L. Benthic Collection (optional)

Chemical sampling only gives us a snapshot of what is going on in a stream. The benthic macroinvertebrates are the insects and other "creek critter" that have to live in a stream through any particular pollution event. By the number and types of critters found, you can get an idea of the cleanliness of a stream.

Students should sample each habitat, from the most diverse, to the least diverse, in the order below.

After collecting the critters, count and identify them

I. Procedure

1. Riffles Riffles are areas with shallow, rapid flow where the water surface "ripples". Because water is moving rapidly over rocks, these areas tend to have lots of oxygen, and lots of food particles moving by for invertebrates to eat. That is why this is the most diverse habitat.

R.1 Sample both the fastest and slowest moving areas of the riffle. Begin at the downstream end of the reach to be sampled and work upstream. The keeps the working area undisturbed.

R.2 With the net opening facing upstream, place the bottom of the net flush on the stream bottom immediately downstream of the riffle. Do not scoop the substrate with the net! Position the handle perpendicular to the stream flow.

R.3 While one person (the "netter") holds the net, another person (the "collector") picks up large rocks (2 inch or greater diameter) within a 1 foot by 1 foot area directly in front of the net opening and gently rubs them in the net opening to remove any clinging organisms. Be sure to hold the rock under the water in front of the net so that flowing water will carry the materials into the net opening. Place (do not toss) the cleaned rocks outside the sampling area.

R.4 When all the rocks (or as many as possible) are removed from the sample area, the "collector" stands approximately one foot upstream of the net opening and kicks the stream bed vigorously to dislodge any remaining organisms into the net. Kick down approximately two inches into the substrate for one to two minutes while moving toward the net.

2. Leaf Packs Look in the stream for leaves that are about four to six months old. These old leaf packs are dark brown and slightly decomposed. Only a handful of leaves is necessary.

L.1 Begin at the downstream end of the reach to be sampled and work upstream. This keeps the working area undisturbed.

L.2 With the net opening facing downstream, place the bottom of the net flush on the stream bottom immediately downstream from the leaf pack. Position the handle perpendicular to the stream flow.

L.3 Gently shake the leaf pack in the water to release some of the organisms, then quickly scoop up the net, capturing both the organisms and the leaf pack in the net.

Tree Roots, Snag Areas, and Submerged Logs Snags are accumulations of debris caught or "snagged" by logs or boulders lodged in the stream current. Caddisflies, stoneflies, riffle beetles, and midges commonly inhabit these areas.

T.1 Select an area on the tree roots, snap, or submerged logs which is approximately 3 feet by 3 feet in size. Begin at the downstream end of the reach to be sampled and work upstream. This keeps the working area undisturbed.

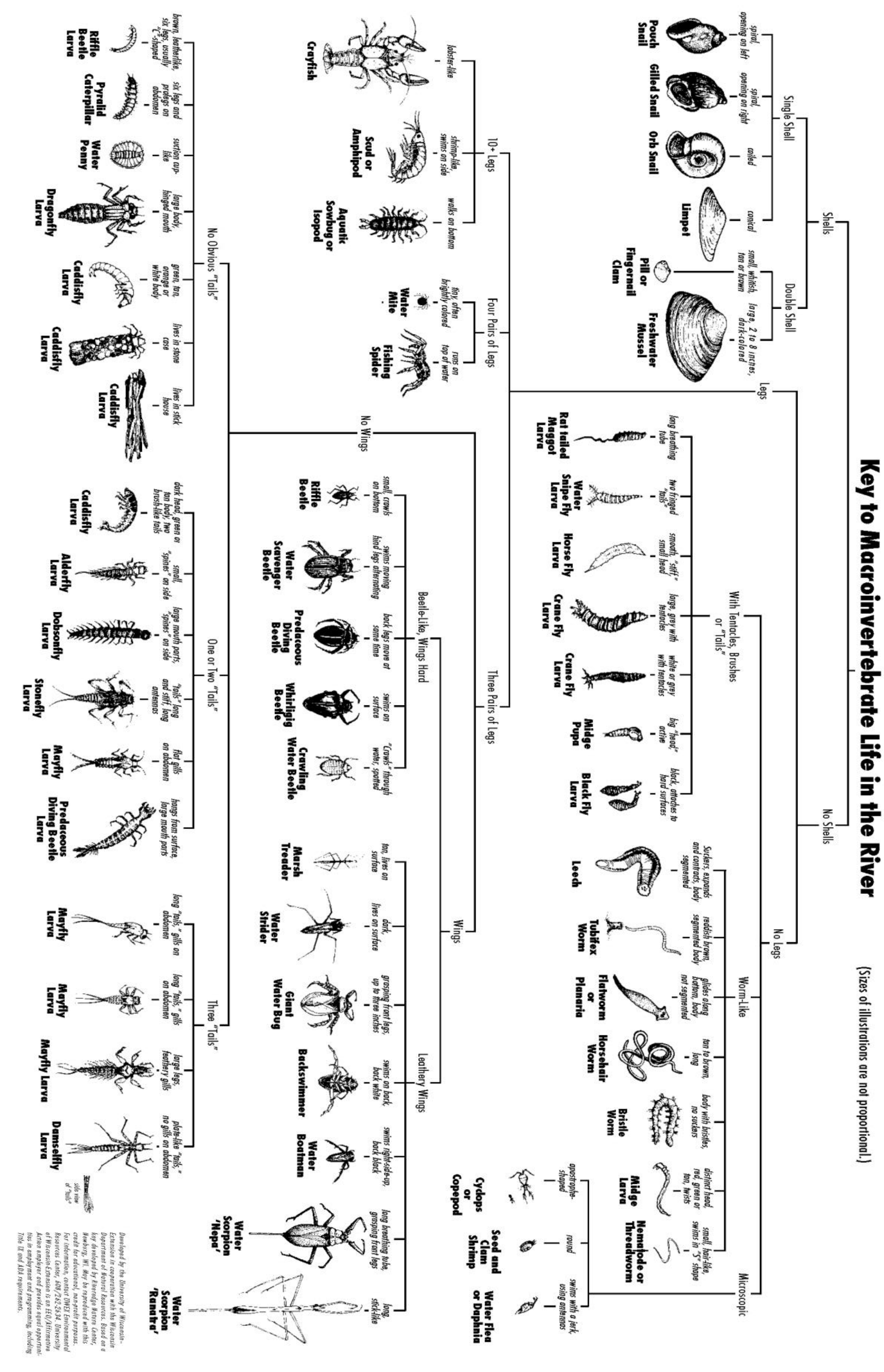
T.2 Scrape the surface of the tree roots, logs, or other debris with the net while on the downstream side of the snag. You can also disturb such surfaces by scraping them with your foot or large stick, or by pulling off some of the bark to get at the organisms hiding underneath. In all cases, be sure the net is positioned downstream from the snag, so that dislodged material floats into the net.

T.3 You may remove a log from the water to better sample from it, but be sure to replace it when you are done.

Undercut Bank Undercut banks are areas where moving water has cut out vertical or nearly vertical banks, just below the surface of the water. In such areas you will find overhanging vegetation and submerged root mats that harbor dragonflies, damselflies, and crayfish.

U.1 Place the net below the surface under the overhanging vegetation.

U.2 Move the net in a bottom – up motion, jabbing at the bank five times in a row to loosen organisms.


Key to Macroinvertebrate Life in the River
(Sizes of illustrations are not proportional.)
Shells
Single Shell
spiral, opening on left
Pouch Snail
spiral, opening on right
Gilled Snail
coiled
Orb Snail
conical
Limpet
Double Shell
small, whitish, tan or brown
Pill or Fingernail Clam
large, 2 to 8 inches, dark-colored
Freshwater Mussel
No Shells
Legs
10+ Legs
lobster-like
Crayfish
shrimp-like, swims on side
Scud or Amphipod
walks on bottom
Aquatic Sowbug or Isopod
Four Pairs of Legs
tiny, often brightly colored
Water Mite
runs on top of water
Fishing Spider
Three Pairs of Legs
No Wings
No Obvious "Tails"
brown, leatherlike, six legs, usually "C"-shaped
Riffle Beetle Larva
six legs and prolegs on abdomen
Pyralid Caterpillar
suction cup-like
Water Penny
large body, hinged mouth
Dragonfly Larva
green, tan, orange or white body
Caddisfly Larva
lives in stone case
Caddisfly Larva
lives in stick house
Caddisfly Larva
One or Two "Tails"
dark head, green or tan body, two brush-like tails
Caddisfly Larva
small, "spines" on side
Alderfly Larva
large mouth parts, "spines" on side
Dobsonfly Larva
"tails" long and stiff, long antennas
Stonefly Larva
flat gills on abdomen
Mayfly Larva
hangs from surface, large mouth parts
Predaceous Diving Beetle Larva
Three "Tails"
long "tails," gills on abdomen
Mayfly Larva
long "tails," gills on abdomen
Mayfly Larva
large legs, feathery gills
Mayfly Larva
plate-like "tails," no gills on abdomen
Damselfly Larva
side view of "tails"
Wings
Beetle-Like, Wings Hard
small, crawls on bottom
Riffle Beetle
swims moving hind legs alternating
Water Scavenger Beetle
back legs move at same time
Predaceous Diving Beetle
swims on surface
Whirligig Beetle
"crawls" through water, spotted
Crawling Water Beetle
Leathery Wings
tan, lives on surface
Marsh Treader
dark, lives on surface
Water Strider
grasping front legs, up to three inches
Giant Water Bug
swims on back, back white
Backswimmer
swims right-side-up, back black
Water Boatman
long breathing tube, grasping front legs
Water Scorpion 'Nepa'
long, stick-like
Water Scorpion 'Ranatra'
No Legs
With Tentacles, Brushes or "Tails"
long breathing tube
Rat tailed Maggot Larva
two fringed "tails"
Water Snipe Fly Larva
smooth, "stiff" small head
Horse Fly Larva
large, grey with tentacles
Crane Fly Larva
white or grey with tentacles
Crane Fly Larva
big "head," active
Midge Pupa
black, attaches to hard surfaces
Black Fly Larva
Worm-Like
Suckers, expands and contracts, body segmented
Leech
reddish brown, segmented body
Tubifex Worm
glides along bottom, body not segmented
Flatworm or Planaria
tan to brown, long
Horsehair Worm
body with bristles, no suckers
Bristle Worm
distinct head, red, green or tan, twists
Midge Larva
small, hair-like, swims in "S" shape
Nematode or Threadworm
Microscopic
apostrophe-shaped
Cyclops or Copepod
round
Seed and Clam Shrimp
swims with a jerk, using antennas
Water Flea or Daphnia
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Identification and Assessment

To record the approximate numbers of live organisms collected in each taxa found in the stream reach, use letter codes: **R** (rare) for 1 to 10; and **C** (common) for 11 or more. **Do NOT count empty shells, pupae, or terrestrial macro invertebrates.

Group 1: Sensitive

_____ Caddisfly Larvae (Trichoptera)
Except Net-spinning caddis (listed in Group 2)
_____ Hellgrammites (Megaloptera)
_____ Mayfly nymphs (Ephemeroptera)
_____ Gilled (right-handed) snails (Gastropoda)
_____ Stonefly nymphs (Plecoptera)
_____ Water Penny (Coleoptera)
_____ Water Snipe fly (Diptera)

Group 2: Somewhat Sensitive

_____ Alderfly larvae (Megaloptera)
_____ Beetle adults (Coleoptera)
_____ Beetle larvae (Coleoptera)
_____ Flack fly larvae (Diptera)
_____ Clams (Pelecypoda)
_____ Crane Fly larvae (Diptera)
_____ Crayfish (from count) (Decapoda)
_____ Damselfly nymphs (Odonata)
_____ Dragonfly nymphs (Odonata)
_____ Net-spinning caddisfly larvae
(Hydropsychidae, and Trichoptera)
_____ Scuds (Amphipoda)
_____ Sowbugs (Isopoda)

Groups 3: Tolerant

_____ Aquatic worms (Oligochaeta)
_____ Leeches (Hirudinea)
_____ Midge Larvae (Diptera)
_____ Pouch snails (Gastropoda)
_____ True bugs (Hemiptera)
_____ Other true flies (Diptera)

STREAM QUALITY SCORE

Group 1:

________ # of R's x 5.0 = __________

________ # of C's x 5.3 = __________

Group 1 Total = ____________

Group 2:

________ # of R's x 3.0 = __________

________ # of C's x 3.2 = __________

Group 2 Total = ____________

Group 3:

________ # of R's x 1.1 = __________

________ # of C's x 1.0 = __________

Group 3 Total = ____________

Total Stream Quality Score = _______

(Sum of totals for groups 1-3; round to nearest whole number)

Check One:

_____ Excellent (> 48) _____ Fair (19 – 33)

_____ Good (34-48) _____ Poor (< 19)

Section Six – After the River/Regrouping

e. Checklist of Remaining "Wrap-Up" Items
f. Reviewing Historical Data/ Data from other sites
g. Why is the Data Important (Student's Actual Data)

a. Next Steps - Leading to Civic Action

a. Checklist of Remaining "Wrap-Up" Items

After you have been out to the river, your work is still not done, several tests need to be finished back in the school building and data needs to be reported. You might want to put a student in a leadership role of making sure all of these things get done.

- ☐ Make sure all lab glassware/plasticware is cleaned
- ☐ Make note of any chemicals that need to be re-ordered
- ☐ Ensure proper disposal of hazardous chemicals (look
- ☐ Arrange to take Total Dissolved Solid Test and Total Phosphate Sample bottles to the GISD (MAKE SURE BOTTLES ARE LABELED with test type (TDS or Phos), school name, teacher, sample date, water body, and sampling location)
- ☐ Conduct BOD test
- ☐ Conduct Fecal Coliform test
- ☐ Fill out data sheet
- ☐ Report data to the Flint River Watershed Coalition
- ☐ Meet with your mentor to discuss your data and look for explanations
- ☐ Prepare for student summit by developing a presentation

b. Compare to Other Sites/Historical Data

It is important to confirm your water monitoring data with others in the community or to test multiple times to assure your results are both accurate and valid. Students can access historic data around the watershed, as well as add their own and do comparative analysis. The various upstream and downstream data over the last 20 years is available, so that students can see if things have improved and worsened over time, and begin to hypothesize about the root causes. Various policies and practices may have influenced these changes, including bans on pollutants, changes in urban and agricultural practices, and new developments in formally undeveloped land. To understand these possible causes better, contact city, county or state officials who affect zoning and land use issues to find out if their policies or practices might have affected your results. You can also contact official and citizens through a public meeting, like a zoning board meeting, where you share your results and make a case for water quality in decisions about land use and funding allocation.

c. Why is the Data Important (Student's Actual Data)

The data collected by the students in GREEN is used by the Genesee County Drain Commissioner's Office, the Flint River Watershed Coalition, and other local decision makers to determine the health of the Flint River and its tributaries. Data collected by the students helps decision makers see trends, trouble spots, and places to focus protection efforts.

d. Next Steps - Leading to Civic Action

Complex environmental problems demand complex solutions, since the physical, chemical and biological systems are interdependent and often have multiple causes. Using the Earth Force Protecting Our Watershed curriculum, however, we can start to isolate one specific root cause which we can affect, whether that is an education campaign about yard fertilizers, advocating for combined sewer overflow updates, or a rain garden and rain barrel campaign. The following is a brief overview of the six step process for taking action on your findings:

1) Conducting a Watershed Inventory
This step calls for water quality monitoring to examine how people use the watershed, and involves the WQI, the PTI and the physical and land use inventory. To supplement these, you can do a photo inventory, a checklist of land use issues you might observe, a community survey of surrounding land owners, and map inventory of issues in space that you observe.
2) Selecting a Watershed Problem
After the river, ask your class - what are the threats that are most pressing or interesting to your group? Through a series of criteria and democratic voting methods, your class then chooses a threat or problem they want to investigate further.
3) Looking at What People Are Doing
This is the research step in which you take another look at the inventory data and start to find out what the root causes are – either policies or practices that affect your issue. You may want to invite an expert panel of community members who deal with this issue, research articles in your local paper, or maybe accessing a database, like a GIS map of land use or the historical WQI data from your local watershed website.
4) Deciding What to Do
After researching the issues, your class should have an idea of potential causes and what's being done about them in your community. In this step you formulate a solution to your problem that your class can directly affect. You have a list of policies and practices that affect your issue, and you'll want to change just one that will have a long-term affect. To give an example, a river clean up would be a service project, but would not solve the long-term practice of littering at a public park. In this case, you might choose to institute a recycling program at a park with public education signage.
5) Taking Civic Action
This step involves the development of a planning strategy to carry out your solution. A detailed plan with delegated tasks around funding, influential players and a timeline are all essential to a successful project. Some projects might need to be carried out over several years (like a recycling project) while others could be achieved by a small group (like an educational pamphlet).
6) Looking Back and Ahead

Reflection and celebration of your hard work are important to understanding your impact and carrying your progress forward after the class has completed its project. You can reflect on how well your project went, what still needs to be done, and what you would do better in the future. Having a summit or class presentation to the public are both ways to share your efforts as well as planning for next steps as you wrap up.