdocs in traditional classroom settings. These centers have partnered with faculty to develop teaching resources, facilitate departmental pedagogy workshops, fund course redesign efforts, and connect with institutional partners such as safety and accessibility offices. Applying such initiatives specifically to field-based courses is critical. We need field teaching training that attends to community standards, physical and psychosocial safety, equity, and stewardship of nature. This training should be offered to entire field teaching teams, including instructors, teaching assistants, peer mentors, and other staff. A toolkit of resources including field safety plans, evidence-based assignments, and community agreement activities should be used as a guidepost. Assessment methods including surveys, reflections, and focus groups should be used to ensure that course outcomes are equitable across student demographics. Communities of practice around field-based teaching should be established to allow for cross-pollination of ideas, troubleshooting of common field teaching struggles, and access to evidence-based tools. Finally, the resources and learning communities developed by research coordination networks and multi-institution initiatives could be leveraged to promote and scale impactful field-based teaching. Collectively, these practices can create teaching and learning environments in which both educators and students feel supported and are successful.

Although field courses can be powerful tools for engaging undergraduate students in ecology, their complex logistics pose a challenge to instructors who are simultaneously responsible for student learning, safety, and well-being. Now is the time to apply a growing body of evidence-based teaching practices to field-based courses. Teaching and learning centers can promote effective field teaching while simultaneously reducing instructor workload by offering resources to support field-centered practices and pedagogy. Field course instructors trained in effective, safe, equitable, and culturally responsive teaching can help ensure that field-based discovery and inquiry-based research opportunities in natural spaces remain hallmarks of inspiration and training in ecology.