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Essay

Designing an Asynchronous, Self-Led Aquatic Ecology Field Trip

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Abstract

Due to the COVID-19 pandemic and increasing need to teach students online, aquatic scientists are looking for ways to give students field experiences virtually. Asynchronous, self-led field trips are emerging as a solution. However, due to the varying circumstances surrounding students and the dangers of exploring near water alone, asynchronous field trips need to be designed with equity, inclusivity, and safety in mind. Here, I provide a guide to creating inclusive field trips meant to introduce students to making qualitative scientific observations about aquatic ecosystems. This guide for designing an asynchronous, self-led aquatic ecology field trip explains how to: i) gauge whether this type of activity is suitable for your students, ii) promote safety and equity in choosing field trip sites, iii) build a community of learners while in a virtual setting, iv) prepare students for their individual trips, v) create a step-by-step worksheet to lead students through the activity, and vi) improve the experience for future classes.

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INTRODUCTION

In the natural sciences, field trips are an important teaching method for introducing students to ecosystems, teaching data collection skills, and building students' scientific identities (1–3). Despite their formative role in training future scientists, field trip opportunities for undergraduate students are in decline (1, 4–6). Large class sizes, potential institutional liability, online class settings, and lack of funding are just a few of the factors preventing field trips (6–8), in addition to the COVID-19 pandemic (9). However, just because the instructor cannot take the students to a field trip location does not mean the students cannot explore nature on their own.

Self-led, asynchronous field trips are one solution being offered to solve the lack of field trips in academia (4, 10, 11). Asynchronous, self-led field trips are activities where students, especially those in online classes or other remote learning situations, visit a nearby place on their own time to do an activity. Because the activity is asynchronous, students with additional home life responsibilities have more flexibility for completing a field trip (12). The concept of a self-led, asynchronous field trip is underutilized, however, and there are many questions and equity concerns instructors must work through before assigning an asynchronous field trip. In particular, aquatic-themed field trips can be especially difficult because of the safety and accessibility concerns of exploring near the water. In this paper, I provide a framework for arranging an asynchronous, self-led field trip designed to stimulate interest and inquiry through observing aquatic systems. This introductory approach will give virtual classroom students a foundation on which to build knowledge of higher-level aquatic ecology concepts. I will discuss 1) the equity considerations of asynchronous field activities and 2) recommendations for designing self-led, asynchronous aquatic ecology field trips (with a series of supporting files: *Tucson example: An asynchronous, self-led wetland ecology field trip*).

CONSIDERING EQUITY FOR UNDERREPRESENTED GROUPS IN THE FIELD

As the inaccessibility of campus spaces (13) and the racialization of higher education (14) are more widely recognized, educators are sharing ways to make learning experiences more equitable. Field learning is one of these areas being explored and reshaped to be inclusive of students of all backgrounds and abilities. Additionally, instructors are assessing risks to groups vulnerable to discrimination in the field (15). When planning field trips, there are situations when instructors need to be conscious of privilege and consider the potential dangers to underrepresented students.

Students may be asked to visit communities in which they are a minority and entering these spaces may be uncomfortable for some students (16, 17). Students who did not have camping or field experiences prior to college may have anxiety or apprehension about field trips, especially if journeying to more rural areas. This is especially true of students of color going to white rural areas (18). When planning asynchronous activities, assignments should ideally be possible near students' homes and comfort zones. Further, the instructor can feature underrepresented scholars, researchers, and recreators in the field through photos or interviews in class materials and implementing diverse class role models (19). Lastly, students should be able to work in groups for safety (17), which also happens to stimulate the formation of a field science community among the students, which is important for scientific identity and retention (19).

During times when field trips are not possible, instructors should be mindful that asking students to asynchronously do fieldwork around their residences does not provide an equal opportunity to all. Socioeconomic and racial inequality determine access to green spaces, level of landscaping, and biodiversity (20, 21), with wealthier areas harboring more biodiversity than lower-income neighborhoods (20, 22, 23). Although residential areas may not provide the best setting for observing nature, not all students have the resources to visit a wild place. For example, students would require access to a vehicle, gas money, time for an excursion aside from work or family duties, etc. Additionally, the cost of outdoor gear (e.g., raincoats, suitable shoes for the terrain) presents a considerable barrier for students from lower socioeconomic status, and students may not know which products are most appropriate for certain situations (16, 19, 24, 25). Therefore, instructors should design learning objectives that can be met in a variety of settings and allow for critical examination of spatial patterns.

Sexual harassment and assault have been shown to be prominent in academic field settings (26, 27). This harassment has been largely directed towards women, especially when women represent a smaller proportion of the group (26, 27). Similarly, women and members of the LGBTQ+ community are not taken seriously as outdoor leaders and are subject to harassment due to gender-role socialization (28). This harassment can lead to self-doubt and withdrawal from outdoor experiences (28). To protect students and promote success, students need support and guidance that is free of bias. Using instructional language that is free of gender expectations, implementing an ethic of care, and creating opportunities for diverse classroom leadership can empower marginalized students (28). Further, making students aware of the problem, asking them to collaboratively write a value statement or safety policy (29), enforcing that safety policy, supporting victims (29), and encouraging microaffirmations (30) can enhance inclusivity.

Accessibility is often overlooked in field trip settings. In the natural sciences, field trips may be especially inaccessible due to a variety of factors (e.g., field trip takes place in a river, loose or soft substrates are prominent, long distances walking, etc.) and instructors may assume all students are physically capable (31). Disabled individuals may not disclose their disability and are often a larger portion of the community than is realized. To make field experiences more inclusive for students with physical disabilities, considering wheelchair accessibility and accessibility for other types of mobility impairments is crucial during planning (32, 33) and campus-based and local excursions should be promoted as locations for the assignment.

RECOMMENDATIONS FOR ASYNCHRONOUS AQUATIC FIELD TRIP DESIGN

Aquatic field trips can be especially difficult to plan because of the dangers of exploring near water (i.e., swift velocities, large depths, inability to swim, questionable water quality, etc.), which many adults cannot recognize (34), and because reaching water can be physically difficult or may require access through private land (author's personal observation). Despite these concerns, students should still be able to gain experience with aquatic ecosystems— a limited field experience can be more valuable than no field experience. Given the considerations for equitable student access in the field, below is a guide for instructors designing asynchronous, self-led aquatic field trips (Figure 1). Ideally, all of these recommendations would be used simultaneously to ensure the most inclusive, universal design.

Collect Student Feedback

Classes usually encompass a variety of students with different needs, comfort zones, and resources. To plan an activity suiting the needs of your students, collecting anonymous data can be useful. At the beginning of the semester, send out a survey to gauge student comfort with journeying locally (example survey in Supporting File S1. Asynchronous Field Trip – Student Feedback Survey).

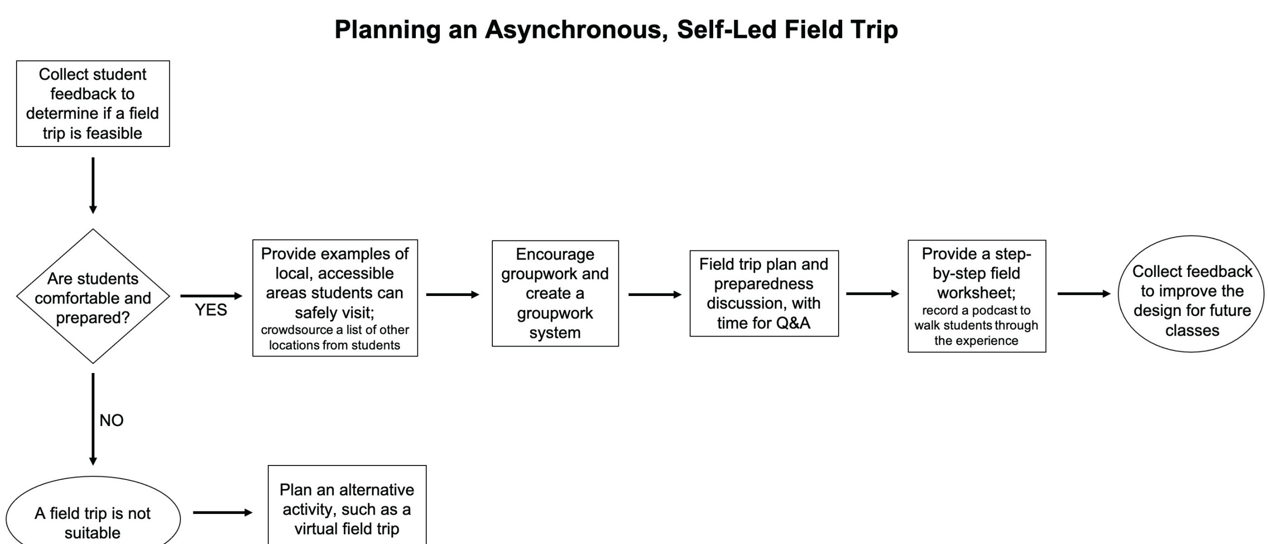

Figure 1. Flow chart outlining the steps for designing an inclusive asynchronous, self-led field trip.

Questions could include:

- How many hours do you spend outdoors per week? (ex: taking walks or bike rides, spending time in parks, hiking on trails, birdwatching...)
- Would you feel comfortable exploring an area of campus alone?
- Would you feel comfortable exploring a city park alone?
- Would you feel comfortable exploring a city park or campus space with a close friend or family member, or another classmate?
- Do you have access to:
    - Sunscreen
    - Water bottle
    - Rain gear (raincoat, rain pants, or umbrella). *Omit in desert regions, such as the University of Arizona, where streams are dangerous in rainy conditions due to flash flood risks*
    - Sturdy, close-toed shoes that can get wet
    - A smartphone or tablet for using free apps and taking pictures
    - A device that can be used to listen to an audio file or to YouTube
    - A notebook

Having data on these questions will inform whether the field trip is possible and how to proceed with the next steps. If many students answer 'no' to most of these questions, then perhaps an asynchronous, self-led field trip is not suitable for this class. However, the instructor could arrange alternative assignments, such as a virtual field trip. One way to arrange this is having the students watch an aquatic camera livestream (31), options for which include both above and below the water and many different biomes. Watching these livestreams allow home-based students to extract ecological information (35). Another option if just a small percentage of students answer 'no' is to assist students in obtaining the necessary materials from the university. Instructors should gauge how manageable arranging access and resources is for their students depending on their class sizes. I recommend doing this whenever possible to improve equity. Finally, if most students answer 'yes' to the questions, then the field trip is on!

Prioritize Student Choice in Location

To maximize student comfort and safety, the students should choose the location where they individually complete the field trip. The instructor should provide a wide variety of examples of possible locations, promoting safe, local areas with accessible designs such as campus spaces (9, 36), or city parks (example of communicating potential locations in Supporting File S2. Asynchronous Field Trip – Giving Location Examples). Further, crowdsourcing suggestions from the students could increase the sense of ownership students have in the trip. Students with the resources to make a longer trip to an aquatic ecosystem site can do so but should be aware of more challenging or demanding conditions. Students' locations could be highly variable within or across regions, and the activity is purely introductory, so the activity should be designed for any stream (or any lake or wetland, depending on the study focus). This being said, the instructor should set some guidelines as to what type of habitat to look for so students choose a relevant site (i.e., standing water, running water, not a swimming pool or bird bath, etc.). The instructor should emphasize the importance of visiting a variety of locations along the gradient from urban to natural, acknowledging that there will be differences in observation, but the diversity of settings is valuable to the class's knowledge and all ecosystems are important. Lastly, working on this early in the semester gives the students a chance to prepare and plan their trip. People of underrepresented backgrounds may feel unwelcome in public recreation spaces (37, 38) and need time to identify a location for the field trip. If a student cannot find a site where they would feel comfortable visiting, the instructor should help the student locate a site within the area the student identifies as their comfort zone.

Encourage Group Work

Although the field trip is self-led, it does not have to be completed alone. Visiting sites with classmates who live nearby, or friends or family if no classmate lives nearby, can contribute to student comfort levels and safety in the field (17). Encouraging students to work with other classmates in the field can build a learning community or peer network, stimulate an individual's scientific identity, and promote retention in the sciences (19, 39). However, group work may not be possible if some students do not live in the same area, or if pandemic safety regulations must be met. To combat isolation of certain students and help build a learning community, the instructor should create a group work network where students check in with each other and communicate about their field experiences and data (example of creating groups in Supporting File S3. Asynchronous Field Trip – Groupwork System). To ensure students are not placed in situations where they are further marginalized, groups should be mostly randomly assigned, but each should contain multiple persons of underrepresented identities (40, 41). Further, to reduce dangers to certain students, the pre-trip survey could include a yes/no question about if there are peers the student does not want to be paired with (follow up with the 'yes' students). Again, completing this step early on gives students time to plan and time for their friend or groupmates to plan as well. Students can use the groups as a tool during field trips for asking questions, discussing observations, and seeking support.

Host a Q&A Discussion

Since students will be arriving in a potentially unfamiliar place and independently doing a new activity, they will require preparation for the trip and clear instructions once they get to the field. In the virtual classroom before the trip, the instructor should talk about the components of the activity, what to expect, what to do if there is an issue, and host a question-and-answer session or discussion board to help students prepare and feel secure (example of organizing a question session in Supporting File S4. Asynchronous Field Trip – Q&A Session). Ensuring that students are aware of risks associated with travel and public spaces and that they know how to recognize risks is important to their safety (10). Instructors should provide students with a safety checklist (e.g., for gear and risk awareness) to consult before they leave for the field trip and during the field trip. Instructors can play a prominent role in reducing stress and the likelihood of danger for at-risk students in the field; see Demery and Pipkin (2021) for strategies.

Provide a Field Trip Activity Worksheet

Next, students can reference the field trip worksheet for detailed information. Step-by-step directions from the instructor guide the activity (example worksheet in Supporting File S5. Asynchronous Field Trip – Trip Worksheet), which is designed such that the students can do the work independently and without specialized equipment. The field trip guide should be in multiple formats to aid students with various visual or auditory disabilities, which additionally benefits all students by providing options (31). First, a written worksheet involving a preparation section and the step-by-step instructions should be available online (to access via smartphone and computer) and downloadable (to print or reference when in the field without internet or cell service). Ideally, students should be able to complete the worksheet on a smart device via a word processor or fillable form, or on paper to be turned in via photo or scan. Including time expectations for each step can be helpful. To reduce the burden of this activity on students, instructors should consider how much time the assignment will take, including travel to the site and filling out the worksheet, and how it fits into fulfilling credit hours. If the instructor opts to make the field component longer and more involved than the regular homework assignments for the week, they should consider canceling lecture to balance the load on students' time.

Second, instructors should create an accompanying instructional podcast that students can listen to in the field while completing the worksheet. Hearing the instructor's voice can improve the students' sense of instructor involvement and care (42, 43) and can aid visually-impaired students (44). The podcast could even incorporate interviews of experts (e.g., land managers, researchers, traditional knowledge holders, etc.) to relay information and perspectives to the students. However, students should be careful about remaining alert while listening to the podcast, because using headphones has been associated with reduced environmental awareness (45), which could be a safety concern. Like the worksheet, the podcast should be available for both online and offline use, so instructors should have the downloadable file available on the course site in addition to the course website's audio player or uploading to YouTube. A previous self-led field trip instructor noted that the accompanying audio was easier for students to manage in small clips; they could easily replay parts that pertained to specific points in the activity (10). The written and audio instruction should tell the students how much time to spend on each task for effective pacing, but also encourage the students to take more time if they need to (31).

The guided activities should involve materials students have at home or have arranged access to. A device for sketching is valuable for many activities, whether in a notebook or on a smart device. If students have access to a smart device that allows them to take photos and use free apps, then group data collection is possible (46). For example, students can take photos of riparian vegetation, upload their photos to the virtual classroom, and make comparison/contrasting observations about the different types of vegetation present, or discuss stream widths, number of exposed rocks, woody debris, etc. Students can also use citizen science apps to identify species (iNaturalist), record whether there is water flowing through the stream or if it's dry (StreamTracker, CrowdWater), document plastic pollution (CrowdWater), and more. The instructor may even be able to create a folder or 'project' within the app that is class-specific for better tracking of student findings.

For the safety of the students and because of accessibility concerns, the guided activities should not mandate entering the water. This ensures that students with mobility impairments and discomfort in the water are able to complete the activities (31). Multiple means of access (i.e., giving the choice of going in the water or on other path within the activity) can be inclusive during a faculty-led field trip (31), but is too dangerous for an unsupervised activity. Further, students may not know how to swim, may not be able to recognize dangerous water velocities, depths, and other hazards, and some water bodies may not be sanitary enough for entry (47, 48). Lastly, people of color disproportionately experience racial discrimination in public parks (49) and underrepresented scientists experience discrimination in the field (17). Students may be uncomfortable around strangers who may label them as a danger to the community (17), thus students may not want to engage in activities that could attract attention or be deemed suspicious by other passerby or the authorities (e.g., wading, netting, measuring). Limiting the activity to making observations and taking photos protects students from this type of scrutiny. Though exploring the water is important to becoming an aquatic ecologist, the safety of the students is paramount, and they will hopefully have opportunities through university research collaborations, internships, and guided recreational experiences to safely explore the water in the future.

Keeping in mind that students will not enter the water, activities need to happen from an accessible viewing area. Many activities can be completed from bridges, overlooks, docks, and accessible trails along the water's edge. For example, students can:

- Observe hydrologic patterns (gravel bar, cut bank, meanders, eddies, backwaters, riffles, pools)
- Draw cross sections of the channel and riparian areas
    - Observe whether there is flow or not; where water reaches at high flow
    - Note substrate size/rocks, woody debris, connections to floodplains and tributaries, and other habitat details
- List organisms seen (fish of many sizes, insects and other invertebrates, ducks, herons, beavers, otters, muskrats, etc.)
- Document terrestrial-aquatic exchanges (may include emerging insects, dragonflies ovipositing, falling leaves, avian or other riparian predators, evidence of aquatic mammal activity, animals coming to drink, etc.)
- Take photos, videos, or audio clips to share and discuss with the class
- Make repeat visits to document change over time
- Add data to citizen science apps
- Collect data on who is recreating at the waterbody
- Learn from informational signage and create a mini-podcast or other digital storytelling assignment

Students could visit the site for multiple activities, which can help broaden their understanding of the ecosystem (10). Simply by being at a water body and following instructions for new ways to think about the setting, students can have novel experiences and learn about the aquatic ecosystem around them.

Assess & Prepare for the Next Iteration

When the field component of the curriculum is over, or at the end of the semester, instructors should collect feedback from students to improve the field trip design for future trips or future classes (example survey in Supporting File S6. Asynchronous Field Trip – Follow-Up Survey).

Instructors could ask:

- Were you comfortable while exploring these areas?
- What areas do you recommend future students visit?
- What items did you use during your visits to the field?
- What items do you recommend future students use on their self-led field trips?
- What aspects of the field trip(s) were difficult?
- What aspects of the field trip(s) did you enjoy?
- Any other comments or feedback

Understanding student experiences will not only help improve the activities, these data can also inform the higher education community about the effectiveness of self-led, asynchronous field trips and contribute to the overall body of scholarly research. Using the post-survey data in conjunction with the worksheet data, instructors can assess the ramifications of different field trip locations on student learning. For example, the data can help instructors assess whether there were differences in students' abilities to make observations when completing the virtual field trip versus visiting a non biologically-diverse site versus visiting a more 'wild' site. Understanding factors that hinder students' abilities to observe and make connections can help instructors design the most equitable, effective field trip experiences for their students.

CONCLUSIONS

Organizing self-led, asynchronous field trips could be a beneficial way to bring variation to online course content. Although not a one-to-one substitution for face-to-face instruction or hands-on practice with field equipment, these individualized experiences give students an opportunity to familiarize themselves with aquatic habitats and gain appreciation for aquatic ecosystems. However, when designing these activities, equity is paramount due to the wide variability in students' circumstances. Instructors should consider resources students may have access to, comfort with individual exploration, physical ability to reach the habitats, and how to guide students virtually. As more instructors implement asynchronous, self-led field trips, the collective knowledge will be an exciting addition to scholarly research in natural science education and potentially a powerful tool for inclusive teaching.

SCIENTIFIC TEACHING THEMES

Active Learning

Students' active engagement will depend on the type of activities the instructor includes. In the example, active techniques include drawing/diagramming, taking photos, making observations, and collecting data.

Assessment

Instructors will measure learning through activity completion. This could include students turning in the worksheet and entering data to the class spreadsheet. Instructors could also implement pre- and post-tests, however, because the activity is designed to be introductory, ecological concepts may not have been covered yet. Since the activity may be new to most students and involves individual exploration without the ability to ask questions during the trip and concern for safety, it is appropriate to give students credit for going on the trip and completing the worksheet to the best of their abilities.

Inclusive Teaching

This activity is inclusive because it is designed to be flexible in students' schedules, cognizant of social bias, accessibility, and student safety, and focused on each student's comfort zone. Additionally, instructors are encouraged to make students aware that all ecosystems are important, no matter how 'pristine' or 'urban' the location. This will show students that their home area is ecologically valuable, regardless of the socioeconomic status. Lastly, the activity allows for alternatives if students do not feel safe participating.

SUPPORTING MATERIALS

- S1. Asynchronous Field Trip – Student Feedback Survey
- S2. Asynchronous Field Trip – Giving Location Examples
- S3. Asynchronous Field Trip – Groupwork System
- S4. Asynchronous Field Trip – Q&A Session
- S5. Asynchronous Field Trip – Trip Worksheet
- S6. Asynchronous Field Trip – Follow-Up Survey

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