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Cultivating Belonging in Field Science Education

Context for Belonging

Sense of belonging is important to student success, from enrollment to graduation and beyond. Belonging also facilitates inclusive student success, by supporting student identities who often feel marginalized or excluded from university – particularly in STEM (Student Experience Project 2022). Here I describe concepts and approaches I apply to cultivate sense of belonging during an intensive field course program I lead in spring. The program depends on close student collaboration, which benefits from sense of belonging shared by each participant. The approaches described here are adapted to this context, but many could be applied in individual campus-based courses in less intensive contexts.

Sense of belonging underlies many measures of academic performance (Zumbrunn et al. 2014). Most departments, programs, and courses articulate student learning outcomes (SLOs) that emphasize content knowledge and skill development. Explicit SLOs rarely include outcomes in the affective domain (Krathwohl et al. 1964). Affective outcomes may result from academic experiences, but these may be coincidental or dependent on student context factors predating the course (O'Connell et al. 2022). For many students, affective factors are pivotal because they facilitate achievement of outcomes in the cognitive and psychomotor learning domains (Bloom et al. 1956) by reinforcing student motivation, persistence, and resilience. Among affective outcomes, sense of belonging to a group, program, or profession is particularly influential. Sense of belonging supports both individual efficacy and group achievement, when students with strong team identity achieve more as a group than they could as individuals. I recognize the importance of belonging, and impacts of its absence, from both experience in cohesive teams and conversely in a department with an entrenched culture of "othering" (Wise 2022). Accordingly, I invest heavily in cultivating belonging in my courses while simultaneously supporting students' cognitive and psychomotor development.

Instruction in teamwork

Working in groups can increase sense of belonging and inclusion. Academic environments tend to emphasize individual achievement, even as most STEM innovations result from collaborative teams. Many academic programs now include group projects and other contexts in which students work in teams, but few provide direct instruction in teamwork skills or team management (Alwin et al. 2021). Most courses, including WWU's STEM curricula, seem to assume implicitly that students will develop teamwork skills organically by working in teams (Nyarko and Petcovic 2023b). Empirical evaluations suggest students develop some skills through teamwork, but skill development is inconsistent and rarely includes higher order skills (Nyarko and Petcovic 2023b). Comprehensive teamwork development and its attendant sense of belonging require explicit instruction in teamwork. Instructor or leader framing is essential to support innovation and low-stakes failure as steps toward success. This framing supports a culture of psychological safety that enhances team performance (Edmondson 2019).

ESCI Field Camp

Each spring I teach a 15-credit program of field courses designed to transform students into scientists in the context of an inclusive community. The program begins with welcoming activities that encourage students to bring their whole selves and to establish social and intellectual context for working and living together. We co-create program norms and codes of conduct to provide emotional safety while taking on individual and group challenges. Most meetings occur outdoors, originally as a strategy to mitigate in-person infection risk during the COVID pandemic, which continues as a way to strengthen connection to each other and to place. Students work in teams to design original field research projects, which they implement during two group expeditions in remote places lasting ten days each. Prior to the program, most students have completed instructor-designed projects but few have conducted their own "authentic" research. Consequently, I mentor students closely throughout project development and implementation to facilitate their transition from student to scientist. I provide similar training and mentoring in outdoor skills, gear, and behaviors. The program helps overcome privilege-based barriers to participation in outdoor activities and field sciences, where entry requires specialized skills, training, and equipment (Homyack 2014, Stafford 2020). I provide those assets regardless of personal identity, leading to confidence, competence, and experience that can change students' lives. The instructional approach diminishes academic hierarchy: my role becomes collaborator more than judge, leading to greater student ownership of their scholarly achievements. Challenge serves to strengthen student community: students work to help each other through physical adversity, they collaborate closely to achieve scientific goals under tight timelines, and they overcome personal insularity to bond socially.

I implement a rigorous system of outdoor risk management, which contributes physical safety as a complement to psychological safety (Leemon et al. 2019, Smith 2021). We give priority to student safety over scientific goals, consistent with recommendations for inclusive field science (Demery and Pipkin 2021). Details on this system and its outcomes are in McLaughlin (2022). I emphasize skill development, experience with outdoor and scientific gear, peer mentorship, and scaffolded experiences help to support comfort outdoors regardless of students' prior backgrounds. Daily shared meals lead to deeper connection, particularly when appetites are raised by physical exertion. We work in teams -- for research, cook groups, and expedition travel -- which builds connections as people subordinate individual desires to achieve group goals. After returning from expeditions, we analyze the data to evaluate project hypotheses. The projects culminate in scientific papers and presentations during Scholars Week. Subsequently, some students have presented their work at international conferences or published in scientific journals (e.g., Johnson et al. 2023). The results have been profound, expressed in student outcomes. They identify as scientists who belong in the scientific community. Many pursue graduate school or professional careers they had not imagined for themselves. Students form such community that they do not want the program to end. Many continue to share adventures with each other long after the program concludes.

Resources and Training in Belonging

I draw on resources, training, and experiences from diverse groups and sources including those listed in Table 2, below. (I also maintain additional training in wilderness medicine and rescue not listed here.) Many of these resources and trainings are available at no cost to other members of the WWU community.

Table 2: Trainings and resources related to student belonging, particularly in field settings.

STEM Equity and Inclusion Workshops, WWU Campus Equity and Inclusion Forum, 2017-2018. Led by Robin Kodner, Lina Dahlberg, and Regina Barber.

DEI in Outdoor Leadership course and certificate, Greenfield Community College, MA, 2021.

River Field Studies Network: Leadership team, NSF grant co-author, and Risk Management chair, 2019-present. River expeditions, instructor trainings, mentoring, curriculum development, DEI support, needs assessment, and network management.

Undergraduate Field Experiences Research Network (UFERN): workshops and discussions with UFERN leaders.

FieldFutures: Harassment Prevention Training, November 2023.

Belonging in Field Education Community of Practice, 2023-2024.

A-DASH Collaborative: webinars on Understanding, Preventing, & Addressing Sexual Harassment on Rivers, 2023 and 2024.

Mental Health First Aid training, WWU CWC, winter 2024.

WWU Office of Equity: Design for Belonging workshops, winter 2025.

ASPIRE: virtual discussions on Community Centered Geoscience, winter-spring 2025.

Strategies for Belonging

Many strategies I deploy to cultivate belonging are neither unique nor untested. At other universities, these strategies have increased student retention, performance, and graduation rates (Jones and Washko 2021, Race et al. 2021). I use all recommendations for field courses in the following table, from Zavaleta et al. (2020). (The sole exception is "Hire a diverse staff" – resource limitations preclude hiring additional instructors, and graduate teaching assistants generally cannot leave campus for the course expeditions. I am exploring options to include undergraduate TAs, who could bring identities and backgrounds complementary to mine.) These strategies also apply all Universal Design for Learning (UDL) guidelines (CAST 2024), although there has been limited need to date to support multiple languages or dialects.

Table 1. Factors That Support or Enhance Retention and/or Career Interest in Ecology and Evolutionary Biology and Recommendations for Their Incorporation into Field Courses

Factor	How field courses can promote
Belonging – social belonging, feelings of membership [6,7]	• Have students work, travel in groups/teams • Have community meal preparation, celebrations • Include group assignments such as presentations, papers • Build in time off outside the classroom.
Self-efficacy – confidence in science skills, competence [4,15]	• Facilitate research design by students, participation • Teach and provide experience in specific science skills like data collection and analysis using field tools, species identification, making and recording observations, and communicating findings • Recognize student contributions to science.
Comfort outdoors – field work, living skills [6]	• Explicitly teach, model outdoor skills • Provide supported experience living, working outdoors
Role models – of any identity, of same identity [6]	• Have staff, instructors travel, work, eat with students • Have 1:1 mentoring (as well as instructional) interactions • Hire a diverse staff
Communal goals/ service to society [6]	• Focus on cooperative problem solving • Practice varied leadership skills • Use student-led inquiry to facilitate discovery • Explore EEB links to stewardship of nature, education, environmental quality and health
Science identity – recognition by self, others as scientist [8]	Provide scientific ownership through authentic research experiences such as original hypothesis generation, experimental design, using evidence to explain findings.

Table 1, from Zavaleta et al. 2020.

Cultivating Belonging in Practice

Implementations of strategies in Table 1 specific to my program are outlined below.

Operational Features

- Replace hierarchical faculty-student structure with collaborative culture. Instructor functions as a member of each student research project team. Frequent interactions throughout project development and implementation.
- Emphasis on group and cohort development, from first meeting.
- Student-designed and conducted research projects.
- Student team–instructor collaboration on research project development.
- Student team–instructor collaboration during data collection.
- Student team–instructor collaboration during data analysis and interpretation.
- Student team–instructor collaboration during presentation development and rehearsal.
- Daily briefings at start of day, throughout each field expedition (Gookin and Leach 2009, Gookin and Swisher 2015)
- Daily de-briefings during evening, throughout each field expedition.
- Group travel: highway driving in rented vans, hiking to base camps and study areas, river travel.
- Research team travel to study sites.
- Group meals and meal preparation.
- Evening check-ins and discussions, around campfires.
- Layover days provide time for data collection, social interactions, rest, and down time.
- Funding provided to students on need basis (funding offsets course fees); transportation provided.
- Much technical gear loaned to students, without charge.
- Training in skills and gear use, prior to expeditions.
- Mentoring in skill development during expeditions, by both instructor and peer mentors.
- Emphasis on growth mindset. Recognize research is challenging; work with students' current abilities, and support efforts to improve competence.
- Emphasize development over judgement: provide feedback on low-stakes drafts before final versions.

Practices

Orientation

- Pre-course orientation meetings, including information about field sites; logistics; scheduling and itineraries; group and personal gear; facilities for sleeping, cooking and eating, restrooms; menstruation during field expeditions; transportation; expected weather; fees and expenses; policies. Include photos.
- Orientation at start of course: repeated, reinforced, clarified pre-course orientation information.
- Norms, Code of Conduct – co-created on 1st day, revisited and confirmed before 1st field expedition.
- Personal gear list: provided before course, reviewed during course before 1st field expedition. Included tips on alternatives to purchasing gear and priorities for essential gear. Also included list of group gear provided, that students need not acquire/pack.

Knowing Students

- Pre-course student survey, including: pronouns, dietary restrictions and preferences, accommodations, professional goals, financial concerns, comfort in field settings, sense of belonging in academic and scientific contexts.
- Medical exams/screening required of all students as per WWU Risk Management guidelines for field

courses. Instructor review of medical forms.
Accommodations, student concerns, and other needs assessed in applications, pre-course surveys, and medical screening: physical, mental, psychological, cultural, religious, family, other accommodations.
Daily check-ins and debriefings with individuals and entire group.
Post-course student evaluations, including student learning outcomes, affective outcomes, professional development, sense of belonging in academic and scientific contexts.

Instructor Messages

Emphasize that anyone can do well if they put in effort.
Emphasize that anyone can do well, regardless of physical ability.
Encourage students to think of themselves as scientists and part of the scientific community.
Encourage students that they have ability to do field research.
Acknowledge challenges of field work.
Openly acknowledge mistakes and failure as a normal part of learning and scientific processes.
Solicit student feedback about the program, on multiple occasions.
Highlight diversity of perspectives and experiences in the field in course content.
Intentionally cultivate non-judgmental atmosphere, supported by norms and conduct code.
Priority to students' physical and mental health, with academic adaptations as needed.

Adaptations to Student Needs and Interests

Course activities and content adapted to weather conditions and student backgrounds.
Course content and activities adjusted to support student research interests and career interests.
Content and skills training adapted to student needs and backgrounds.
Instruction adapted as needed based on student feedback
Adaptation of schedule and activities as per student needs and accommodations.
Course materials available in multiple formats: Canvas, program web site, hard-copies in course library.
Multiple modalities and opportunities for students to demonstrate performance.
Relevance of topics and expedition locations to student interests reinforced.
Diversity of perspectives offered, recognized, and valued.

Teamwork

Leader framing for psychological safety (Edmonson 2019, McClard and Smith 2024).
Expedition behavior instruction, expectation setting, and reinforcement (Gookin and Leach 2009, Ostis 2015).
Instruction in effective feedback and task monitoring.
Program norms and code of conduct, co-created to support equitable teamwork.
Projects in scaffolded parts to facilitate planning and team management (Nyarko and Petcovic 2023a). (Literature search, lit. review, project proposal, draft and final presentation, draft and final reports)
Early failure destigmatized with low-stakes drafts, feedback, and revisions.
Emphasis on group accomplishment over individual achievement.
Instructor as active team member.

Risk Management

Group environmental briefing, to raise awareness of hazards and co-create group rules (Smith 2021).
Regular tick-checks in tick habitat.
Rigorous attention to proper food storage.

Allergen information shared among group.
Instruction, expectation, equipment, and rigorous attention to hand washing.
Training in river safety and incident response (Ostis 2015, 2017; Polsby and Munger 2021).
Instruction in PPE use, and regular verification.
Safety talk prior to river launch.
Shared knowledge of locations of communication devices, expedition first aid kits, and rescue gear.
Policies on group travel on land, boat order and spacing on water.
Rapid scouting as a group, with intended lines and plans of all boat captains shared with group.
Each participant decides whether to run rapids or walk around, without judgement.
Maintain C.L.A.P. on river (Communication, Line of sight, Avoid hazards, Position of maximum utility).
Daily satellite text messages to department and participant emergency contacts.
(Many additional risk management measures applied, beyond scope of student sense of belonging.)

Interactions

Peer Interactions

Pre-course orientation meetings, with opportunity for students to meet each other.
Research groups self-selected, based on student interest.
Cook groups self-selected, but different from research groups.
Research and cook groups shuffled between expeditions.
Guidelines and systems for effective teamwork.
Instructor interventions, if needed, as outlined in co-created code of conduct.
End-of-course celebration: photo and video viewing, awards ceremony, shared dinner.

Informal Interactions

Free time, rest time, and social time built into course schedule and expedition itineraries.
Community-building activities and games: first group meeting, and regular subsequent activities. Some initiated by instructor, others organized by students.
Shared meals: all dinners shared, prepared by cook teams (including instructor). Breakfasts and lunches eaten as group, with individual food.
Shared chores: all group camp chores shared. Group camp gear set up before individual tents/camps. (i.e., expedition behavior norms explained, expected, and cultivated.)
Campfires: group campfires each evening, accompanied by group dinners, baked desserts, debriefs, discussions, readings, and stories.

Outcomes Resulting from Belonging

For those fortunate enough to observe ESCI Field Camp students, their sense of belonging is conspicuous and palpable. For everyone else, many products of the program demonstrate multiple benefits of cultivating belonging. These products include student scholarship, news coverage about the program, an energized student community, and alumni with greater personal and professional aspirations and achievements. Some students seek guidance from other WWU faculty, who have been generous in their support of student scholarship. (Thank you to Rebecca Bunn, Greg Green, Marco Hatch, Jim Helfield, Abe Lloyd, Merrill Peterson, Chris Templeton, and others I may have overlooked.) These outcomes help fulfill all four goals in Western's Strategic Plan. They align with all three priorities in the College of the Environment's

Strategic Vision. Below is a list of products and other outcomes that have resulted from investments in student belonging.

(1) Scholars Week presentations, 12 since 2022 in the Faculty-Student Collaborations program and 12 prior to 2022 in Scholars Week Poster Presentation events.

(2) Scholars Week oral presentations in the College of the Environment Speaker Series, 15 May 2024; Video recording: https://vimeo.com/1085058691

(3) Presentations (2) to Western's Board of Trustees, 20 May 2021 and 10 April 2025.

(4) University Communications article, 5 May 2025 (Nerad and Cruz 2025).

(5) Student testimony and student learning outcomes, article published in *Bulletin of the Ecological Society of America* (McLaughlin 2022).

(6) Student-authored publication in *Frontiers in Ecology and Evolution* (Johnson et al. 2023).

(7) Student poster presentations at national and international conferences.

Trejo A, C Moran, J Baxter, and J McLaughlin. 2019. Habitat Selection of the Spotted Sandpiper (*Actitus macularius*) along the Elwha River, Washington. *National Diversity in STEM,* SACNAS, Honolulu, Hawai'I, 31 October 2019.

Lane J, K Nicpon, and B Cudkowicz. 2024. Dam Removal: Lupine Hastens Forest Recovery. Society for Ecological Restoration, Vancouver, BC, Canada, 30 October 2024.

Cudkowicz B, Lane J, and K Nicpon. Dam Removal: Lupine Hastens Forest Recovery. River Management Society Symposium, Ashland, OR, 8 April 2025.

(Additional student poster presentations were accepted but canceled when conferences were canceled during the height of the COVID-19 pandemic.)

(8) Student oral presentation at a regional conference.

Duvall E and J McLaughlin. 2021. Responses of river-dependent birds to dam removal on the Elwha River. Olympic Science Days, 4 November 2021.

(9) Article published in the *River Management Society Journal* (McLaughlin 2023).

(10) Several manuscripts in preparation, for submission to publication in scientific journals.

Lane J, K Nicpon, B Cudkowicz, and J McLaughlin. (in prep, for *Northwest Science*) *Lupinus rivularis* preferentially facilitates native plant establishment on coarse sediments following dam removal; Elwha River, Washington State.

Harkness T, H Greenwood, and J McLaughlin. (in prep) Large woody debris abundance and distribution on the Elwha River ten years after dam removal.

Swanson G, AJ Denton, and J McLaughlin. (in prep) Echoes in the watershed: Establishing baseline bat inventories in the Elwha and Grande Ronde River basins.

Duvall E and J McLaughlin. (in revision) Evaluating river-dependent birds as restoration indicators after Elwha dam removals.

(11) Many program graduates now are enrolled in graduate programs (MS and Ph.D.) and professional careers beyond what they imagined for themselves. Some are first generation college graduates.

ESCI Field Camp, spring 2024. Photo by Joey Lane.

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