MACROINVERTEBRATES OUTDOOR LAB
TEACHER'S GUIDE

Learning Goal: Learners will be able to use macroinvertebrate sampling data to evaluate water quality and ecosystem health.

Objectives:
- Use sampling equipment to collect aquatic macroinvertebrates.
- Identify macroinvertebrates by observing traits and using a key.
- Assess a macroinvertebrate sample as an indicator of water quality.
- Understand life cycles of selected macroinvertebrates.

Note: Before the lab, scout the site and identify several areas where students can sample throughout the day to reduce impact and maximize collection. When setting up for this lab, make sure you have enough rubber boots/waders, and D-nets (or dip nets) for each group. Set up a table where samples can be sorted and have identification keys, pipettes, forceps, magnifying glass/hand lenses and spoons available. Ice cube trays are useful for sorting macroinvertebrates.

As a general timeline, we recommend: 5 minutes for review of classroom, 5 minutes for safety and demonstration of sampling, 15 minutes for collection, 20 minutes for completing the worksheet and scoring.

1. Introduce the leaders and volunteers who will be involved in the module. Discuss outdoor learning safety aspects and proper use of sampling equipment.

2. Briefly review content from the indoor lab including aquatic insect life cycles (complete/incomplete metamorphosis, larva, pupa), how aquatic invertebrates have different tolerances, and how we can use those tolerances to assess the quality of water where invertebrates are sampled.

3. Have students open their lab books and review pages 2-4. Give students an overview on what they will be doing in this session. This lab is very similar to the indoor lab, but in this case the students are collecting their own sample.

4. Have student pairs work together, with one person sweeping the sediment and aquatic plants for macroinvertebrates. The second person should assist in examining the net and gently removing any macroinvertebrates found. Each group should go to a designated area close to shore where they can be monitored.

5. The team can sort through their samples at the table that is set up for identification purposes. Make sure there is an opportunity to swap roles so that all students can use the equipment to sample.

6. At the table, students should sort out their sample and use the identification key (page 4) to determine which macroinvertebrates they have found. After all macroinvertebrates have been identified, students should turn to page 2 and circle any of the macroinvertebrates pictured.
   - If the students find more than one individual of the same species, it is only recorded once. We are determining the diversity of organisms present, not the abundance of each species.

7. Demonstrate how to tabulate the data on page 2 and transfer the information to the summary page (page 3).
   a. Explain that the left-hand column should be filled in with the total number of organisms in each of the four groups (sensitive, semi-sensitive, semi-tolerant, tolerant) that they found in their sample. Then, show the students that they should multiply column A with the appropriate ranking to fill in column B. Finally, divide the total from column B by the total from column A, and round to the nearest tenth. This will give students their index score.
   b. Have students circle the rating that is associated with their score: excellent, good, fair, poor.

8. Be sure to wrap up in time to review the key points and fill out the macroinvertebrate questions in the lab book.
   a. Different types of macroinvertebrates: you can talk about how the presence of certain species indicates higher water quality. Discuss how these organisms require higher oxygen levels or are sensitive to pollutants. Conversely, if all of the macroinvertebrates are tolerant, the score will be lower and the assessment would be "poor" or "fair".
   b. Connect to broader context, linking the importance of water quality to lake ecosystems and how we use water quality information to determine and manage the health of our lakes. You can discuss topics such as:
      i. Factors that determine good critical habitat.
      ii. The presence of aquatic plants for increased oxygen and habitat availability, and absorption of pollutants (phosphorus, nitrogen, etc.).
      iii. Presence of invasive plants (e.g., curly-leaf pondweed) that start growing in the fall and disintegrate earlier in the summer, releasing their phosphorus and nitrogen loads during the hottest part of the year. This can cause algae blooms and adversely affect water quality.
      iv. Increased water clarity: sediment retention through shoreline restoration efforts can improve habitat for sensitive species. However, invasive quagga and zebra mussels can also increase water clarity, but are harmful to ecosystems where they invade.

9. After the tally and score is completed, the macroinvertebrates are released in the area they were found, save for any aquatic invasive species/non-indigenous beings, which should be humanely preserved or disposed of. Instructors should also initial the completed macroinvertebrate page and move the total score to the student lab cover page before students depart.