Benthic Macroinvertebrates (BMI) Identification

In this activity students will identify benthic macroinvertebrates collected from a stream. 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.

For this activity, there are resources that can be of great value. *A Guide to Common Freshwater Invertebrates of North America* by J. Reese Voshell, Jr. has fine pictures of stream critters and provides an excellent introduction to these critters, their ecology, and their various sensitivities to pollution. *Field Guide to Freshwater Invertebrates of North America*, by Thorp and Rogers, has good pictures and covers a wider range of critters in less detail than does Voshell's guide. *Pond Life,* an inexpensive Golden Guide book, is also very helpful and has good illustrations. The Huron River Watershed Council's bug ID sheet *Macroinvertebrates of the Huron River Basin* is another fine resource. It can be downloaded from the HRWC web site or obtained from their office.

It is highly desirable that the volunteers in charge of this station be experienced participants in the HRWC's benthic macroinvertebrate surveys, aka 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

Collecting Specimens: Roles and Responsibilities

Collecting should be done Prior to this station, either by adults before the activity or as a prior station. See the BMI Collection Activity for details.

Equipment

<u>To Identify:</u>
-Tub of critters
-Forceps 1 per student
-Plastic spoons, preferably with netting, 1 per student
-Small picking table or plastic ground sheet- Use a picnic table if available.
-White plastic ice cube trays
-Magnifying glass, 1 per pair
-HRWC bug ID sheet- 2 copies, preferably laminated in plastic
-Voshell's <u>A Guide to Common Freshwater Invertebrates of North America</u>, 1 copy
-Data forms, clipboards, pencils
-Display boards
-Calculator (Optional- needed if you plan to calculate a water quality index from the data)

-Collecting bottles, labels, isopropyl alcohol 90-99% (Optional- needed only if planning to preserve the collection, rather than catch-and-release, which is the normal practice)

Identification

Students can use the spoons and forceps to collect the critters from the tray. To sort the critters, fill the compartments of the ice cube trays 2/3rds full of stream water and put different kinds of critters into different compartments. For big critters such as hellgrammites, crayfish, and large cranefly larvae, you may need to use one of the sorting pans or plastic bowls. The critters will appreciate it if you keep them in the shade as much as possible.

For identification, use the HRWC's bug ID sheet, the poster, and Voshell's guide to BMIs. Review the list of critters on the BMI worksheet to determine which bugs need to be identified all the way to family (ex: Dobsonfly larvae in Group 1) and which bugs only need to be identified to order or class (ex: Caddisfly larvae, case building in Group 1; Clams and Mussels in Group 2). An experienced volunteer can be very helpful on this.

Fill out the BMI worksheet and use it to determine the number of taxa (types) of critters that were collected, Use the data sheets to calculate and record the water quality index for that stream site.

Post-Activity Discussion

1) How many different types of critters did we find?

2) How would you rate the quality of the stream based on our collection?

3) What factors in the stream and the surrounding area do you think affect the quality of life in the water positively or negatively?

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?"

BMIs live mostly on stream bottoms, on woody debris or leaf packs, on and under rocks, and in root wads, gravel, and aquatic vegetation. BMIs 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).

BMIs 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 BMIs, fish, frogs, turtles, etc. Without BMIs, 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 BMIs are some that are very sensitive to pollution and low dissolved oxygen levels. This includes what is often referred to as the EPT category (Ephemeroptera, Plecoptera, Trichoptera). These taxa include mayflies, stoneflies and caddisflies. 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.

Benthic Macroinvertebrates Worksheet

- Sort your bugs – Place bugs that look different into separate compartments in the ice cube trays
- Use the bug identification chart Macroinvertebrates of the Huron River Basin to figure out the name of each different type of bug that you found. Get help from an adult if you're not sure
- Place a checkmark in the "Found" column if you find that bug, even if you only find 1 individual!
- Count how many check marks you have in each group
- Place that number in the bottom row of each Group (Group 1, Group 2, and Group 3)

Group 1 ***Very sensitive*** **to pollution**

Critter Name	Found	Critter Name	Found
1. Caddisfly larvae with case	☐	**3. Mayfly nymph**	☐
2. Dobsonfly larvae	☐	**4. Stonefly nymph**	☐
		Count (# of checks)	

Group 2 Can ***tolerate a little*** **pollution**

Critter Name	Found	Critter Name	Found
5. Alderfly larvae	☐	**13. Dragonfly nymph**	☐
6. Blackfly	☐	**14. Midge larvae**	☐
7. Caddisfly larvae (free-living)	☐	**15. Riffle Beetle**	☐
8. Clam or Mussel	☐	**16. Scud**	☐
9. Cranefly larvae	☐	**17. Snail**	☐
10. Crayfish	☐	**18. Water Penny Beetle**	☐
11. Damselfly nymph	☐	**19. Water Strider**	☐
12. Diving Beetle	☐	**20. Whirligig Beetle**	☐
		Count (# of checks)	

Group 3. Pollution tolerant—can ***live in quite polluted*** **water**

Critter Name	Found	Critter Name	Found
21. Aquatic Worm	☐	**25. Mosquito**	☐
22. Back-swimmer	☐	**26. Sowbug**	☐
23. Giant Water Bug	☐	**27. Water Boatman**	☐
24. Leech	☐	**28. Water Scorpion**	☐
		Count (# of checks)	

In general, what do your bugs tell us about water quality?

- If you found any critters from Group 1, the water quality is very good.
- If you found no critters from Group 1 but you did find critters from Group 2, the water quality is fair to good.
- If you found no critters from Group 1 or Group 2 but did find critters from Group 3, the water quality is poor.
- If you found no critters at all, the water quality is bad!

For a more accurate (and scientific) understanding of what your bugs tell us about water quality, calculate a <u>taxon-averaged water quality index</u>:

Write down the number of taxa found in each group:

N_1 = number of kinds in Group 1
N_2 = number of kinds in Group 2
N_3 = number of kinds in Group 3

(N_1 = _____) + (N_2 = _____) + (N_3 = _____)= N_{total} _____

(1xN_1 = _____) + (3xN_2 = _____) + (5xN_3 = _____) = Q_{taxa} _____

<u>Calculate the Water Quality Index</u>. Q_{taxa} ____ ÷ N_{total} ____ = **Index**_____

This index lies in the range 1 to 5.
The <u>smaller</u> the index you calculate, the <u>higher</u> the water quality is.

<u>Questions:</u>

1. What was the water quality like in your sample, as indicated by the bugs you found?

2. In general, what do benthic macro-invertebrates tell us about water quality over time?

3. What can you do to improve water quality?

KEY: Macro-Invertebrates

In general, what do your bugs tell us about water quality?

- ➔ This question is good enough for very young kids (you can skip the calculations on the second half of the page, unless you have very interested youngsters)
- ➔ Explain to older kids that these are the general assumptions we can make based on the bugs in our sample, but we're scientists so we want to gain a more accurate understanding of water quality from these bugs
- ➔ To do that, we go on to calculate a taxon-averaged water quality index

For a more accurate (and scientific) understanding of what your bugs tell us about water quality, calculate a <u>taxon-averaged water quality index</u>:

- ➔ This is where you want to get older kids
- ➔ The taxon-averaged water quality index takes into account the number of taxa you found in each group, unlike the statements at the top of the page

<u>Questions:</u>

1. What was the water quality like in your sample, as indicated by the bugs you found?

   Answers will vary

2. In general, what do benthic macro-invertebrates tell us about water quality over time?

   The bugs tell us that the water quality in this spot has been consistent enough to support their lives over time (as they live and grow).

   Compare using bugs to monitor water quality to other water sample tests (like conductivity or tests for specific pollutants) that only tell us what the water quality is like that that moment.

3. What can you do to improve this condition (water quality)?

   A. Decrease dirt in water
   B. Decrease salt in water
   C. Stabilize banks
   D. Increase trees and shrubs near banks
   E. Slow flow of storm water to river
   F. Unless the kids say something really outlandish, most of their answers are good answers!

BMI Identification 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. When we know what we have collected, we will be able to tell what kind of water quality has been present here. The BMI's only can live where the conditions are right for them.

1. 1. My name is _____ and I'm a volunteer with the Benthic Macroinvertebrates Identification station. Please tell me your names. (Go around)
2. There are lots of ways to know something about water quality. For example, we can sample the water to test for dissolved oxygen, for chemicals in the water or for the amount of dirt in the water. There are laws that say what chemicals can be in the water, and at what percentage. However, all those tests have one big limitation. Can you think what might be the problem with testing the conditions of the water? (The tests only measure the condition of the water at the moment of testing.)
3. Explain that another type of monitoring is to collect and identify the macroinvertebrates that live in the water. Point out that these critters live here every day and night. They have certain requirements and tolerances. If the conditions are right, they will be here. If things weren't right, they won't be here.
4. Explain that if we know which critters are here, we can know something about the quality of the water over time.

The Activity. 10 – 15 minutes. Explain the activity. Assign the roles. Start sorting and identifying.

5. Show how to use the spoons and forceps to capture the critters from the labeled cups. Show the ice cube trays, and ask them to put similar critters together.
6. Show the posters with the pictures and names of the commonly found BMI's.
7. Students pick through the cups, sorting and identifying.
8. Students use the lab sheet to tally the names of critters they have identified.

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

9. Take a look at the lab sheets to see the names and tallies of the BMI's identified.
10. How many different types of critters did we find? How many sensitive species (EPT) were present?
11. How would you rate the quality of the stream based on our collection?
12. Explain some results of good BMI bio-diversity. (Stronger food web, more sport fish.)
13. What factors in the stream and the surrounding area do you think affect the quality of life in the water positively or negatively?
14. Explain that they will learn more about how to help the creatures in the streams at the other stations.
15. Thanks for visiting with me today. It's time for you to go to your next station _____.