

Bring
Stream Life
to You!



How to Build Your Own
Macroinvertebrate
Discovery Tank



Since 1967, Stroud Water Research Center has been leading the effort to produce innovative solutions for preserving and restoring fresh water. The Stroud Center is an independent 501(c)(3) nonprofit organization. Find out more at stroudcenter.org.

Stroud Water Research Center
Avondale, Pennsylvania

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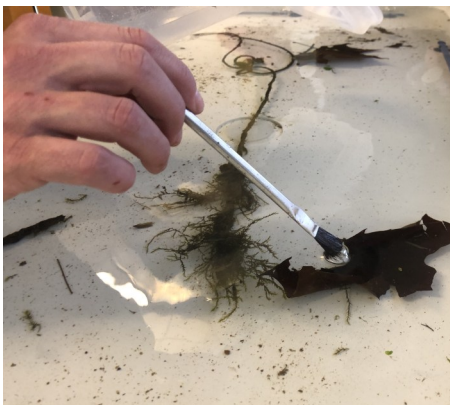
Overview

If you are an educator and wish to introduce aquatic macroinvertebrates to audiences who can't get in or near a stream, this guide is for you.

In this guide, you will learn:

- How to build a macroinvertebrate discovery tank.
- How to use a tank in programs or at events.
- How to collect aquatic macroinvertebrates.
- How to care for macroinvertebrates and return them to the stream.

Be sure to read all instructions before beginning to build your tank.



Before You Begin

Check your local regulations for handling aquatic macroinvertebrates. In Pennsylvania, a fishing permit issued by the Pennsylvania Fish and Boat Commission is required.

The macroinvertebrate discovery tank is not a long-term or permanent way to keep aquatic macroinvertebrates. Macroinvertebrates should be returned to the original stream collection site immediately after program completion.

Participants should not directly handle macroinvertebrates with their hands but instead use tools. For more tips, see "Programming Suggestions" on page 10.

Building the Tank

The macroinvertebrate discovery tank is designed to be simple and inexpensive to build with an emphasis on ensuring the well-being of the aquatic macroinvertebrates and providing a hands-on and interactive experience for participants. See page 11 for a list of parts and where to buy them online. If you have any questions, please contact Stroud Water Research Center's Education Department at educationprograms@stroudcenter.org.



Steps to Build a Macroinvertebrate Discovery Tank

These instructions are for building one tank. Please review the list of supplies on page 11 and purchase the quantity that's right for you.

Step 1

Unfold the legs of the table and stand upright (see image A).

Step 2

Add a white or clear size #10 stopper to the center drain hole. Note: The table comes with a stopper, but it does not function for the needs of the tank and is too loose.

Step 3

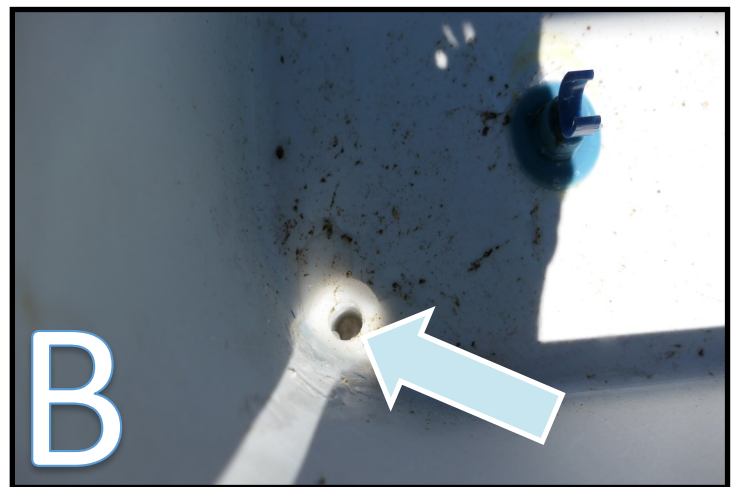
Drill a hole in one of the corners for the size #2 stopper (see image B). The table now has two drains.

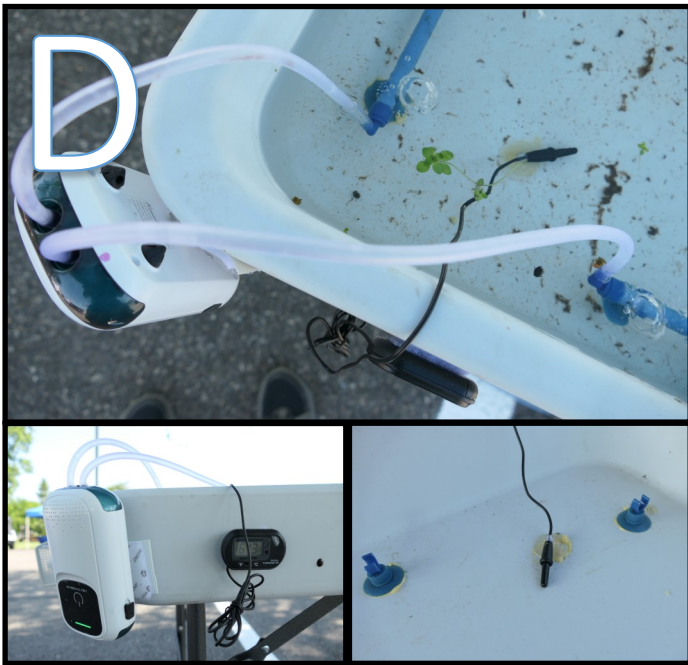
Step 4

Add Velcro strips to opposite corners for hanging each of the bubblers (see image C). Attach the hook (scratchy) side of the Velcro flat to the table. The loop (soft) side of the Velcro can be attached to the hook side, but must be made loose enough to leave space for the bubbler to hang from it. If using the bubblers on the parts list (see p. 11), turn the metal clip so that it hangs with the two tube connectors facing upward.

Step 5

Use glue to attach thermometers near the corners with the bubblers. Run the end of each thermometer over the table's edge and attach the sensor to the corner of the table with a suction cup (see image D on p. 3).





Step 6

Glue the suction cups of the air stones and temperature sensors to the table, placing the air stones on the bottom of the tank about 2 inches from the inside edge so that ice packs can fit between the sides of the tank and the air stones. Ensure that each air stone's air tube connector is facing the bubbler (see image A on p. 2 and image D).

Step 7

Remove the suction cups that are attached to the air stone bars. Glue the suction cups to the table about 2 inches from the inside bottom edge (see image D). Super Glue works well. Place a rock or other weight on top of each suction cup and let sit until the glue dries completely. Check that the suction cups are secure after they have dried. Glue again if necessary. When dry, reattach the air stone bars to the suction cups.

Step 8

Wipe the inside of the tank with a wet cloth to remove any dust, glue, or plastic drilling pieces.

Step 9

Test the tank without adding the macroinvertebrates. Charge the bubblers. Insert all rubber stoppers. Fill two 5-gallon buckets about three-fourths full with water and pour into the tank. Turn on the bubblers. Ensure all parts are working. When finished, remove all air stones, then place one 5-gallon bucket under the #10 center stopper. Remove the stopper and allow the water to drain. Reinsert the stopper when the first bucket is three-fourths full. Then drain the rest of the tank into the second 5-gallon bucket. For any water that remains, drain from the #2 stopper in the corner of the table, tilting the table if needed. A squeegee can be used to push water toward the drainage hole.



The macroinvertebrate discovery tank is a fun and innovative way for both children and adults to discover live macroinvertebrates.

Bringing Live Aquatic Macroinvertebrates Into Programs

Using Macroinvertebrate Discovery Tanks

Collecting Aquatic Macroinvertebrates

What you'll need:

- A safe and legally accessible stream, preferably one that you are familiar with, that has good macroinvertebrate biodiversity.
- A thermometer and a dissolved oxygen test (kit or strip, whichever you prefer) or meter.
- Two 5-gallon buckets with lids.
- A method for collection such as a kick seine net, D-frame net, or pre-placed leaf packs. Alternatively, macroinvertebrates can be collected by hand off of rocks.
- Three flip-top storage boxes, or other plastic bins of your choice.
- Other materials, such as paint brushes, normally used for collecting macroinvertebrates.



Step 1

Record the site location. You will later return here to release the macroinvertebrates back into the stream.

Step 2

Record temperature and dissolved oxygen stream data first. Keep this as a reference point for the tank to stay within range (see “Caring for Macroinvertebrates” for more details).

Step 3

Fill the two 5-gallon buckets with lids about three-fourths full with creek water to use in the tank. Add five fist-sized rocks to the buckets to later be used as macroinvertebrate habitat in the tank.

Reproduce for use

Field Data Sheet/Site Map

SITE INFORMATION	Organization/Group Name: _____ Waterway: _____ Major Watershed: _____ Sub-Watershed: _____ Closest Town/City: _____ Site Code: _____	Investigators: _____ Total Time Spent Monitoring: _____ Number of Participants: _____ <small>HHMM</small> Latitude: _____ Longitude: _____ Site Name: _____
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PACK DATA	<table border="0" style="width: 100%;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Placement Data</th> <th style="text-align: left; border-bottom: 1px solid black;">Retrieval Data</th> </tr> <tr> <td>Date: _____</td> <td>Date: _____</td> </tr> <tr> <td>Number of Packs: _____</td> <td>Number of Packs: _____</td> </tr> <tr> <td>Air Temp (* C): _____</td> <td>Air Temp * C): _____</td> </tr> <tr> <td>Water Temp (* C): _____</td> <td>Water Temp (* C): _____</td> </tr> </table> Leaf pack contents/weight: _____ Habitat type for placement: <input type="checkbox"/> Pool <input type="checkbox"/> Riffle <input type="checkbox"/> Run	Placement Data	Retrieval Data	Date: _____	Date: _____	Number of Packs: _____	Number of Packs: _____	Air Temp (* C): _____	Air Temp * C): _____	Water Temp (* C): _____	Water Temp (* C): _____
Placement Data	Retrieval Data										
Date: _____	Date: _____										
Number of Packs: _____	Number of Packs: _____										
Air Temp (* C): _____	Air Temp * C): _____										
Water Temp (* C): _____	Water Temp (* C): _____										

STORM & NON-STORM EVENTS	A. Did any storm events occur while your leaf packs were in the stream? If YES for A, list the following: <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="font-size: small;">Storm Date</th> <th style="font-size: small;">Precipitation [cm]</th> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr> <td colspan="2" style="text-align: center; font-size: small;">Total Amount [cm]</td> </tr> </table>	Storm Date	Precipitation [cm]							Total Amount [cm]	
Storm Date	Precipitation [cm]											
Total Amount [cm]												
B. Did flooding occur? <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No	C. Was this site experiencing a drought during your monitoring? <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No											

COMMENTS	_____ _____ _____
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Submit data to the online portal at MonitorMyWatershed.org

To record stream site info, use a field data sheet like the one available as a free [download](#) from the Leaf Pack Network, an initiative of Stroud Water Research Center.



Step 4

Add 1 inch of creek water to each of the flip-top storage boxes, as well as a few leaves and plants as habitat.

Step 5

Collect a variety of large and small macroinvertebrates, such as crane flies, dragonflies, crayfish, larger stoneflies, and hellgrammites into each of the three plastic bins. Use a kick seine for riffles, a D-frame net for vegetative edges, and leaf packs, or simply pick macroinvertebrates off of submerged rocks. Transport the plastic bins in a cooler with towels, ice packs, and bubblers (see image E).

Caring for Aquatic Macroinvertebrates



Aquatic macroinvertebrates can become stressed if not properly cared for. Signs of stress include doing push-ups, laying upside down, and death.

To prevent stress:

- Maintain temperature and oxygen (see image F), both during transport and in the tank, at levels close to those recorded at the collection site (± 5.0 °F for temperature and ± 0.5 mg/L for oxygen).
- Do not keep macroinvertebrates longer than needed.
- Always keep macroinvertebrates submerged under water.
- Never keep larger predators (e.g., Megaloptera, Odonata, and some Plecoptera) in a bin or bucket of water with other critters over a long period of time due to the risk of predation.
- Leave a few pieces of leaf in the plastic bins so the macroinvertebrates have a place to hide, rest, and cling. Alternatively, use pieces of screen or mesh in the carriers.
- Separate any macroinvertebrates from the tank that are being overhandled and place them into a plastic bin for observation only (see image G).



Setting Up the Site

(see image H)

What you'll need:

- A cooler filled with extra frozen ice packs.
- Step stools.
- Hanging baskets filled with petri dishes, plastic spoons, and paintbrushes.
- (Optional) A second table with instructional supplies, hand lenses, stereo microscopes, macroinvertebrate keys, and ID cards.
- (Optional) A pop-up tent.



Step 1

For community or other outdoor public programs, find a shaded spot or use a pop-up tent (or two) to keep the tank from getting too hot. If using more than one table for activities, set up the tank table last and no more than 10 to 15 minutes before program start to ensure ice packs and creek water stays cooler longer.



Step 2

Unfold the legs of the table and stand upright. Insert the two stoppers in the tank, and ensure they are secure.

Step 3

Attach the air stone bars, and hang the bubblers with tubes attaching to the air stones.

Step 4

Hang baskets off each short end and fill with petri dishes, plastic spoons, and paint brushes (see image H).



A second table is set up with microscopes, instructional supplies, hand lenses, macroinvertebrate keys, and ID cards.



A pop-up tent provides protection from the elements and helps keep the water in the tank cooler longer.

Step 5

About 10 to 15 minutes before the program begins, add each of the 5-gallon buckets of creek water to the tank. Add rocks, leaves, and/or a few plants as habitat.

Step 6

Turn on the bubblers and ensure they are working.

Step 7

Add one ice pack behind the air stone on each of the shorter sides and two packs on each longer side.

Step 8

Note the temperature on the thermometers and record. Check these every 30 minutes. Replace any melted ice packs with extra frozen ones (about every 1.5 hours, depending on the heat).

Step 9

Gently add the macroinvertebrates from the plastic bins, as well as any leaves and any plants you may have collected. NOTE: Do not add sand or small gravel to the tank because this will make the take-down process long and challenging.

Step 10

Place larger macroinvertebrates into a critter carrier (see parts list on p. 11); add creek water and a small rock. Then place the carrier in the center of the tank for observation only (see image G on p. 5).

Step 11

Add a few step stools around the table for easier viewing.



Along with the macroinvertebrate discovery tank, the Stroud Center uses the biotic index on its Watershed Education Mobile Lab for macroinvertebrate identification at community events. For programming suggestions, see page 10.

Tearing Down

(see images I-L)

Step 1

Gather the 5-gallon buckets and place one under the center rubber stopper (see image I).

Step 2

Collect all the rocks, leaves, and plants and place in buckets.

Step 3

Turn off the bubblers.

Step 4

Remove all the air stones.

Step 5

Remove any large macroinvertebrates and place in a 5-gallon bucket with creek water.

Step 6

Unplug middle stopper and fill bucket three-fourths full. Using a paint brush, gently guide smaller macroinvertebrates through the hole (see image J). Plug the hole. Place the second bucket under the hole, remove the stopper, and allow the tank to drain as much as possible.

Step 7

Use a squeegee (see image K) to push water toward center hole. Move the bucket under the smaller corner stopper, remove the stopper, and tilt the table to capture any remaining water (see image L on p. 9). Squeegee again if needed.





Step 8

Look for any stray macroinvertebrates that cling onto the tank or air stones and place them in 5-gallon buckets. Put lids on the buckets.

Step 9

If traveling far, ensure the 5-gallon buckets containing creek water and macroinvertebrates stay cool and aerated.

Step 10

Return macroinvertebrates, as well as any rocks and leaves collected, to the stream immediately after program completion. Release them upstream of the collection site where flow is slow but not pooling to increase their potential to recolonize. Thank the macroinvertebrates for being ambassadors for streams and rivers!

Aquatic Macroinvertebrate Resources to Support Programming With a Macroinvertebrate Discovery Tank

Macroinvertebrates.org features GigaPan high-resolution 3D images of macroinvertebrates of Eastern North America, a macroinvertebrate-identification learning site with printable [resources](#), life history information, and links to download the free PocketMacros app.

The [Leaf Pack Network](#) features a [resources](#) page with links to macroinvertebrate ID flashcards, dichotomous key, biotic index, hand lenses, methods for monitoring aquatic macroinvertebrates, and a leaf pack simulation.

The [Water Quality App](#) includes data entry, identification, and learning pop-ups about chemical (e.g., dissolved oxygen, *E. coli*, pH, nitrate, and turbidity), physical (e.g., water temperature and turbidity), and biological (e.g., a digital field guide to macroinvertebrates and short videos) water quality parameters.

[Creek Critters](#), a children's book in English and Spanish, and the [Stream Bug Scavenger Hunt Fundana Bandana](#) are widely available from many different vendors.

Stroud Water Research Center's [macroinvertebrate resources](#) page includes all of the above resources, a photo gallery, 3D models to print, and more.



Programming Suggestions

Stroud Water Research Center uses the macroinvertebrate discovery tank for community events, teacher professional development workshops, and some summer camp days when there isn't enough time to visit a stream or when an accessible stream isn't nearby.

Programs usually run 1 to 4 hours and provide an introduction to aquatic macroinvertebrates (e.g., life history, identification, etc.) as indicators of stream health.

The Stroud Center also sets up a separate table that has instructional supplies to take a closer look at the macroinvertebrates and can include hand lenses, stereo microscopes, macroinvertebrate keys, ID cards, and more.

Following are examples of how to engage participants in the experience and discover the world of aquatic macroinvertebrates:

- Invite participants to the tank and ask them to look at the stream critters called aquatic macroinvertebrates. They can either observe them swimming while you mention a few important facts or collect one and take it to another table set up with microscopes and hand lenses to look at it closer and/or learn how to identify it. You explain that stream critters are indicators of water quality and that they all have different sensitivities to pollution. You can also identify a few larger ones for the participants, share fun facts about their life history, and more.
- The Stroud Center typically has at least two educators to lead a program using a macroinvertebrate discovery tank; one at the tank and one at the other table. The educator at the tank not only invites individuals to engage in the tank but also monitors the temperature and ensures the bubblers are running and that everyone is respectful of the macroinvertebrates.
- An extra set of ice packs is often needed. The Stroud Center has had the tanks active at public events lasting up to about 4 hours, and on a day reaching 80 degrees Fahrenheit, the packs needed to be changed once (after 1.5 hours).



- The Stroud Center has a Watershed Education Mobile Lab with a large biotic index on the side and has invited those who identify macroinvertebrates from the tank to add their IDs to the biotic index. Similarly, you could use a white board to tally the different types found. See the Leaf Pack Network [biotic index data sheet](#) for ideas.
- For families with smaller children, encourage parents and chaperones to assist with the macroinvertebrate observation or collection. If you see anyone using paint brushes or spoons to splash water or to poke the macroinvertebrates, redirect them or remove the tools that aren't being used appropriately.

Parts List for One Tank

Macroinvertebrate Collecting Supplies Not Included

To more easily see and care for collected macroinvertebrates, opt for white parts when purchasing.

PART NAME WITH LINK TO PURCHASE	QUANTITY
Folding Ice Cooler Table (24"D x 47.5"W x 32.5"H).	1
White Rubber Stoppers Size #2 (for small drain hole). We buy extra in case one gets lost.	1–2
White Rubber Stoppers Size #10. We buy extra in case one gets lost.	1–2
White Hanging Baskets to hold petri dishes, paint brushes, plastic spoons: these hang perfectly and are metal. They allow for wet items to dry.	2
Air Stone (28").	2 packs
Air Stone (14").	2 packs
Aerators/Bubblers – Rechargeable.	2
Thermometers.	2
Paint Brushes.	at least 15
White Plastic Spoons are available at most grocery stores.	at least 15
Petri Dishes.	20–30
Ice Pack – 1 lb. (Yeti: thin and long).	at least 6 (12 is better)
Ice Pack – Small (Yeti: square).	4–6
Velcro, Heavy Duty.	1 package
Glue: Gorilla Super Glue.	1
White 5-Gallon Bucket With Screw Top Lid (Lowe's or Home Depot).	2
Rubber Window Squeegee.	1
OPTIONAL (but helpful!) SUPPLIES	
Small Clear Plastic Critter Carrier.	1–2
Hand Lenses, Stereo Microscopes, Blue MacroLens.	various
Macroinvertebrate ID Flashcards (and or Life Cycle & Habitat Flashcards).	1–2 sets
Folding Step Stool so everyone can see!	1–4
Pop-Up Tent for shading tank on sunny days.	1
Estimated Total Cost to Create One Table (without optional supplies)	\$450–600