A Stream In A Bucket

An introduction to aquatic macroinvertebrates
and other stream life.

Safety Notes:

Stream water is not sterile. Students should be instructed not to allow any water to enter their mouths. They should wash their hands before leaving the lab.
If this lab is done at a stream, students should be instructed to stay within sight and away from deep water.
Crayfish and Dobson fly larva (hellgrammites) can pinch - be careful!

Introduction:

In this exercise you will examine a collection of aquatic macroinvertebrates that was collected and brought into class or you will make a collection from a stream and then study it. Very few students realize the diversity of life that exists in a good quality stream. This activity will help them to learn the different types of bottom dwelling (benthic) macroinvertebrates. Most are the aquatic stages of insects such as stonefly, mayfly, dragonfly, and damselfly nymphs, or caddisfly, cranefly and midge larvae. Others, such as crayfish, aquatic snails, scuds, and cress bugs live in the water all of their lives.

There is also a strong relationship between the numbers and types of aquatic macroinvertebrates and water quality. Pollution and habitat degradation lowers the diversity and quantity of organisms present. Organisms such as mayflies and stoneflies are very sensitive to pollution, sedimentation, and low dissolved oxygen (DO). In this lab you will learn to use at least one method of determining water quality from studying the diversity of aquatic macroinvertebrates. For more background information benthic macroinvertebrates and how they are used as indicators of water quality consult chapter 6 of the Field Manual for Water Quality Monitoring by M. Mitchell and W. Stapp.

Objectives:

The learner will be able to ...

1. Identify members of at least five major groups of aquatic macroinvertebrates.
2. Use the identified organisms to calculate water quality using the Pollution Tolerance Index.
3. Explain why aquatic macroinvertebrates are often a better way to assess water quality than chemical testing.
4. (OPTIONAL) Collect a sample of aquatic macroinvertebrates by using a kick net or D-frame net.

Materials:

Pre-collected Sample of macroinvertebrates*
8 Field Manuals for Water Quality Monitoring
6-10 white-bottomed containers
6-8 Stereo Scopes or magnifying glasses
Lab write write-up and data sheets

OPTIONAL MATERIALS
Kick net (1-3)
D-frame net (1-3)
Collecting containers (6-10)
boots (hip waders or low boots)

Aquatic Insect Slides
Slide projector

* Macroinvertebrates can be collected and held for 24 hours if they are kept cold.
Use a cooler with some stream water and non-Cl ice or sealed ice pack.
Use a paper cup to scoop out a cup of water and dump it back into the cooler, thus adding DO to the water.
In Pennsylvania, if over age 15, you must have a current fishing license to legally collect macroinvertebrates (considered fish bait).

Procedure:

1. Take notes on slides and/or discussion of the characteristics of the major groups of aquatic macroinvertebrates and how to recognize them.

2. OPTIONAL - Use kick net and/or D-frame net to collect aquatic macroinvertebrates.

3. Move to one of the numbered samples.

4. Use your Field Manual for Water Quality Monitoring (pages 129-133), your notes, and the lab write-up to identify, get an approximate count, and classify according to pollution tolerance the organisms in your sample.

5. Record your results on the **Macroinvertebrate Sample** data sheet.

6. Move to another numbered sample and repeat steps 4 and 5.

7. When instructed, use the information from your data sheet to calculate the Pollution Tolerance Index. Other methods, such as Sequential Comparison Index or the Diversity Index (page 126-133) can also be used to measure water quality.

8. Complete the discussion questions.

Name -_____ Period -____ Date - _____

Discussion Questions

1. What habitat requirements of an organism might make it “pollution-sensitive?”

2. List five organisms that are pollution-sensitive (pollution-intolerant).

   1. _____ 2. _____ 3. _____

   4. _____ 5. _____

3. Why are aquatic macroinvertebrates often better indicators of water quality than chemical testing?

4. Take the following data, collected from Laurel Run on October 4, 1995, and calculate a Pollution Tolerance Index, Cumulative Index Value, and give a Stream Quality Assessment:

5 green caddisflies	1 hellgrammite	2 swimming mayflies
7 crayfish	3 tan midge larva	1 aquatic worm

   Cumulative Index Value = _____ Water Quality Assessment = _____

5. What stream substrate usually has the most diverse macroinvertebrates?

6. Explain how to tell a mayfly nymph from a stonefly nymph.

Teacher Notes for Stream in a Bucket

Begin the lesson by quickly going over each aquatic macroinvertebrate group that your students will need to know. This varies with each stream that is sampled.

Stonefly Nymphs

Tiny to almost 2-inches long, two tails, gills look like a fuzzy mass where each leg joins the thorax. Plant eaters. Prefer streams with a rubble (assorted-sized stones) bottom in clean high DO (dissolved oxygen) water. Over 90 species in PA, but only several are common in our part of the state. [2 of the most common are in the slides]
Some species live in the nymph form for more than one year.

Mayfly Nymphs

Most species less than 1-inch long, most have 3 tails and rows of gills along the abdomen. Herbivoresfeed on algae or by shredding dead leaves. Most prefer swiftly flowing stream with clean, high DO water. Most species emerge (change from nymph to adult) during the same week each year. This is species and stream specific. Over 700 species occur in North America. There are three basic body types:

SWIMMING - streamlined bodies with 6 small legs. They swim by quickly arching and straightening their bodies.

CLINGING - flattened bodies with 6 strong muscular legs. Arms are used to cling to rocks in swift current. Flattened bodies allow the water to flow over them.

BURROWING - stocky bodies with small legs. Large gills are used to filter oxygen from lower DO water. Live in burrows that they dig in the sediment. Prefer slower velocity water.

Caddisfly Larva

An aquatic larva with 6 small legs all located near the head. Up to 1-inch long. Some caddis larva are free-living, some build webs in the current which they use to filter algae from the water, others build cases by gluing tiny sticks or stones together. [Thus the common names “stick worm” or “stone caddis.”] Stick builders tend to live in slower water, while the stone caddis use their “house” as ballast in swifter current.

Water Penny

Looks like a tiny suction cup or a miniature trilobite, up to 1/2-inch long. Eat algae from the surfaces of rocks. Needs high DO water.

Cress Bugs and Scuds

These tiny crustaceans spend all of their lives in the water. They are most common in limestone water. Cress bugs (aquatic sow bugs) can live with some organic pollution.

Cranefly Larva

These large semi-clear jelly-like “worms” are actually the aquatic larva of the cranefly, (which looks like a giant mosquito). Order: *Diptera,* Family: *Tipulidae* They usually live in areas of lower velocity. Some grow to over 2 inches long (10 - 25 mm). They do not need high DO.

Dragonfly and Damselfly Nymphs

Relatively large aquatic nymphs that live in the water for one to four years. Order: *Odonata.* They have large heads with big eyes. Dragonfly nymphs are predators - a favorite food is mosquito larva. They have stocky bodies which are sometimes covered with algae and look "fuzzy." They have no tails. They can "jet" through the water by expelling water from their rectal chamber. Damselfly nymphs are more slender and the have 3 flattened "tails" (caudal lamella) at the end of their abdomen.

Macroinvertebrate Sample Data Sheet

See pages 130-133 in the Field Manual for Water Quality Monitoring.

Stream Sampled - _____ Date- _____

Location - _____ Substrate - _____

Organisms from Group 1

_____

_____

_____

_____

Organisms from Group 2

_____

_____

_____

_____

Organisms from Group 3

_____

_____

_____

_____

Misc. Vertebrates

_____

_____

Calculate Pollution Tolerance Index

 # Group 1 ____ X 3 = _____

 # Group 2 ____ X 2 = _____

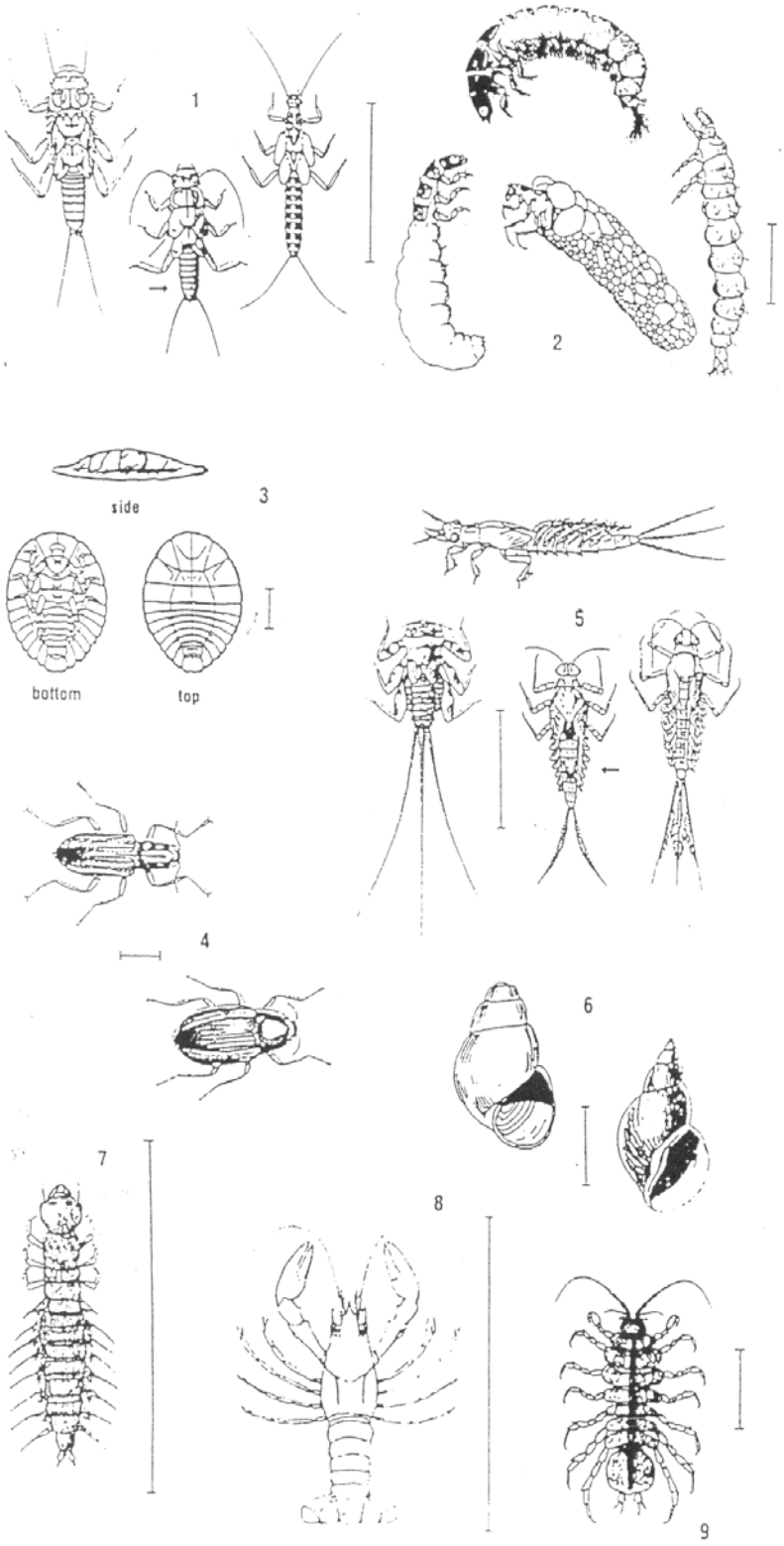
 # Group 3 ____ X 1 = _____

_____

Cum. Index Value = _____

Cumulative Index Value		**Stream Quality Assessment**
23 and above	**=**	**Excellent**
17 - 22	**=**	**Good**
11 - 16	**=**	**Fair**
10 or less		**Poor**

Stream Quality Assessment _____



Bar lines indicate relative size

Stream Insects & Crustaceans

GROUP ONE TAXA

Pollution sensitive organisms found in good quality water.

1 *Stonefly: Order Plecoptera.* 1/2" - 1 1/2", 6 legs with hooked tips, antennae, 2 hair-like tails. Smooth (no gills) on lower half of body. (See arrow.)

2 *Caddisfly: Order Trichoptera.* Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock or leaf case with its head sticking out. May have fluffy gill tufts on lower half.

3 *Water Penny: Order Coleoptera.* 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs on the other side. Immature beetle.

4 *Riffle Beetle: Order Coleoptera.* 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 *Mayfly: Order Ephemeroptera.* 1/4" - 1", brown, moving, plate-like or feathery gills on sides of lower body (see arrow). 6 large hooked legs, antennae, 2 or 3 long, hair-like tails. Tails may be webbed together.

6 *Gilled Snail: Class Gastropoda.* Shell opening covered by thin plate called operculum. Shell usually opens on right.

7 *Dobsonfly (Hellgrammite): Family Corydalidae.* 3/4" - 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

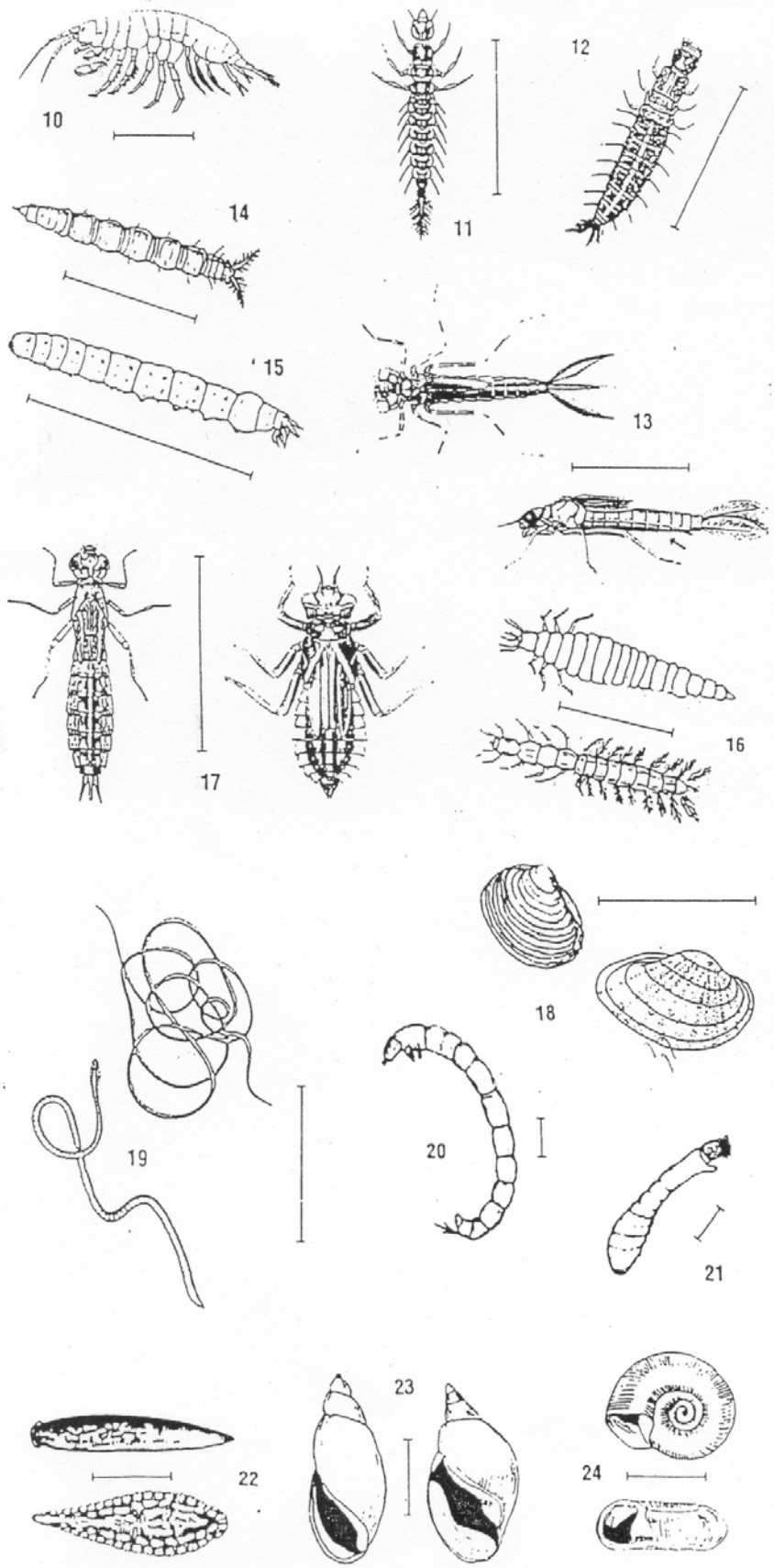
Somewhat pollution tolerant organisms can be in good or fair quality water.

8 *Crayfish: Order Decapoda.* Up to 6", 2 large claws, 8 legs, resembles small lobster.

9 *Sowbug: Order Isopoda.* 1/4" - 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.

Save Our Streams

Izaak Walton League of America
1401 Wilson Blvd. Level B
Arlington, VA 22209



Bar lines indicate relative size

GROUP TWO TAXA continued

10 *Scud: Order Amphipoda.* 1/4", white to grey, body higher than it is wide, swims sideways, more than legs, resembles small shrimp.

11 *Alderfly larva: Family Sialidae.* 1" long. Looks like small hellgrammite but has 1 long, thin, branched tail at back end (no hooks). No gill tufts underneat

12 *Fishfly larva: Family Corydalidae.* Up to 1 1/2" long. Looks like small hellgrammite but often a lighter reddish-tan color, or with yellowish streaks No gill tufts underneath.

13 *Damselfly: Suborder Zygoptera.* 1/2" - 1", large eyes, 6 thin hooked legs, 3 broad oar-shaped tails positioned like a tripod. Smooth (no gills) on side of lower half of body. (See arrow.)

14 *Watersnipe Fly Larva: Family Athericidae (Atherix* 1/4" - 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns at back end.

15 *Crane Fly: Suborder Nematocera.* 1/3" -2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 *Beetle Larva: Order Coleoptera.* 1/4" 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 *Dragon Fly: Suborder Anisoptera.* 1/2" - 2", large eyes, 6 hooked legs. Wide oval to round abdomer

18 *Clam: Class Bivalvia.*

GROUP THREE TAXA

Pollution tolerant organisms can be in any quality of water.

19 *Aquatic Worm: Class Oligochaeta.* 1/4" - 2", can very tiny; thin worm- like body.

20 *Midge Fly Larva: Suborder Nematocera.* Up to 1/- dark head, worm-like segmented body, 2 tiny leg on each side.

21 *Blackfly Larva: Family Simulidae.* Up to 1/4", one end of body wider. Black head, suction pad on en

22 *Leech: Order Hirudinea.* 1/4" - 2", brown, slimy body, ends with suction pads.

23 *Pouch Snail and Pond Snails: Class Gastropoda.* No operculum. Breathe air. Shell usually opens o left.

24 *Other snails: Class Gastropoda.* No operculum. Breathe air. Snail shell coils in one plane.