Backyard STEM

Creek Critters: Ecological Detectives

An Introduction to Biological Stream Monitoring

Project Area: Environmental Science

Skill Level: Intermediate—Advanced

Learner Outcomes:

⇒ Be able to explain how to collect a samle of benthic macroinvertebrates from a stream.

⇒ Be able to use an identification guide to identify common benthic macroinvertebrates.

⇒ Be able to describe the difference between pollutant tolerant and sensitive species and use a water quality index.

Tennessee Science Curriculum Standards:

CLE3295.4.3

CLE3255.1.1

CLE3204.Inq.4

Success Indicator:

Students can explain the use of indicator species to evaluate water quality of a stream.

Science Skills: Evaluate, observe

Life Skills: Observing, Reasoning

Tags: benthic macroinvertebrates, monitoring

Materials:

Sample sheets

Identification Key

Calculator

Optional: flashcards, kick net, gloves and wading boots, tweezers, magnifying class, bucket, jars, isopropyl alcohol, squirt bottle, ice cube trays, plastic droppers, white shallow trays, water aerator

The types of life in a stream tells us about the water quality of the stream. Just like any home, the cleaner the better for most!

Ask your students:

⇒ Where do you think insects like dragonflies, butterflies, and beetles begin their life? Where do they call home for their formative stages? Discuss how small creeks and wetlands are the nursery for insects before they can fly.

Vocabulary Word	Definition
Benthic Macroin-vertebrate	Organisms that do not have a backbone and are visible to the naked eye and live in the benthos environment; benthos is the bottom of a stream channel. [abbreviated BMI]
Tolerant	Species that can thrive under the stresses of pollution.
Sensitive	Species that cannot thrive under the stresses of pollution and therefore are not found in polluted habitats.
Sediment	Eroded soil that is a pollutant in large quantities.
Biological Stream	A protocol for monitoring of aquatic species to estimate the condition of
Watershed	The land area that drains to a common point.

⇒ Where you would rather live? [show two pictures, one of a pristine forest stream, the other of an urban stream with litter] Discuss why.

Introduce Key Concepts:

GO OUTSIDE!

Take the students on a schoolyard tour of small streams, creeks, or wetlands. Scout for places to collect BMI samples!

Sometimes it's easy to tell if a stream is polluted or impacted by landuse change in the watershed (refer back to photos of pristine stream and urban /agricultural stream). But sometimes it's not as clear. That's when biological stream monitoring can give us a clearer picture. We can tell a lot about a river by looking at what types of organisms live in it. *Macroinvertebrates* are organisms that do not have a backbone and are visible to the naked eye. A variety of these organisms live in the bottom of streams, which is also called the *benthos*. *Benthic macroinvertebrates* (or BMIs) are a group of organisms comprised of larval and nymph stages of insects, snails, worms, and other small crustaceans. Because BMIs are confined to there stream bottom habitat, they are particularly susceptible to water pollution as well as limited to food sources that are carried by the river from upstream. Because of this, we can look at the BMI community of a creek to tell us what kind of food-gathering adaptations are being used and the level of water quality in the creek.

Credits: Andrea Ludwig and Jennifer DeBruyn

Creek Critters

Project Area:
Environmental Science

Skill Level: Intermediate—Advanced

Helpful links:

Tennessee Department of Environment and Conservation Watersheds Program: http://www.tennessee.gov/environment/water/watersheds/index.shtml

West Virginia Department of Environmental Protection BMI Resources: http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/Macros.aspx

US Environmental Protection Agency Surf Your Watershed: http://cfpub.epa.gov/surf/state.cfm?statepostal=TN

Photos of a "pristine" stream (good water quality and habitat) and an impacted urban stream (poor water quality and habitat). Try to find local examples when possible.

ACTIVITY: Ecological Detectives!

There are indoor activities and outdoor activity options depending on your particular situation and time constraints. You may choose to 1) use the BMI sample sheets for indoors only, 2) collect a sample from a stream with the collection kit before your session and bring into the classroom, or 3) take the students out to a nearby flowing creek and allow them to collect their own sample (highly recommended if possible!!).

Explore the options for BMI identification guides and flashcards. A highly recommended source is "A Guide to Common Freshwater Invertebrates of North America." http://www.mwpubco.com/conservation.htm

Option 1 – Indoors only

Materials:

BMI Sample Sheets, calculator, BMI Field Key and/or ID flash cards

Procedure:

- Divide students into pairs or small groups and pass out one BMI sample sheet and ID key to each group.
- Ask the students to identify the BMIs in their sample using the ID key and flashcards.
- Ask the students to calculate their Water Quality Index score using the ID key.
- Compare the results of the BMI sample scores and ask the students to rank the BMI samples in quality from highest to lowest.

Option 2 – Bring sample in from field

Materials:

Kick net, tweezers, dropper, bucket, large white trays (9"x12"x4"), ice cube trays, kick net, gloves and wading boots (optional), isopropyl alcohol (50-70%), glass containers (small mason jars), BMI Sample Sheets and field key

Procedure:

- Identify a wadeable stream near the location of your class.
- Find an easily accessible riffle (fast moving shallow water).
- Place the kick net perpendicular to flow and downstream of your targeted sampling area.
- While holding onto the kick net for balance, kick up the streambed in front of the kick net. Try to disturb about a 3'x3' area several inches deep. If necessary, pick up large rocks and rub rocks to dislodge attached insects.
- Dump out net and spray with water bottle to empty onto white tray.
- Repeat process if necessary.
- Go to the creek bank. Run kick net under vegetation to collect leaf packs and organic material.
- Empty into white tray. Keep the bank and stream bed samples separate to show potential differences in habitat.
- Use tweezers to pick out BMIs and place in isopropyl alcohol. Try to obtain as many BMIs as possible.
- Take BMI sample to class and allow students to pick through the sample.

Option 3 – Outdoor classroom

Materials:

Kick net, tweezers, dropper, bucket, large white trays (9"x12"x4"), ice cube trays, kick net, gloves and wading boots (optional), isopropyl alcohol (50-70%), glass containers, BMI Sample Sheets and field key

Procedure: See above procedure for collecting sample. Ask students to take turns with the kick net and have teams with tweezers pick through leaf packs and net samples. Use the ID key and Water quality index to assess water quality in the creek with the sample collected.

Divide students into small groups (3-5). Give each group a "sample" and an identification guide/flashcards.

Indoor option with paper "sample":

Ask the students to identify the BMIs on their sample sheet. Then use the water quality index score card to assess the scores of the samples and compare between groups. Ask your students to hypothesize what kind of creek the samples came from using describing words like "natural," "pristine," or "impacted" or "impaired."

Indoor option with real sample:

Divide the sampled BMIs into subsamples for each group. Allow the students to pick through the sample if it is a live sample. Use the water quality index score card to assess the score the of the stream. Explain that the real BMIs will look different than the simplified drawings on the field key, but point out that they are looking for basic body structures and general shapes. Compare between groups to see if they all got relatively the same score. If not, why not? Explain that splitting the sample caused the discrepancy.

Outdoor option:

If appropriate, ask for volunteers to help collect the sample with a kick net. Have the rest of the group be the streambank team, dividing samples and picking out BMIs with tweezers and placing into ice cube trays. Use the water quality index score card to assess the score the of the stream. Explain that the real BMIs will look different than the simplified drawings on the field key, but point out that they are looking for basic body structures and general shapes. Assign a score to your schoolyard creek.

Creek Critter Index

Name of your Creek:

_____

What is the water quality in the creek as indicated by your total index score?

_____

What characteristics of your creek do you think influence water quality?

References:

The key used in this activity: http://www.mostreamteam.org/Documents/VWQM/BugCard1.10.pdf

Activity adapted from: http://www.rivanna-stormwater.org/aquatic.pdf

Be sure to note that the score is based on total types! If a BMI is duplicated, only count it once!!

Water Quality Index

Score Card

Group 1 Taxa – Sensitive Species

Examples: Mayfly Stonefly

Caddisfly Right-Handed Snail

Total Types ___ x 3 = _____

Group 2 Taxa – Moderate Species

Examples:

Crayfish Dragonfly

Scud Damselfly

Riffle Beetle Sowbug

Total Types ___ x 2 = _____

Group 3 Taxa – Tolerant Species

Examples: Blackfly Cranefly

Worms Midge

Leech Left-Handed Snail

Total Types ___ x 1 = _____

Total: _____

Water Quality Classification:

Excellent = 23 and higher

Good = 17 – 22

Fair = 11-16

Poor = 10 or lower

Water Quality Index Scores of Samples Provided:

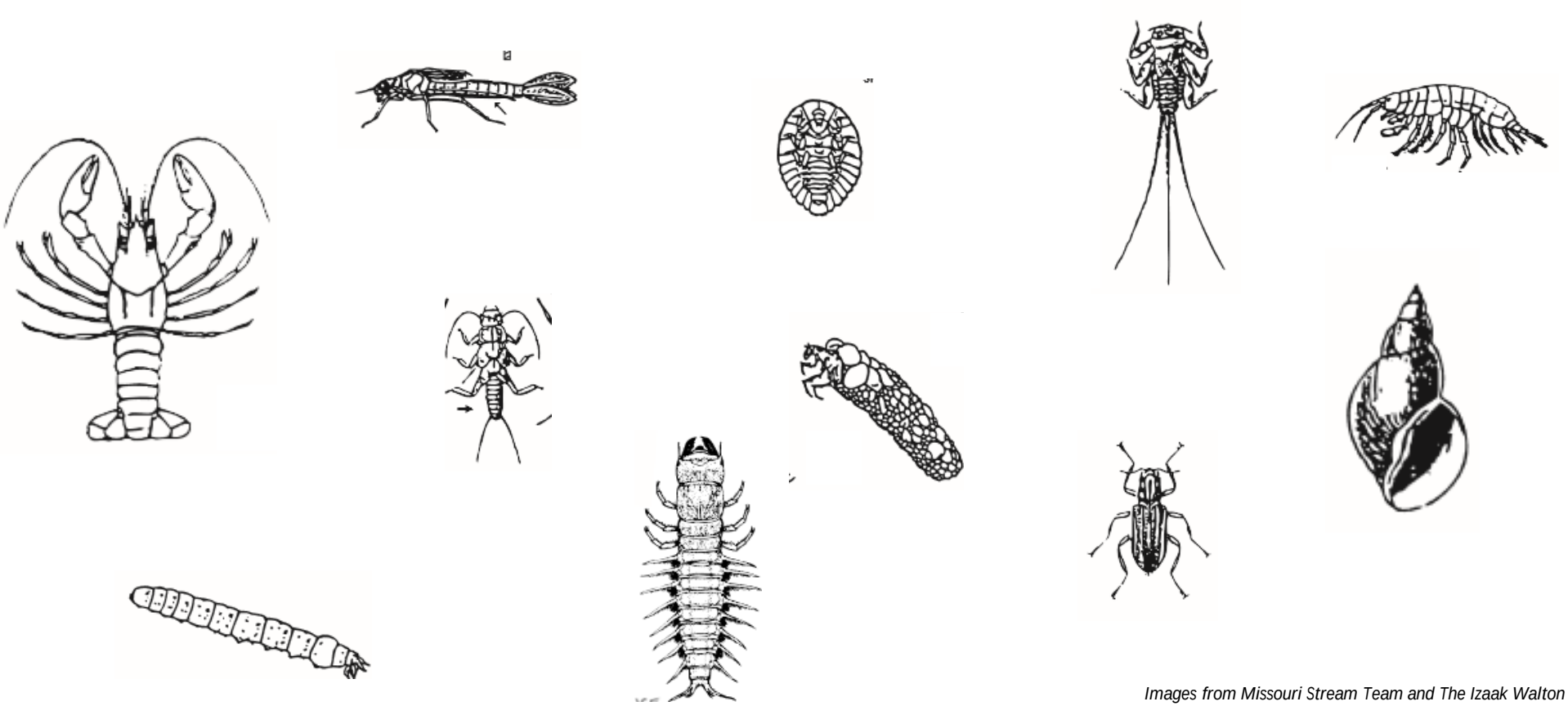
Sample 1—Slick Rock Creek—29 [Excellent]

Sample 2—Fines Creek— 9 [Poor]

Sample 3—Town Branch— 14 [Fair]

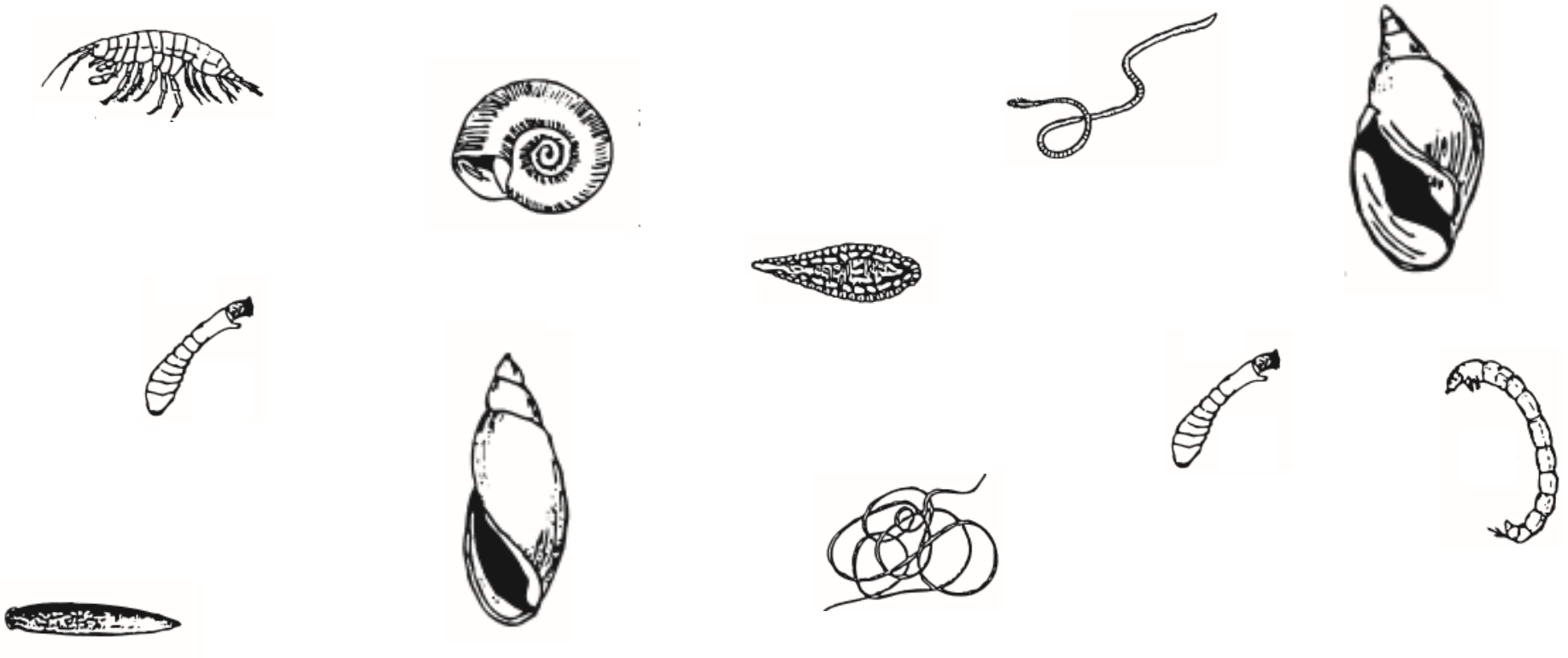
Sample 4—Grassy Fork— 20 [Good]

BMI Sample 1 – Slick Rock Creek



Images from Missouri Stream Team and The Izaak Walton League

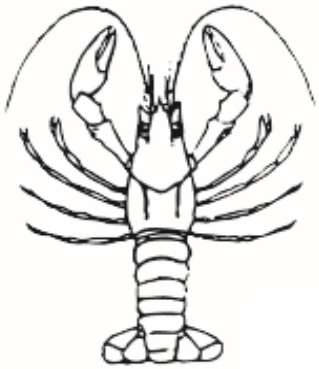
BMI Sample 2 – Fines Creek



Images from Missouri Stream Team and The Izaak Walton League

BMI Sample 3 – Town Branch



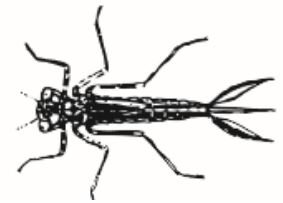


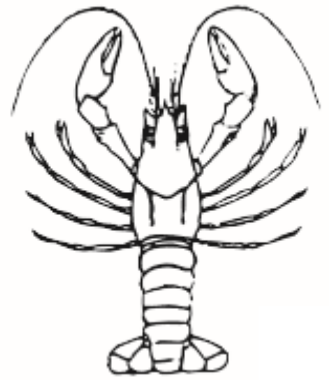


Images from Missouri Stream Team and The Izaak Walton League

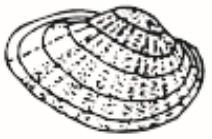
BMI Sample 4 – Grassy Fork





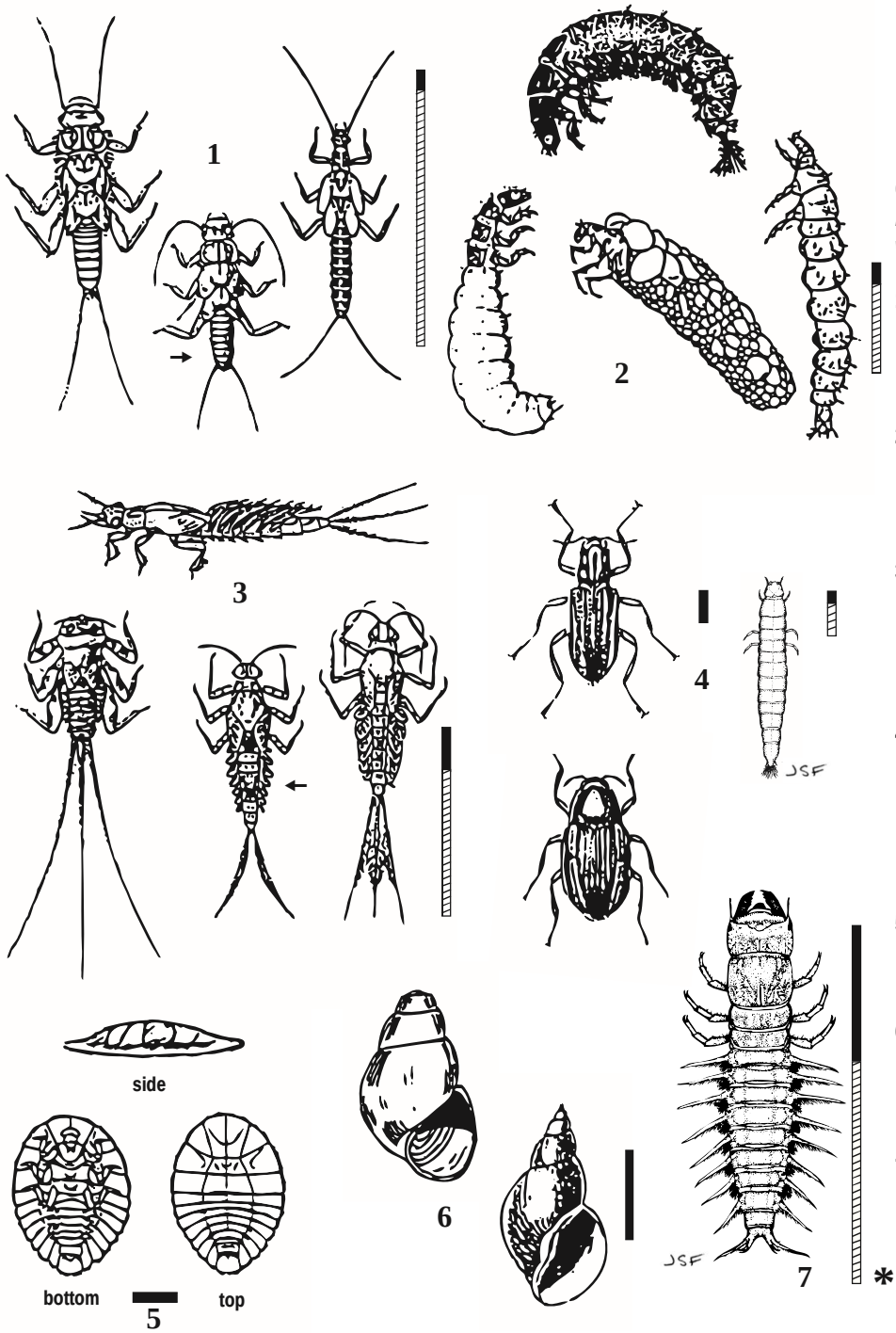







Images from Missouri Stream Team and The Izaak Walton League

Stream Insects & Crustaceans



GROUP ONE TAXA

Pollution sensitive organisms found in good quality water.

1 Stonefly nymph: *Order Plecoptera.* 1/8" - 1 1/2"; 6 legs with hooked tips; 2 hairlike tails. Smooth (no gills) on abdomen (see arrow). May have gills on thorax under the legs.

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

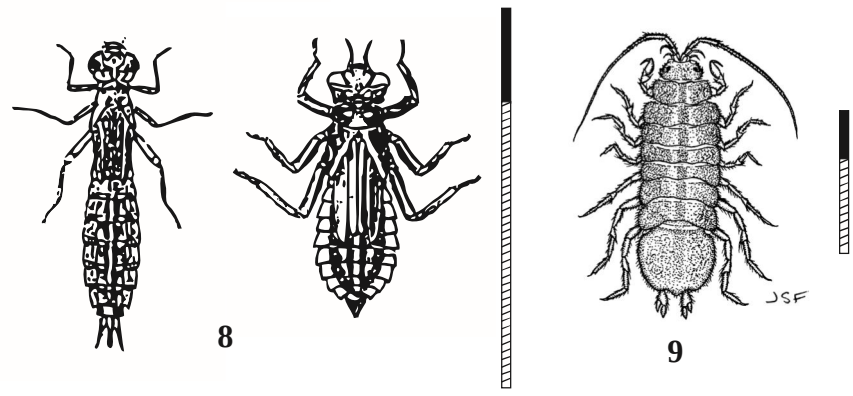
3 Mayfly nymph: *Order Ephemeroptera.* 1/4" - 1"; moving, platelike, or feathery gills on abdomen (see arrow); 6 large hooked legs; antennae; 2 or 3 long, hairlike tails. Tails may be webbed together.

4 Riffle Beetle*: Order Coleoptera.* Adult: Tiny, 6-legged beetle; crawls slowly on the bottom. Larva: Entire length of body covered with hard plates; 6 legs on thorax; uniform brown or black color. Combine number of adults & larvae when reporting total counts.

5 Water Penny larva*: Order Coleoptera.* 1/4"; flat saucer-shaped body, like a penny; segmented with 6 tiny legs underneath. Immature beetle.

6 Gilled Snail: *Class Gastropoda.* Shell opening covered by thin plate called operculum. When pointed up and opening facing you, the shell opens to right. Do not count empty shells.

7 Dobsonfly larva (hellgrammite): *Family Corydalidae*. 3/4" - 4"; dark-colored; 6 legs, large pinching jaws; eight pairs lateral filaments on lower half of body with paired cottonlike gill tufts along underside of lateral filaments; short antennae; 2 pairs of hooks at back end.



GROUP TWO TAXA

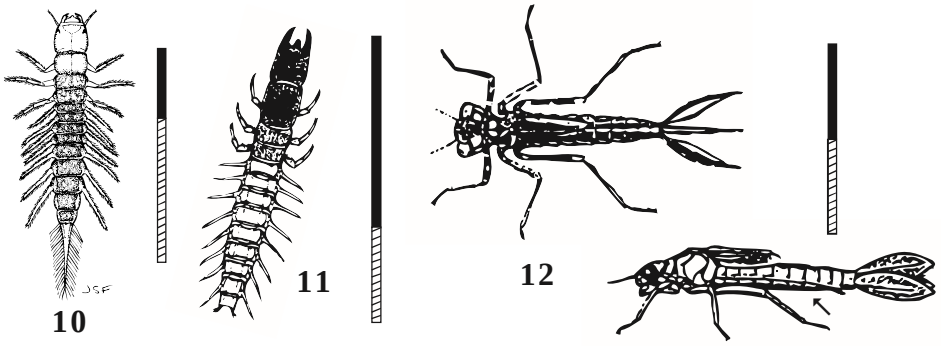
Somewhat pollution tolerant organisms can be in good or fair quality water.

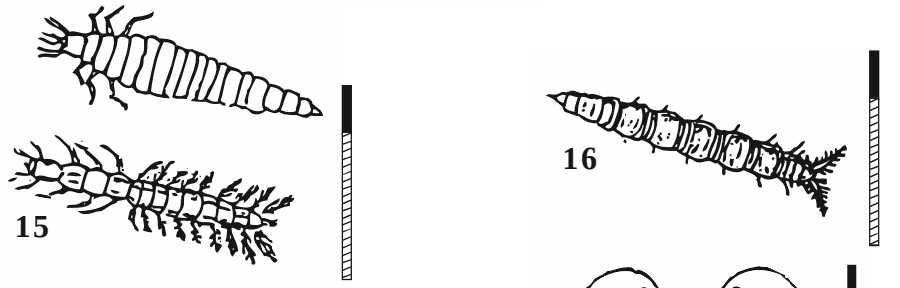
8 Dragonfly nymph: *Suborder Anisoptera.* 1/2" - 2"; large eyes, 6 hooked legs. Wide oval to round abdomen, masklike lower lip.

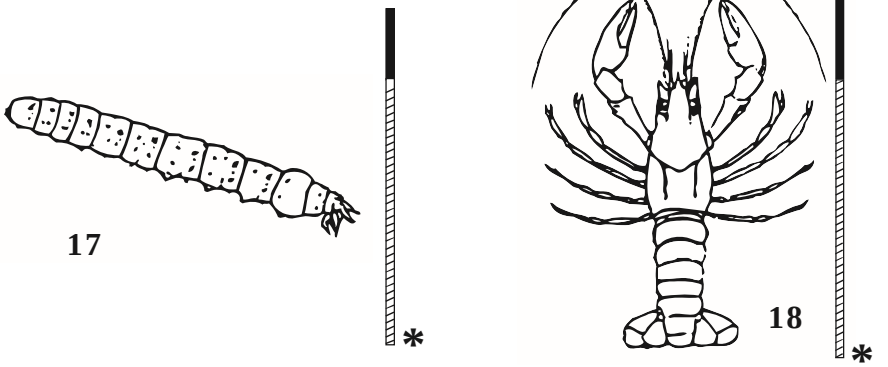
9 Sowbug: *Order Isopoda.* 1/4" - 3/4"; gray oblong body wider than it is high, more than 6 legs, long antennae, looks like a 'roly poly.'

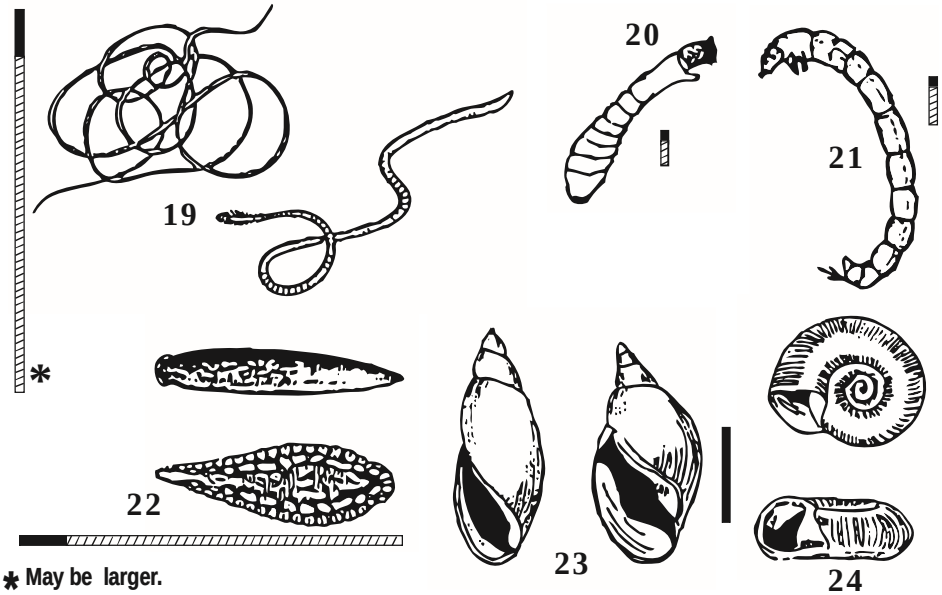
*** May be larger.**
~Solid bar indicates approx. minimum size. Combined solid and striped bar is approx. maximum size.~

Save Our Streams









GROUP TWO TAXA continued

10 Alderfly larva: *Family Sialidae.* 3/8"- 1"; looks like small hellgrammite but has 1 long, thin, branched tail at end of abdomen (no hooks). No gill tuft underneath the lateral filaments on abdomen.

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

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

13 Clam/Mussel: *Class Bivalvia.* Do not count empty shells.

14 Scud: *Order Amphipoda.* 1/4"- 3/4"; white to gray, body higher than it is wide; swims sideways; more than 6 legs; resembles small shrimp.

15 Other Beetle larva: *Order Coleoptera.* 1/4" - 1"; light-colored; 6 legs on upper half of body; feelers; antennae; obvious mouthparts. Diverse group.

16 Watersnipe Fly larva: *Family Athericidae (Atherix).* 1/4" - 1"; pale to green; tapered body; many caterpillar-like legs; conical head; two feathery 'horns' at back end.

17 Crane Fly larva: *Suborder Nematocera.* 1/3" - 4"; milky, green, or light brown; plump caterpillar-like segmented body. May have enlarged lobe or fleshy fingerlike extensions at the end of the abdomen.

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

GROUP THREE TAXA

Pollution tolerant organisms can be in any quality of water.

19 Aquatic Worm/Horsehair Worm: *Class Oligochaeta/ Phylum Nematomorpha.* Aquatic worm: 1/4"- 2"; can be very tiny, thin wormlike body. Horsehair Worm: 4"-27"; slender, can be tangled.

20 Black Fly larva: *Family Simulidae.* 1/8"- 3/8"; one end of body wider. Black head, suction pad on end.

21 Midge Fly larva: *Suborder Nematocera.* Less than 1/4"; distinct head; wormlike segmented body; pair of tiny prolegs under head and tip of abdomen.

22 Leech: *Order Hirudinea.* 1/4" - 6"; flattened muscular body, ends with suction pads.

23 Pouch Snail and Pond Snails: *Class Gastropoda.* No operculum. Breathe air. Shell usually opens on left. Do not count empty shells.

24 Other snails: *Class Gastropoda.* No operculum. Breathe air. Snail shell coils in one plane. Do not count empty shells.

*** May be larger.**

~Solid bar indicates approx. minimum size. Combined solid and striped bar is approx. maximum size.~

01/10
STR 250