

Benthic Macroinvertebrates (BMIs): Habitat and Collection

In this activity students will collect benthic macroinvertebrates from a stream and do some gross sorting. Benthic macroinvertebrates are stream-dwelling invertebrates capable of being seen with the unaided naked eye. It is these traits that yield the name benthic macroinvertebrate: *benthic = bottom, macro = large, invertebrate = animal without a backbone* Healthy streams will have a wide variety of species in relative abundance so sampling is an effective way to gauge the health of a stream.

It is highly desirable that the volunteers in charge of this station be experienced participants in the HRWC's benthic macroinvertebrate surveys, a.k.a. the Spring and Fall Roundups. Completing the HRWC leader and/or collector training will also make running this activity much easier and more rewarding.

Although the pre and post discussions are necessary to provide important information about each topic, it is the activity that is most vital to this unit. Be sure to allow plenty of time to complete the activity.

Pre-Activity Discussion (Answers can be found in the Background Information section below)

- 1) What are benthic macroinvertebrates and why are they important?
- 2) Is it good to have lots of bugs in stream water?
- 3) Based on a quick observation of the stream itself and surrounding areas, what would you judge the quality of the water to be and why?

The Activity

IMPORTANT: To help ensure a successful activity without incident, scout out the stream in advance to pick a site that is safe and will harbor good specimens. You may want to work with the leader in charge of BMI Identification if this activity is also being offered. ****Depending on the age of the students and time allotment, the collecting may be done by the adult leader, by one or more students, or by both. When time is limited or site quality is questionable, collecting may have to be done in advance, either on or off site.*

Site Selection: Safety Concerns- Please read these guidelines carefully!

1. The stream should be easy to access and wade at the site selected
2. The water should be neither too swift nor too deep for safety
3. The bottom should not be too muddy to wade
4. Always remember the #1 Rule of Collecting: Don't go in if the water looks dangerous

Site Selection: Collection Concerns

To collect a wide array of critters, select a site with a variety of habitats and stream conditions. Look for:

- 1) Bottom conditions: Areas of gravel; areas with cobble; areas with sand
- 2) Muddiness: Avoid areas that are too muddy. You will find far fewer critters.
- 3) Vegetation: aquatic plants; leaf packs; woody debris; root wads; overhanging growth
- 4) Stream conditions: riffles; slow areas; deep pools
- 5) Overhanging banks

Equipment

This activity requires a lot of equipment. It will be helpful to appoint a student or two as equipment managers to make sure nothing is lost. After the event, search the site to make sure all equipment is picked up.

For the Collector(s):

- Dip net (It is generally best to limit the group to one collector to avoid muddying the water excessively)
- Hip boots or waders (depending on stream depth)

For the Student Pickers:

- Squirt bottles- 2- for washing critters and debris from the net into the collecting pans and for use at the picking table
- White collecting pans (4-5 so several students can pick through the samples at the same time)
- Sorting containers (small tubs) for the critters your station has collected. The tubs may be labeled for habitat, but it is often impossible to make these distinctions, particularly when the collecting has been done in advance or off site. Use the labels at your discretion. When the activity concludes, the tubs will be brought to the identification station if it is offered.
- Plastic net spoons- one for each picker. This is the collection tool of choice
- Forceps
- Eyedroppers
- Magnifying glass
- Small picking table or plastic ground sheet. Use a picnic table if available.

Collecting Specimens: Roles and Responsibilities

A collecting team consists of 3 roles: The Collector, the Runner and the Pickers. One collector and one runner should be adequate but a team will usually have several pickers. Before beginning the collecting, the leader should identify the variety of habitats within a stream and point out the importance of sampling each one.

The collector is the person in the stream with the net. The things that are netted or collected by hand should be put into the white collecting pans. The collector should sample as many likely habitats as are available—gravel riffles, submerged and overhanging vegetation, woody debris, root wads, etc. Items such as rocks, leaf packs, and woody debris can be removed from the stream without a net.

The collector may want to get the pickers started quickly by giving them a few rocks and/or pieces of woody debris. This material should be returned to the stream when it has been picked over.

The collector should use his dip net aggressively. These nets are tough and can take a lot of abuse. Avoid getting large quantities of mud in the trays. Mud makes the pickers' job difficult. An experienced volunteer can be helpful to a student collector by offering advice about net techniques and habitats to sample.

The runner helps the collector remove the contents of the net by using the squirt bottle filled with stream water to wash critters and detritus from the net into the collecting pans. The runner also shuttles pans back and forth between the collector and the picking table. Another important task for the runner: Remind the collector to sample all habitats in that portion of the stream. The runner is an optional assignment but will help the process move along much more efficiently. Check to see that the runner has appropriate footwear, as the bank may be wet and muddy.

The pickers will carefully pick through the stuff in the white collecting pans and take out every living thing no matter how small or how quick. Plastic net spoons are generally best for catching critters in the pans. The spoons are easy to use, good for catching fast swimmers, and much gentler on the critters than forceps, which should be used sparingly and carefully. Eyedroppers are good for catching very small, fast-moving specimens.

The critters that are removed from the white collecting pans should be put into sorting tubs. Small tubs are provided for this. Each tub should have clean stream water. Critters should be sorted by general appearance without worry of having more than one species in a tub. The goal is to note the variety of living creatures and their differences, not identification. *These sorting tubs will be passed on to the BMI Identification leader (if this activity is being offered) where more precise sorting and identification will occur.*

To make picking easier, keep enough water in the white pans to permit sloshing it around now and again. A few seconds after sloshing, the critters will begin to move. Sloshing helps dislocate critters from hiding spots. Another trick: Use the squirt bottles to gently dribble water on rocks, pieces of wood and leaves and then watch for movement.

The critters will appreciate it if you keep the pans in the shade as much as possible. If a fish, turtle, or frog is caught, remember that these are not invertebrates and, after examination, should be returned unharmed to the stream. You may want to retain it in a pan in the shade during the day's activities so that all the students can view it.

Post-Activity Discussion

- 1) What surprised you most about today's activity?
- 2) Did we find any sensitive species? A variety of species? What habitats proved productive?
- 3) How would you rate the stream's health? What might improve it at this location?
- 4) How do these critters fit into the stream's food web?
- 5) What are some challenges that these critters face in their habitats? (Force of water, evading predators, dirt in the water, etc.)

Background Information

Contrary to what most kids think, it is good to have lots of bugs in a stream, especially if there is also lots of diversity. If these critters- the benthic macroinvertebrates- are not present, the questions that must be asked are "Why? What is killing them off?"

BMI's live mostly on stream bottoms, on woody debris or leaf packs, on and under rocks, and in root wads, gravel, and aquatic vegetation. BMI's include flatworms, oligochaete

worms, leeches, water mites, mollusks (snails, clams, mussels), crustaceans (crayfish, scuds, aquatic sowbugs, freshwater shrimp), and a very broad spectrum of aquatic insects (adults) and aquatic insect larvae and nymphs (juvenile forms). Be sure to note to the students that the majority of critters collected are generally juvenile form of insects that look much different as adults.

BMI's are a vital part of the living community of a stream. They are a major link in the aquatic food chain. In most streams the energy stored by plants is available to herbivores and omnivores as (1) leaves that fall into the water, (2) algae and bacteria that grow on rocks, woody debris, etc., and (3) other aquatic submerged, floating, and emergent plants. These provide an energy source to the herbivores and omnivores, who in turn provide an energy source to the carnivores—predatory BMI's, fish, frogs, turtles, etc. Without BMI's, most sport fish would quickly starve to death. Closer study of these energy relationships shows that the food chain is quite complex, more of a food web than a food chain.

Among the BMI's are some that are very sensitive to pollution and low levels of dissolved oxygen. These include what is often referred to as the EPT category (Ephemeroptera, Plecoptera, Trichoptera). These taxa include mayflies, stoneflies and caddisflies. Other pollution-sensitive organisms are listed on the HRWC bug ID sheet. When critters are collected to determine the health of a stream, the collectors look for diversity and also to see how many of the sensitive species are also present. These are your indicator species. In winter, the HRWC looks for a couple of species of stoneflies that are also sensitive indicators of stream health.

To protect our streams' small inhabitants, we must also protect the watershed so that erosion and pollutants from surrounding areas don't damage the health of our waterways. By protecting the critters, we also create an environment that is friendly to humans and safe for swimming, fishing and other activities. There is much to be gained by keeping our waters clean and free from silt and contaminants.

**For this and all other units, advanced level information is available if desired.
Contact the HRWC and request an electronic version of the unabridged manual.**

BMI Collection Lesson Narrative

Intro. 5 – 8 minutes. The mission is to make these points: We collect the benthic macroinvertebrates because they are indicators of water quality. Water samples only tell us about the condition of the stream at one moment. Some BMIs are sensitive to water quality. That means they can only live where the water is good quality. If the water has not been good quality all the time, they will not be found. We sample different parts of the stream because different critters live in different microhabitats. For example, some live on rocks. Some live in leaf packs. Some live in gravel.

Note that this activity works best when there are 2 adult roles: Collector and Leader. This narrative assumes that 2 adults are present.

Collector narrative

1. My name is _____ and I'm a volunteer with the Benthic Macroinvertebrates station. I will be the Collector, and _____ will be the leader. Please tell me your names. (Go around)
2. When you look at the water in this stream, do you think anything lives the stream?
3. What might live here? (Students are likely to say fish.)
4. Agree that fish might live here.
5. Ask what the fish might be eating? (Students are likely to say bugs, or insects.)
6. Agree that there have to be organisms for the fish to eat, and that many of them are insects. Some are other invertebrates. We call all these invertebrates that live in the stream Benthic macroinvertebrates. Benthic means living on or at the bottom of a body of water. Macro means big and invertebrates means having no backbone. So benthic macroinvertebrates are invertebrates big enough for us to see that live in the stream. We say BMIs for short.
7. We collect the benthic macroinvertebrates because they are indicators of water quality. Water samples only tell us about the condition of the stream at one moment. Some BMIs are sensitive to water quality. That means they can only live where the water is good quality. If the water has not been good quality all the time, they will not be found.
8. We sample different parts of the stream because different critters live in different microhabitats. For example, some live on rocks. Some live in leaf packs. Some live in gravel. I will sample these habitats, as well as logs, rocks, and underneath overhanging banks. Each microhabitat may shelter different kinds of critters.

Leader Narrative

The Activity. 10 – 15 minutes. Explain the activity. Assign the roles. Start collecting.

9. Explain that the collector in the water will sample different microhabitats in the stream. S/he will need a runner to carry the samples to the students on the shore. The students will pick through the trays of samples, looking for anything that moves. They will put all the critters into a set of labeled tubs for the Identification station to sort and identify.

Note: Although the tubs may be labeled for habitat, it is often impossible to make these distinctions, particular when the collecting has been done in advance or off site. Use the labels at your discretion.

10. Assign the roles.

11. The Leader demonstrates how to use the squirt bottles, the spoons and forceps. If collecting is being done in a manner so that samples from each habitat are separate, make note of the following: Point out that the tubs are labeled for each microhabitat. Ask students to be sure they are putting the BMIs into the cup that matches the tray they are picking from.

12. Students pick through the tubs. They place the BMIs into the labeled cups.

13. When possible the Collector will call attention to the microhabitat being sampled.

The Wrap Up: 5 minutes. Gather the group back at the table/station. Discuss the key questions.

14. Can you identify different body shapes (flattened, rounded, long or short-legged, worm-like, etc.) in the collections from different habitats?

15. How might these body shapes adapt the organisms for the habitats in which they were found?

16. What conditions likely influenced where certain body shapes of critters were found? (Current speed, riffles/pools, eddies, cover, etc.)

17. What conditions could cause the measurements to be different?

18. Explain what people can do to improve the habitat. (Limit erosion, reduce run-off, stabilize banks, add logs, plant trees for shade, etc.)

19. It's time for you to go to your next station. Please take these cups with you to the BMI Identification station where you will learn more about the critters. Thanks for visiting with us today.