

Multi-plate Sampling

Adapted from: Field Manual for Water Quality Monitoring, Aquatic Entomology, and State of Ohio Environmental Protection Agency: Biological Criteria for the Protection of Aquatic Life

Grade Level: basic-advanced

Duration: Three weeks in water; one or more class periods of retrieval and identification

Setting: Stream-site or classroom

Summary: Students will examine artificial substrate samplers to identify what types of macroinvertebrates live in substrate.

Objectives: Students will gain an understanding of aquatic macroinvertebrate diversity in various aquatic habitats.

Vocabulary: artificial substrate sampler, multi-plate sampler, quantitative study, qualitative study

Related Module Resources:

- Leaf pack bags and activity

Materials (Included in Module):

- Multi-plate samplers
- Rope or Strong Twine
- D-frame nets
- Gallon Sized Ziploc Bags
- White, flat sorting trays
- Sorting equipment: forceps, spoons, eyedroppers, magnifying glasses/boxes, petri dishes
- Magnifying Glasses
- Labeled Identification Bug Cups

Additional Materials (NOT Included in Module):

- Concrete blocks (optional)
- Bricks (optional)
- Flagging Ribbon or Marking Flags (optional)
- Buckets (optional)
- Scissors
- Refrigerator or Ice Cooler (optional)
- Other sorting containers for identification (optional)

ACADEMIC STANDARDS (ENVIRONMENT AND ECOLOGY)

7th Grade

4.1.7.C Explain the effects of water on the life of organisms in a watershed.

- Explain how the physical components of aquatic systems influence the organisms that live there in terms of size, shape, and physical adaptations.

10th Grade

4.1.10.C Describe the physical characteristics of a stream and determine the types of organisms found in aquatic environments.

- Describe the physical factors that effect a stream and organisms living there.
- Identify terrestrial and aquatic organisms that live in a watershed.
- Categorize aquatic organisms found in a watershed continuum from headwater to mouth (e.g. shredder, predator, decomposer).
- Identify the types of organisms that would live in a stream based on the stream's physical characteristics.
- Explain the habitat needs of specific aquatic organisms.

12th Grade

4.1.12.C Analyze the parameters of a watershed.

- Interpret physical, chemical, and biological data as a means of assessing the environmental quality of a watershed.

ACADEMIC STANDARDS (SCIENCE AND TECHNOLOGY)

7th Grade

3.3.7.A. Describe the similarities and differences that characterize diverse living things.

- Explain how to use a dichotomous key to identify plants and animals.

BACKGROUND:

There are many different ways to collect aquatic macroinvertebrates. Kick nets and d-frame nets are the most common collection equipment, but other nets include drift nets and surber samplers. Another way to collect aquatic insects is to use artificial substrate samplers.

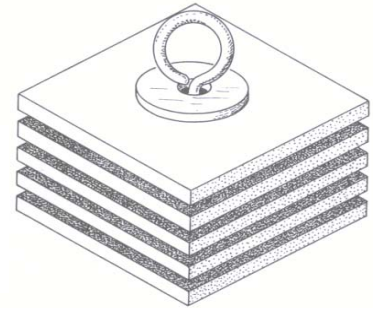
An **artificial substrate sampler** simulates the natural stream bottoms (rocks, clumps of leaves) that can be colonized by macroinvertebrates. Examples include multi-plate samplers, leaf pack bags, wire mesh baskets of rocks or other debris. Researchers place these samplers in the water for a few weeks allowing aquatic insects to move in and then the samplers are removed. The insects can then be identified and counted.

Multi-plate samplers can also be called multi-plate artificial substrate samplers (MPASS) or Hester-Dendy

samplers. Constructed of hardboard plates (either square or circular) stacked on top of each other with spaces in between, the multi-plate sampler is becoming a more popular way of collecting macroinvertebrates from a stream by universities and by government agencies. For instance, the Environmental Protection Agency uses multi-plate samplers to collect macroinvertebrates to help determine stream health.

The basic procedure for use of the multi-plate sampler is to securely attach it to the stream bottom by using the eye bolt that holds it together, leave it in the stream for a few weeks, then collect it and see what macroinvertebrates have moved in to live on it. Only one person is needed for placing and retrieving the multi-plate samplers, however for safety, you should not do creek work alone.

Multi-plate sampler - a quantitative sampling method.



Sampling methods of stream organisms fall into two categories – qualitative sampling and quantitative sampling. A **qualitative** study is less strict, less scientific in the approach, and is more concerned with visual observations and discovering all of the organisms within the stream area, thus providing some overall data. It does not require that measurements and records are made of how many or how much of something is present. The qualitative study simply asks what was observed. And it doesn't really matter how the observations are made; procedures can vary and be less technical because they do not have to be specifically repeated in the future.

A **quantitative** study requires that data are measure, not simply observed. The amount, number, size, shape, and degree of various factors must be measured and recorded. For example, a quantitative stream macroinvertebrate study would require recording the amount and type of aquatic life present. The study could also include measuring other water parameters (temperature, water flow rate, etc.). Quantitative studies are also much more concerned about specific scientific procedures in collecting data, procedures that could possibly be repeated in the future to compare data. This would include having a fixed amount of area being studied, for example 3 square meters. The numerical data of quantitative samples can be compared among different sites and can also provide better results for professional stream evaluations.

The multi-plate sampler is a quantitative method of collecting because there is a set procedure that could be repeatable at a different site or in a different year. The multi-plate sampler also has a set area for insect colonization. The surface area of the plates (area for macroinvertebrates to live) can be determined, and is 145.6 square inches for common square multi-plate samplers.

OVERVIEW: Students will place multi-plate samplers in various aquatic conditions to capture and identify aquatic insects.

PROCEDURE:

Teacher Preparation: (placing the Multi-plate sampler in the stream)

1. The Hester Dendy multi-plate artificial substrate sampler (hereby referred to as multi-plate sampler) should be placed either in riffles (shallower water that is moving, tumbling over rocks) or in runs (deeper stretches that flow, not stagnant), rather than in pools. These locations simulate the natural ecological conditions where macroinvertebrates are most likely to be found and are areas where rocky substrate is exposed.
2. There should be a minimum of three sampling sites scattered along the length of the stream so that changes in water quality and biodiversity can be observed. If possible place extra samplers in the event that one becomes dislodged and is lost downstream.
3. Using rope or strong twine, securely fasten the samplers to the stream bottom by anchoring them with a concrete block or brick, or by fastening them to a large rock, fallen log, or tree roots that are in the stream. When placing the samplers in the stream, please consider the following:
 - The sampler needs to remain in place for a few weeks, withstanding possible higher water, faster water conditions. It also needs to be surely attached because each sampler costs \$18.00 - \$25.00!
 - The sampler needs to be completely submerged in the water or else aquatic macroinvertebrates will not colonize.
 - The sampler should be placed along the bottom of the substrate and NOT be high up in the water column away from the stream bottom. These samplers are to mimic the rocky substrate and will not attract macroinvertebrates that live in the rocks if they are not level with the rest of the substrate. Scientists often attach the multi-plate sampler to a concrete block, dig a hole in the stream bottom, and bury the concrete block with the sampler sticking out on top of the concrete block. This makes it level with the surrounding substrate.
4. Carefully mark the location of all samplers for easy retrieval. You may want to make a map for each location in the stream where the samplers were placed (you can do this on the MULTI-PLATE SAMPLER FIELD DATA SHEET), and/or tie some flagging tape to some vegetation along the stream bank directly across from/beside the sampler location. However, if people visit your stream, these flags may be torn down.
5. Once the samplers have been set into place, fill out the remainder of the MULTI-PLATE SAMPLER FIELD DATA SHEET.
6. It is recommended that the samplers be left undisturbed for about three weeks so that the macroinvertebrates can colonize.

Student Procedure I: (retrieving the Multi-plate samplers from the stream)

1. During retrieval take care to disturb the samplers as little as possible. Approach each sampler from downstream. Before touching the sampler, place a d-frame net, bucket, or gallon-sized Ziploc bag directly downstream and beneath it to catch any organisms you accidentally dislodge from the sampler.
2. Cut the rope or twine, being careful to limit the amount you move the sampler. Once cut, carefully place the sampler in the net, bucket or Ziploc bag.
3. Retrieve any bricks or concrete blocks you placed in the stream for anchoring the sampler.
4. Place the samplers in a bucket of water or in a Ziploc bag filled with some water for transportation back to the classroom. Keep them separated if you want to compare what you found in each.
5. Collect additional stream water in a bucket or other container. This will be used during freshwater macroinvertebrate sorting.
6. If not sorting through the samplers right away, place the buckets or Ziploc bags into a refrigerator or ice-filled cooler. Most aquatic macroinvertebrates can be refrigerated or iced in coolers overnight. Do not leave the macroinvertebrates in the Ziploc bags for more than 24 hours or they will die. If you need to keep them longer before sorting, consider placing each sampler into a separate container of water, which is kept cool and ideally aerated.

Student Procedure II: (collecting macroinvertebrates from the Multi-plate samplers)

1. Make sure you keep your samplers separated and do not combine contents if you are trying to keep their results separated for your experimental design.
2. Fill the white, flat sorting trays enclosed in the module (or some other containers) with the creek water (DO NOT USE TAP WATER BECAUSE IT HAS CHLORINE IN IT). Place the sampler in the trays, and begin to remove the macroinvertebrates living within the sampler. Remove the insects from the tray or sampler with forceps, eyedroppers, or spoons.
3. You can unscrew the bolt holding the sampler plates together, separate the plates, and scrape them clean of anything living. Make sure you check the undersides of all plates and keep your eyes peeled for anything moving. Look closely because the macroinvertebrates may be small and well camouflaged.
4. Place the macroinvertebrates you find in any of the following filled with creek water (You may want to place similar looking creatures together in one container):
 - labeled identification bug cups (included in module)
 - plastic butter containers
 - petri dishes
 - ice cube trays

5. Identify macroinvertebrates using resources such as the laminated identification guides (included in the module). View them closer using magnifying glasses or microscopes.
6. Teachers may want to create a class data sheet to record results or use the enclosed MULTI-PLATE SAMPLER FIELD DATA SHEET.

DISCUSSION:

After listing the kinds and numbers of macroinvertebrates collected using the multi-plate samplers, discuss the results. If multi-plate samplers were placed in more than one stream or sites, where there differences in results between sites? Why might there have been differences?

Did the multi-plate samplers harbor a great diversity of insects?

Where there any particular types of insect that seemed to dominate in the samplers? *Mayflies, stoneflies, net-spinning caddisflies, fishfly larva, small dobsonfly larva, alderfly larva, midge fly larva, and black fly larva are often found.*

Where there any particular types of insects that were not found? Why not? *The multi-plate sampler does not provide the habitat needs for some types of insects. For instance, some insects are climbers (dragonflies, damselflies, scuds) that prefer vegetation and plant stems. Some insects like crane fly larva and some worms and stoneflies, scuds, and aquatic sowbugs prefer to live in soft organic debris like leaves instead of the hard, rock-like plates of the samplers.*

What is the different between qualitative and quantitative sampling methods? Which type is the multi-plate sampler? *See background section.*

What are the benefits of using multi-plate samplers? What are the drawbacks? *Benefits – easy to install, retrieve, quantitative method, easy method to duplicate and repeat, acceptable by many researchers and government agencies. Drawbacks – device may become lost, vandalized, buried, not found; tendency to collect only certain types of insects; takes time for insects to colonize.*

EVALUATION:

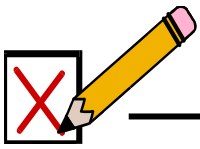
- Discussion questions above.
- Correctly completed Data Sheets.
- Use of proper testing techniques.

EXTENSIONS AND MODIFICATIONS:

- Consider that multi-plate samplers mimic hard substrate like rocks. Install multi-plate samplers in rocky bottom streams/sections and in muddy, sandy bottom streams/sections and compare the results.
- Is there a significant difference between what is found at sites with riffles and sites of slower current or pools? (also possibly a rocky vs. muddy bottom comparison here).
- Install the multi-plate samplers to try to determine if stream health is affected by land use and human impacts on waterways.

NOTES (PLEASE WRITE ANY SUGGESTIONS YOU HAVE FOR TEACHERS USING THIS ACTIVITY IN THE FUTURE)

Activity Version: May 2003



DATA SHEET I : MULTI-PLATE SAMPLING

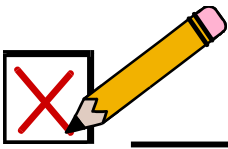
Name _____ Date _____

Stream Name: _____

Approximate location of sampling site (i.e., 60 meters upstream from Rt. 19 bridge):

Stream Observations (flow rate, appearance, size, plant life, animal life):

Description of Substrate (stream bottom) of overall stream (big rocks, gravel, sand, silt, leaf material, submerged vegetation):



DATA SHEET II: MULTI-PLATE SAMPLING

Sketch of Sample Location. Include the location and number of multi-plate samplers you placed in the stream. Note any identifiable natural features in or near the stream (fallen tree, large rock, pine tree, etc.) or unnatural features (pipe, sidewalk, etc). Exact or approximate measurements may be useful. This map may be useful in finding the samplers later, so show details.

A large, empty rectangular box with a black border, intended for the student to draw a sketch of the sample location in the stream.

