

# Instructor Guide

## Days 4 and 5: Field Training & Reflection

### Overview

Students will conduct a hands-on investigation at their designated stream study site, practicing the use of field measurement tools to assess water quality. In the field, they will learn to collect and identify macroinvertebrates, observe and compare different stream habitats, measure flow rate and turbidity, and gather *E. coli* samples. Back in the classroom, students will analyze their data to explore how each measurement, especially the presence and diversity of macroinvertebrates, serves as an indicator of stream health. Through discussion and reflection, they will connect their field observations to broader concepts in aquatic ecology and environmental monitoring.

### Standards Alignment

*AFNR Natural Resource Systems Career Pathway Standards, Common Career Technical Core (CCTC)*

**NRS.01.** Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.

**NRS.01.02.** Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographic region.  
(NRS.01.02.04.a., NRS.01.02.04.b., NRS. 01.02.04.c.)

### Learning Objectives

- Students will operate field measurement tools and apply standardized sampling techniques to collect accurate water quality data at the study site for stream flow, turbidity, and *E. coli*.
- Students will collect, sort, and identify macroinvertebrate samples from their study site.
- Students will analyze how variations in stream habitat characteristics influence macroinvertebrate biodiversity and abundance.
- Students will interpret macroinvertebrate sampling results to evaluate overall stream health and support their conclusions using established water quality indices.

### Materials

- Stream Team Field Guide (1 per student)

- Fall Day 5 Field Reflection worksheet (1 per student or group)
- Writing instrument
- Field monitoring kits for *E.coli*, stream flow, turbidity, and macroinvertebrates (per group)
  - Pole samplers
  - turbidity tubes
  - D-nets and kick nets
  - Waders/boots
  - Sorting trays
  - E.coli sample bottles
  - Gloves
- 5-gallon bucket with bubbler (for overnight storage of macroinvertebrates)
- PocketMacros app
- Foreceps (for each group)
- Macro ID cards/ pictures
- preserved macroinvertebrate samples (optional)
- DI water

## Vocabulary

- *Benthic Macroinvertebrates* – small aquatic animals with no backbones living in the streambed.
- *Water Quality Rating* –a score representing the quality of water for supporting macroinvertebrate life, particularly pollution-sensitive organisms.

## Advanced Preparation

1. Review the stream chemistry, macroinvertebrate and *E. coli* sampling protocols in the Field Guide – be prepared to demonstrate each technique.
2. Scout the site in advance to confirm safe access to riffles, pools, leaf packs, undercut banks, or other habitat types.
3. Assign roles within teams, i.e., stream chemistry, flow/turbidity, macroinvertebrate collector/picker, and data recorder.
4. Collect materials and print copies of the *Field Training Reflection* worksheet for students to complete back in the classroom.
5. Assign students the "Stream Bugs Tell the Story" section from the Field Guide as homework to prepare them for an in-class discussion on macroinvertebrate sampling and water quality ratings.

## Lesson Sequence

Time period: homework (reading) prior to class and two class periods, one completed in the field (Field Training), plus one in the classroom for practicing macroinvertebrate identification and completing the *Field Day Reflection* worksheet.

### *Day 1 – Field Training*

**Travel to the study site** (5 minutes)

**Engage: Introduction to Safety Protocols and Sampling Methods** (10-15 minutes)

1. Briefly review field safety including depth checks, proper footwear, team roles.
  - a. Demonstrate how to check stream depth before entering the stream.  
Sample discussion question:
    - *Why might it be important to check the depth of the water before stepping in?*
  - b. Emphasize proper footwear (closed-toe water shoes or boots or waders with good traction) to prevent slipping on rocks or sharp objects.  
Sample discussion question:
    - *How can choosing the right footwear affect both safety and data collection?*
  - c. Remind students about avoiding sudden movements while in the stream to prevent slipping and staying within their designated study location.
2. Introduce macroinvertebrates as “bioindicators,” or organisms whose presence or absence can reflect long-term water quality trends. If available, pass around preserved macroinvertebrate specimens. Connect back to the reading students completed in the Stream Team Field Guide and explain that certain macroinvertebrate groups are more sensitive to pollution (e.g., stoneflies, mayflies, caddisflies) while others are more tolerant (e.g., leeches, worms).  
Sample discussion question:
  - *What might it mean if we find a high diversity of sensitive macroinvertebrates in a stream?*
3. Connect *E. coli* testing to public health concerns, highlighting how it indicates possible contamination from human or animal waste.

**Explore: Field Measurement Practice** (15-20 minutes)

1. Demonstrate the field measurements students need to practice (e.g., flow, turbidity, probes, *E. coli* samples). The sampling protocols for the field measurements are in the Stream Team Field Guide.

Sample discussion questions:

- *What is our top priority with field sampling? (Safety! Remind students of the safety discussion from the start of class)*
  - *What could happen if we contaminate an E. coli sample during collection?*
2. Have students rotate through stations or roles so everyone practices collecting and recording measurements.

### **Explore Continued: Macroinvertebrate Sampling (20-25 minutes)**

1. Model the collection and sorting techniques students need to practice for macroinvertebrate sampling using the sampling techniques for specific habitat types located in the Stream Team Field Guide. For each demonstration, emphasize correct net placement, rinsing procedures, and how to carefully transfer organisms into trays. Review how to use the macroinvertebrate collection equipment, including trays, forceps, and containers.
2. Assign teams and habitats. Divide students into small groups. Assign each team one habitat type to begin with. Provide trays, forceps, and containers for samples.
3. Organize the sampling area into four stations (riffle/run, pool, leaf pack, undercut bank) and rotate groups through habitat types.
  - a. Set a visible timer for 5 minutes at each station to keep rotations structured and efficient. Give students a 30-second warning before switching.
  - b. As students work, circulate actively between groups:
    - i. Watch for gentle handling of organisms and safe movement in the stream area.
    - ii. Offer real-time feedback and redirect as needed.
  - c. Pause briefly at each group to answer questions, reinforce correct techniques.
  - d. Signal when time is up, then direct all teams to rotate simultaneously to the next habitat station, ensuring that every team practices in all four habitats.

### **Wrap Up, Equipment Care, and Travel to Classroom (5 minutes)**

1. Check that nets are cleaned and rinsed correctly. Rinse multi-meter probes with DI water. Make sure the samples collected from each station are put in the trays to bring back to the classroom for sorting and analysis.

**Extending the Fieldwork into the Classroom:** If time permits in the same day as the Macroinvertebrate Sampling, sorting can be done in the field or back in the classroom as outlined in the explain section below. To maintain the macroinvertebrates overnight, consider putting the collected samples into a covered 5-gallon bucket with a fish tank bubbler.

## *Day 2 – Macroinvertebrate Identification, Analysis, and Reflection*

### **Explain: Macroinvertebrate Identification (30-35 minutes)**

1. Explain that students will now sort their collected samples into groups and use the free *PocketMacros* app to begin identifying species. Have students download the app (if not already done) before starting.
2. Demonstrate how to gently transfer specimens into water-filled sorting trays. Show how to begin separating organisms into broad categories (e.g., worms, mayflies, caddisflies, beetles).
3. Walk students through the three main functions of *PocketMacros*:
  - a. Field Guide: Explore species overviews and pollution tolerance levels.
  - b. ID Key: Use the step-by-step key to identify unknown specimens; emphasize that once identified, the app links directly to the species profile in the Field Guide.
  - c. Flashcards: Practice with the study resources to strengthen recognition skills.
4. Have teams use *PocketMacros* to identify at least 4-5 organisms from their samples. As students work, monitor their macroinvertebrate sorting and identification and answer app-related questions.
5. Once every group has had the opportunity to identify a few macroinvertebrates, guide the students through a brief discussion to debrief the field and sorting experience.

#### Sample discussion questions:

- *What might it mean if we find a high diversity of sensitive macroinvertebrates in a stream?*
  - What differences are you noticing between habitats?
  - Which habitat seems to have the most variety?
  - *Why do you think certain organisms are found in some habitats*
6. Have students turn to the Datasheet- In Classroom Recording page of their Stream Team Field Guide. Introduce the topic of a Water Quality Rating (WQR). Ideally, all students will be familiar with this topic if they completed the assigned reading located in the Advanced Preparation section. Lead a brief discussion detailing why WQRs are used by scientists.

#### Sample discussion questions:

- *Why do you think scientists use living organisms, like aquatic macroinvertebrates, instead of only water chemistry analysis to rate water quality?*
  - *What advantages might a water quality rating give compared to a single-day set of measurements from a multimeter tool?*
  - *How could water quality ratings help track changes in a stream over time?*
7. Have students turn to the Reference Sheet for Water Quality Ratings in their Stream Team Field Guide. Lead a brief discussion on how WQRs are calculated.

Sample discussion questions:

- *How do scientists decide on a rating — what does it mean when a stream is rated “excellent,” “fair,” or “poor” based on macroinvertebrates?*
- *How do sensitive and tolerant species each contribute to the water quality rating?*

### **Elaborate: Field Training Reflection (20-25 minutes)**

1. Pass out the *Field Training Reflection* handout to the student teams.
2. Encourage student teams to work through the handout by using the “Think About It” discussion questions to guide their ideas. Remind the students that these questions are meant to spark conversation within the team before they write down their responses.
3. Bring the class back together for a full group discussion and highlight one or two key takeaways. Reinforce that combining all these indicators helps them tell the “story” of their stream’s health.

### **Optional Evaluate: Macroinvertebrate Identification Formative Assessment (15-20 minutes)**

1. Create stations for students to rotate through with macroinvertebrate samples (preserved or live specimens- if available, photos, and printed ID cards) representing a mix of common species (e.g., mayfly, caddisfly, leech, snail) and a few tricky look-alikes.
2. Have students rotate through the stations in teams using the PocketMacros app. At each station, students should work to identify the macroinvertebrate and to record the organism’s name and whether it is pollution tolerant, somewhat tolerant, or sensitive.
3. To make it more fun for students, consider gamifying the station identification process, where students can earn points as a team for each macroinvertebrate they correctly identify.

4. As correct answers are revealed and points are tallied, reinforce that the purpose of the game was because identifying macroinvertebrates isn't just about naming bug, it's about using them as indicators of stream health.