

Student Handout



**Environmental Science** 

Skill Level: Intermediate— Advanced

#### Learner Outcomes:

- $\Rightarrow$  Be able to explain how to collect a samle of benthic macroinvertebrates from a stream.
- $\Rightarrow$  Be able to use an identification guide to identify common benthic macroinvertebrates.
- $\Rightarrow$  Be able to describe the difference between pollutant tolerant and sensitive species and use a water quality index.

Tennessee Science **Curriculum Standards:** 

Did you know that there

streams and rivers in

of habitat for benthic

macroinvertebrates!

Science Skills: Evaluate, observe

### Life Skills: Observing, Reasoning



# **Creek Critters: Ecological Detectives**

An Introduction to Biological Stream Monitoring

The types of life in a stream tells us about the water quality of the stream. Some organisms can't tolerate a messy house (aka pollution!), while others do just fine.



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 Monitoring	A protocol for monitoring of aquatic species to estimate the condition of streams.
Watershed	The land area that drains to a common point.



Imagine you are a dragonfly just starting out in life. You are a benthic macroinvertebrate, so you begin your life in a stream bed like the ones in the photographs.

Which stream would you prefer to begin your life?

are over 60,000 miles of Why? What are the qualities that make the stream an inviting Tennessee? That's a lot place? What gualities make the alternative not inviting?



**Project Area:** Environmental Science

Skill Level: Intermediate— Advanced

# <u>Helpful links:</u>

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

# **Creek Critters**

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.

A variety of environmental stressors can impact BMI communities. Many of these stressors may come from nonpoint source pollution, which is carried to streams by runoff. Some common pollutants that impact BMI communities include sediment (or eroded soil), fertilizers, pesticides, heavy metals, oils, sewage, and gasoline products. There are three general categories that BMIs fall into regarding tolerance of these stressors and pollutants in their habitat: *sensitive, moderately tolerant*, and *tolerant*. **Sensitive** BMIs cannot thrive in creeks where these stressors are present. **Moderately tolerant** BMIs can thrive under some stressor influence, while **tolerant** BMIs will thrive in polluted creeks.

# GO OUTSIDE!

Look to see if there is a stream at your school or near your home. Pick up a rock or leaf pack and see if anything moves. If so, it's probably a benthic macroinvertebrate!

# **REFLECT: What makes healthy habitats?**

In the space below, describe the qualities of a healthy habitat. What are some characteristics of that habitat that make it an attractive place to live for living organisms?

# **ACTIVITY: Ecological Detectives!**

Use the following worksheet and field identification key to perform biological stream monitoring to determine the water quality index score for the stream.



Water Quality Index		
Score Card		
<u>Group 1 Taxa – Sensitive Species</u>		
Examples: Mayfly Stonefly	Conclusion Statement:	
Caddisfly Right-Handed Snail		
Total Types x 3 =	Biological stream monitoring was performed on	
<u>Group 2 Taxa – Moderate Species</u>		
Examples:	[insert stream name]	
Crayfish Dragonfly	and the data showed the stream to	
Scud Damselfly	be in	
Riffle Beetle Sowbug	[insert quality] condition.	
Total Types x 2 =		
<u>Group 3 Taxa – Tolerant Species</u>		
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		

# **Go Further!**

Go to the following website to investigate the water quality around you: http:// watersgeo.epa.gov/mywaterway/ What did you find out about the streams around you?



Stream Insects & Crustaceans

### **GROUP ONE TAXA**

Pollution sensitive organisms found in good quality water.

- 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.
  - 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.

8



# **GROUP TWO TAXA**

7

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.'

# Save Our Streams

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



#### \* May be larger.

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

### **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.
- Fishfly larva: Family Corydalidae. Up to 1 1/2"; 11 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.
- Scud: Order Amphipoda. 1/4"- 3/4"; white to gray, 14 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.

