Creating a Water Quality Report Card for your favorite stream

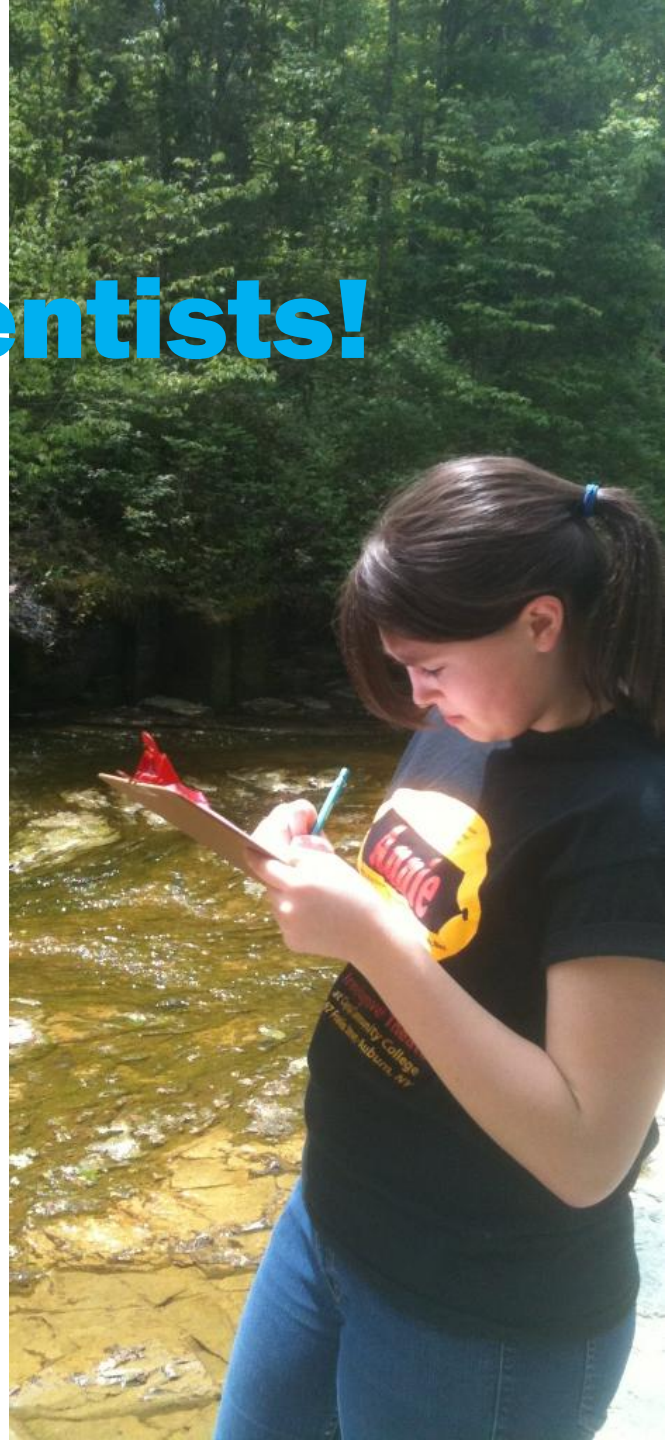
Prepared by Adrianna Hirtler, biomonitoring coordinator
adriannalouise@gmail.com

Greetings, Young Scientists!

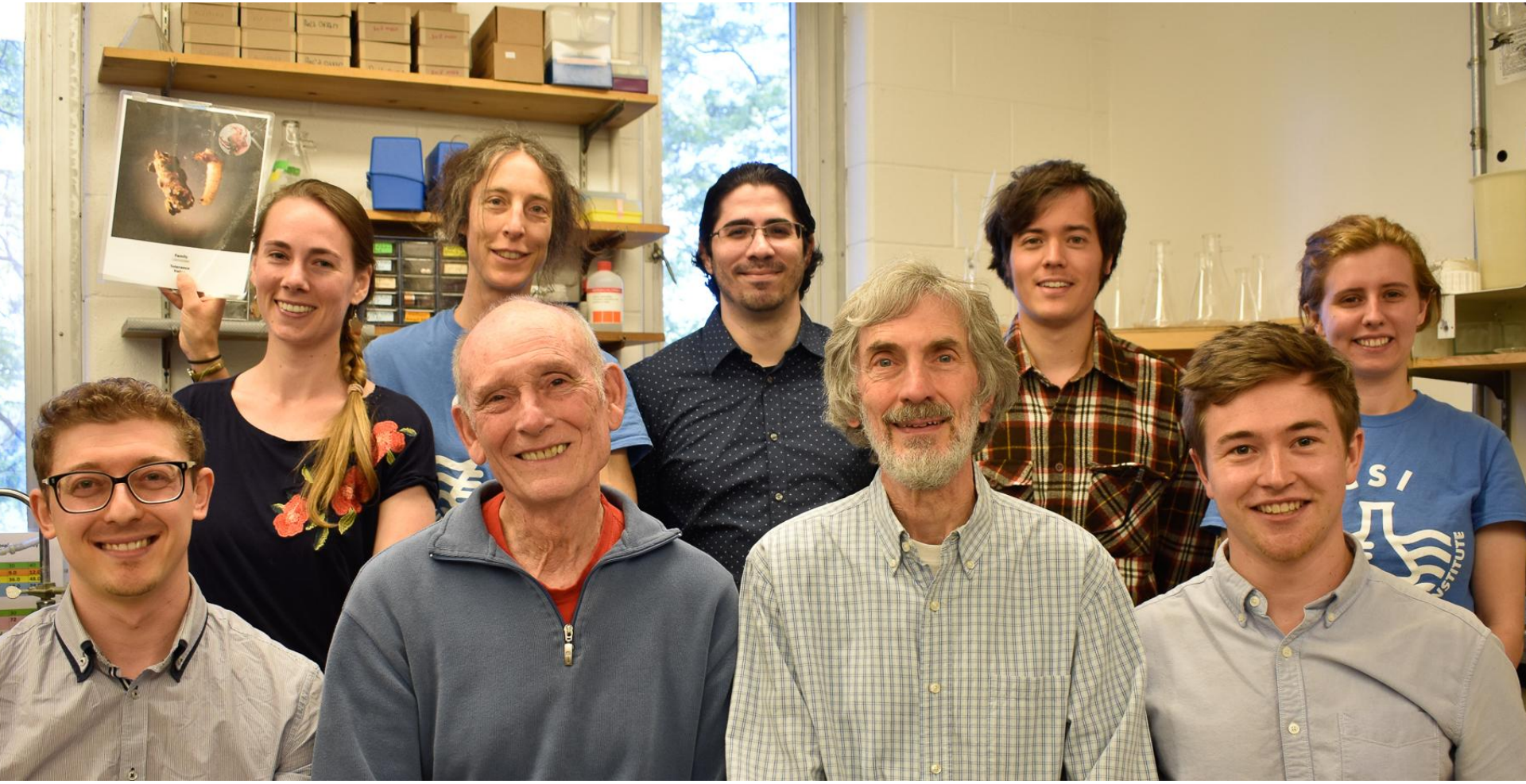
THE COMMUNITY SCIENCE INSTITUTE

CSi

Partnering with communities to protect water



The Community Science Institute (CSI) is a not-for-profit, state-certified water testing lab based in Ithaca, NY.



We're excited that you're going to be working with us to monitor water quality!


CSI partners with hundreds of community volunteers to monitor water quality in local streams and lakes.

Thanks for caring about local streams

And for helping learn more about how healthy they are!


We often talk about stream “health”
in terms of
WATER QUALITY

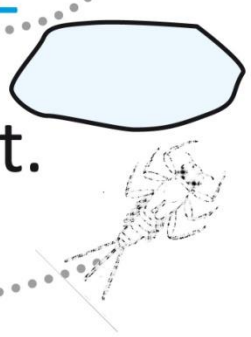
Did you know that you can learn a lot about water quality in a stream by observing what lives in it?

Photo from Wendi Hartup blog, peanc.org

Anything that you see moving around underwater amidst the rocks in a creek (that isn't a fish or a salamander) is probably a

BENTHIC MACROINVERTEBRATE

We call them BMI for short.



Benthic = Bottom-dwelling

Macro = Big enough to be seen without a microscope

Invertebrate = Animal without a backbone

Some examples of some local BMI!

Some examples of some local BMI!


Water Penny Beetle Larvae


Common Stonefly Nymphs


Cranefly Larvae


Flatheaded Mayfly Nymphs


Uenoid Caddisfly Larva

Try turning over some rocks in your favorite stream to find some BMI for yourself.

Most BMI are the larval forms of insects…

Mayfly nymph

Stonefly nymph

Caddisfly larva

Cranefly larva

riffle beetle larva

Insects typically start their lives as wingless larvae…

…that turn into flying adults

Mayfly adult

Stonefly adult

Caddisfly adult

cranefly adult

riffle beetle adult

through the process of metamorphosis.

(*Caterpillars are the larval form of butterflies just as worm-like mayfly nymphs in the creek become flying adult mayflies*)

Insect Characteristics (as adults):

- Hard Exoskeltons
- 3-segmented bodies (head/thorax/abdomen)
- 6 legs
- 2 or 4 wings
- MOST undergo metamorphosis

Mayfly adult

Stonefly adult

Caddisfly adult

cranefly adult

riffle beetle adult


16
2
1
1
1
13
Most of the BMI shown here from a sample from a healthy creek in May are insect larvae…
18
2
3
1
206
10
1
1
9
3
1
5
10
2
7
1
1
Tug Hollow Creek 5/1/14


Most of the BMI shown here from a sample from a healthy creek in May are insect larvae.
EXCEPT…..
Adult riffle beetle
These ARE insects, but they are no longer in their larval form (look to its left to see what a riffle beetle larva looks like).
Aquatic Earthworm
These are NOT insects.
Tug Hollow Creek 5/1/14

Some BMI are NOT insects.

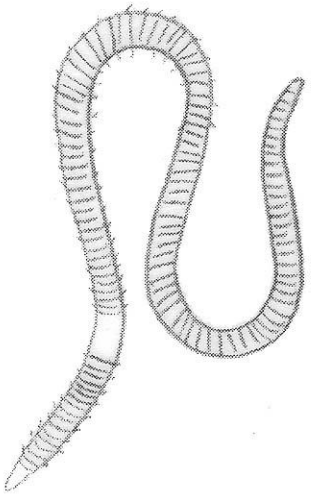
Photos by National Park Service
From www.nps.gov/vafo

Crayfish are NOT insects.

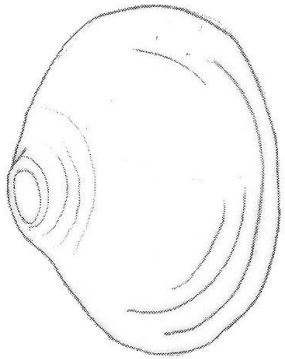
Photos by National Park Service
From www.nps.gov/vafo

Rusty Crayfish
(an invasive species)

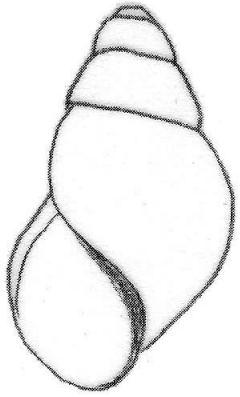
Some other BMI that are NOT insects:



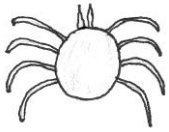
Aquatic Earthworm



Aquatic Clam

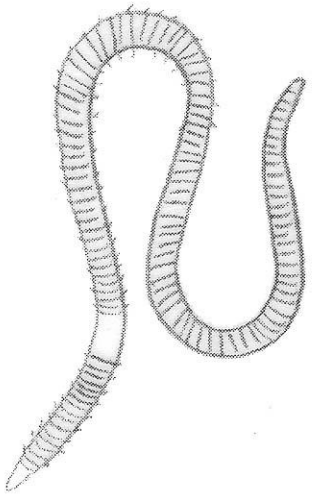


Aquatic Snail

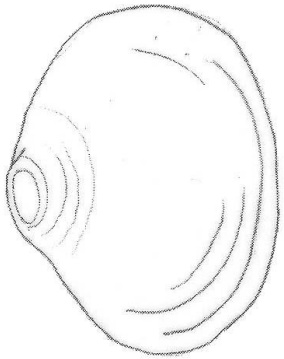


Aquatic Mite

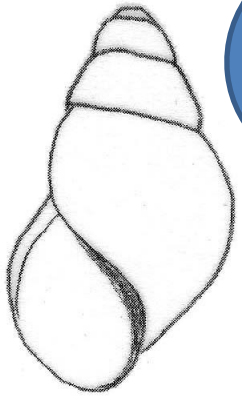
Some other BMI that are NOT insects:



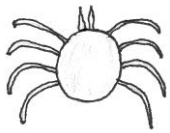
Aquatic Earthworm



Aquatic Clam



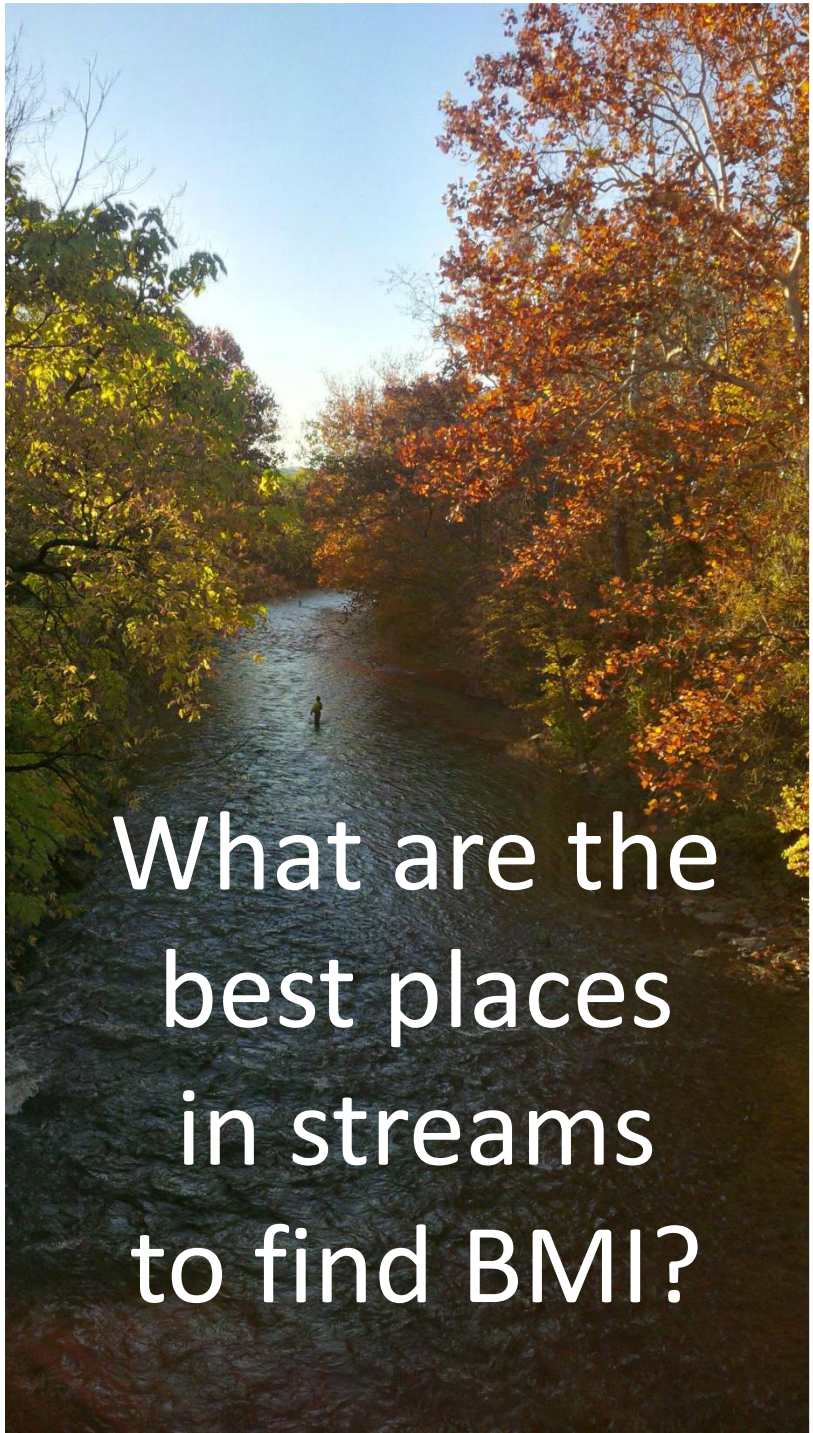
Aquatic Snail



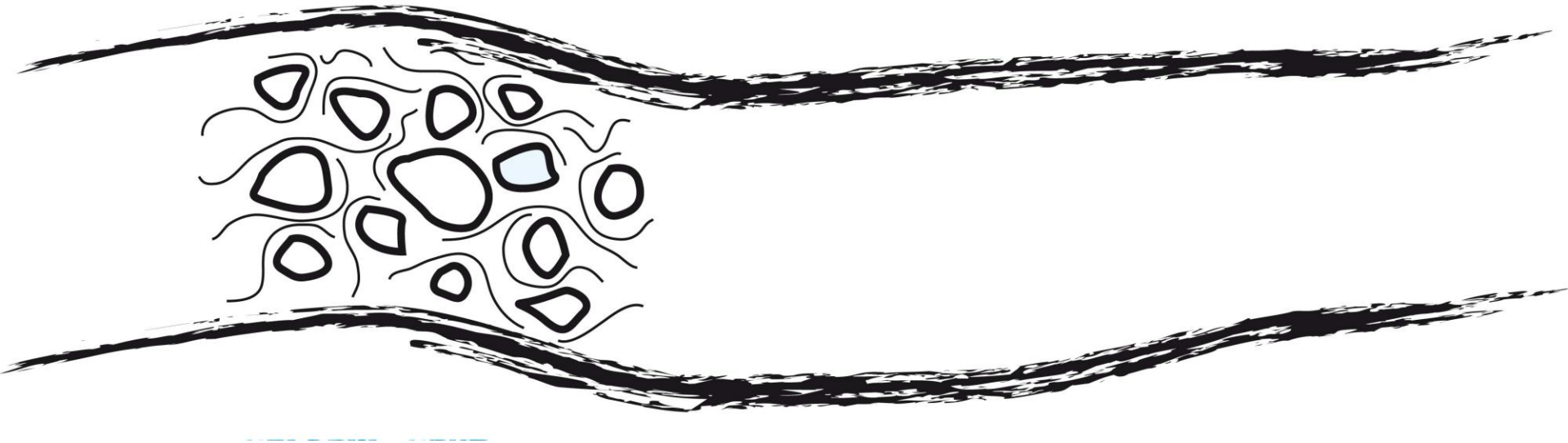
Aquatic Mite

Compare with Adult Insect characteristics:

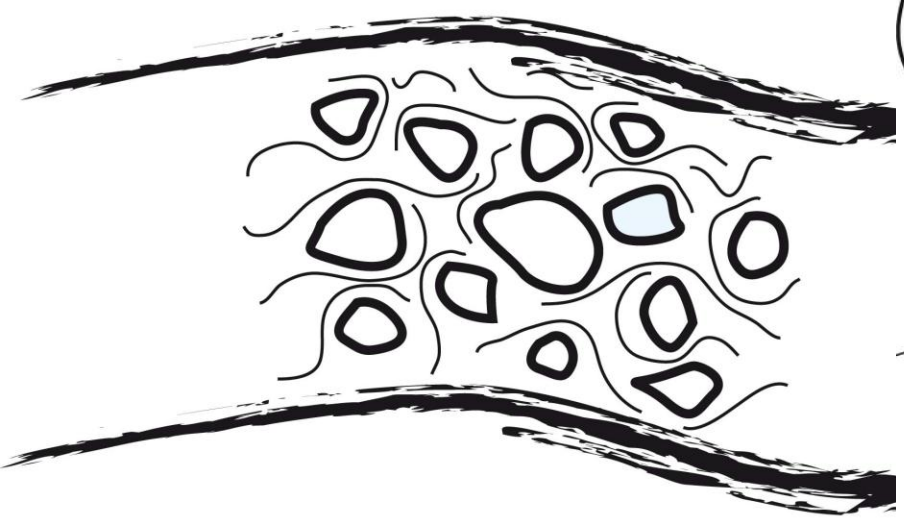
- Hard Exoskeltons?
- 3-segmented bodies? (head/thorax/abdomen)
- 6 legs?
- 2 or 4 wings?
- Undergoes metamorphosis?


What are the
best places
in streams
to find BMI?

Riffles!



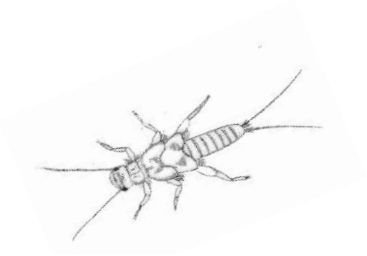
Riffles!



Listen

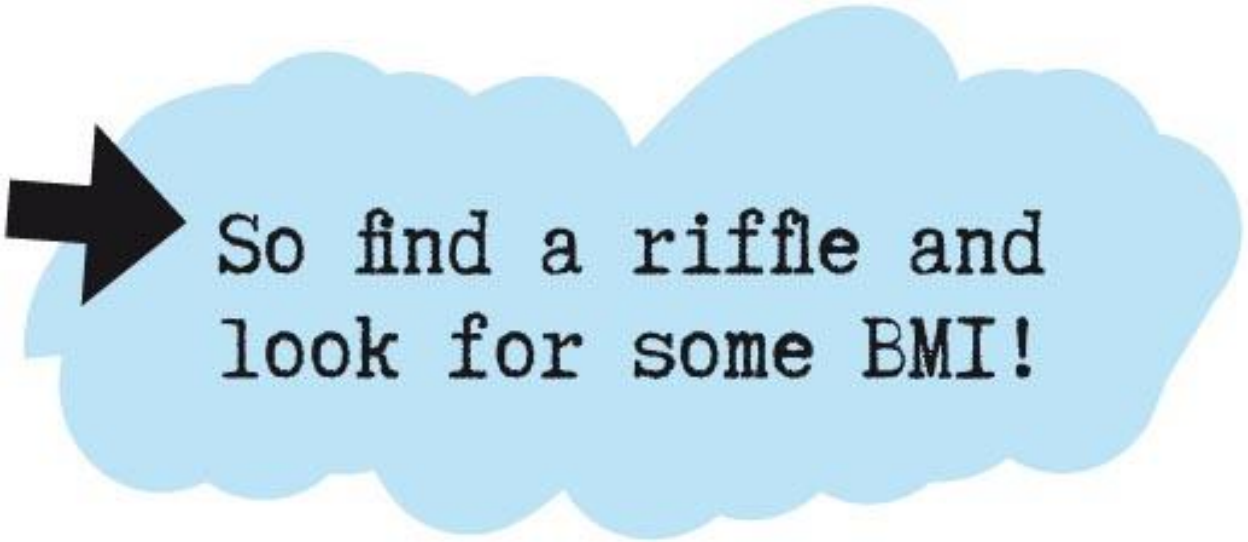
You can often hear them!

Riffles are places in a stream where you can see (and hear) water flowing and burbling over rocks.

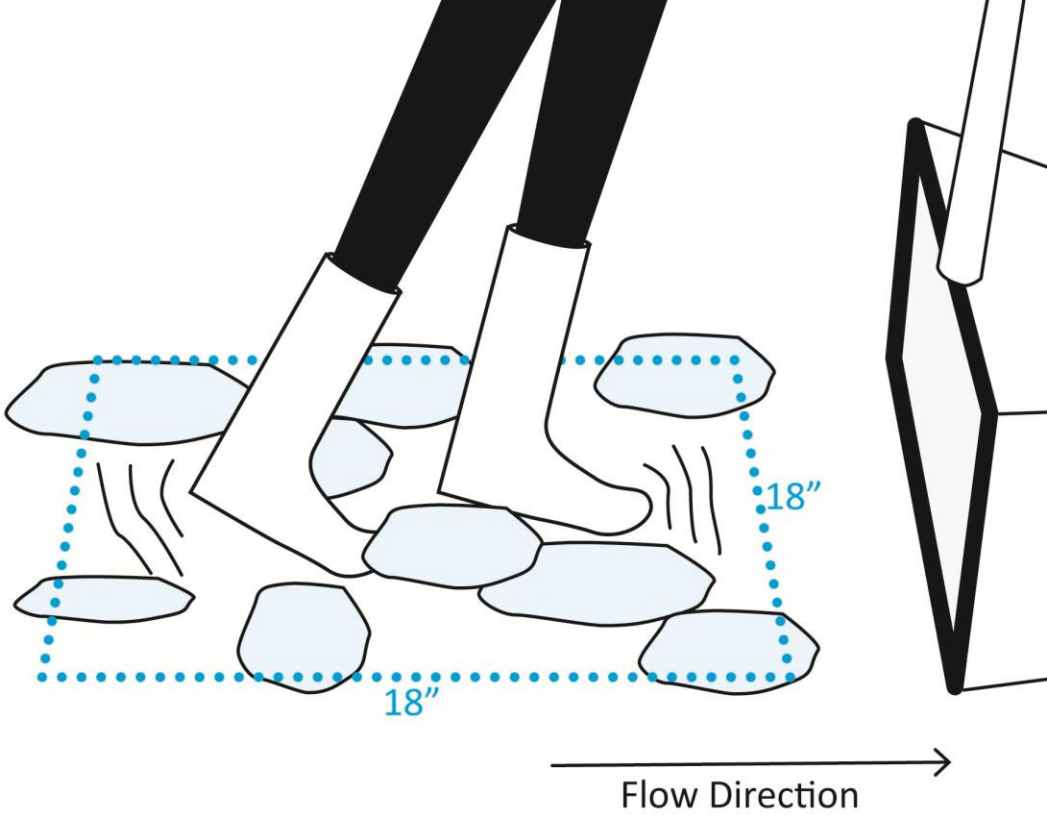


Oxygen mixes into the water in riffles…so riffles are a good environment for water-dwelling organisms who need Oxygen to survive and thrive.

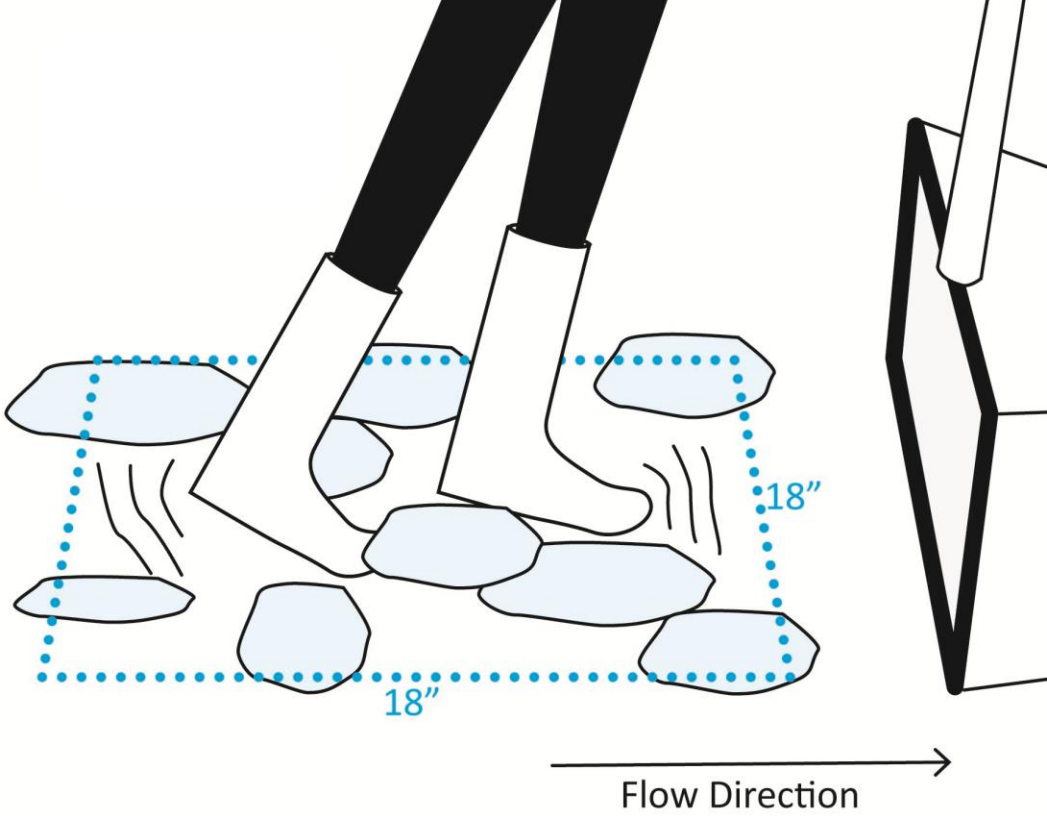

A riffle in Enfield Creek


So find a riffle and
look for some BMI!

The main technique used to collect samples in riffles is called kick sampling



You basically “dance” around within a riffle, disturbing rocks under your feet while holding a net directly downstream of where you are “kicking.” The net opening should be perpendicular to the flow of the water so that the water and anything you’re disturbing from the bottom flows into the net.



Play around with this technique and see what you catch in your net!

The next 5 slides describe some standard stream biomonitoring sampling protocols followed by both Community Science Institute Volunteers and New York State Department of Environmental Conservation professional stream evaluators.


First, Choose a spot for a 5 meter transect across the stream. Your transect should ideally angle slightly downstream.
5 m transect
flow

If your riffle or stream isn't wide enough, the 5 meter transect can zigzag back and forth heading downstream.

Next…

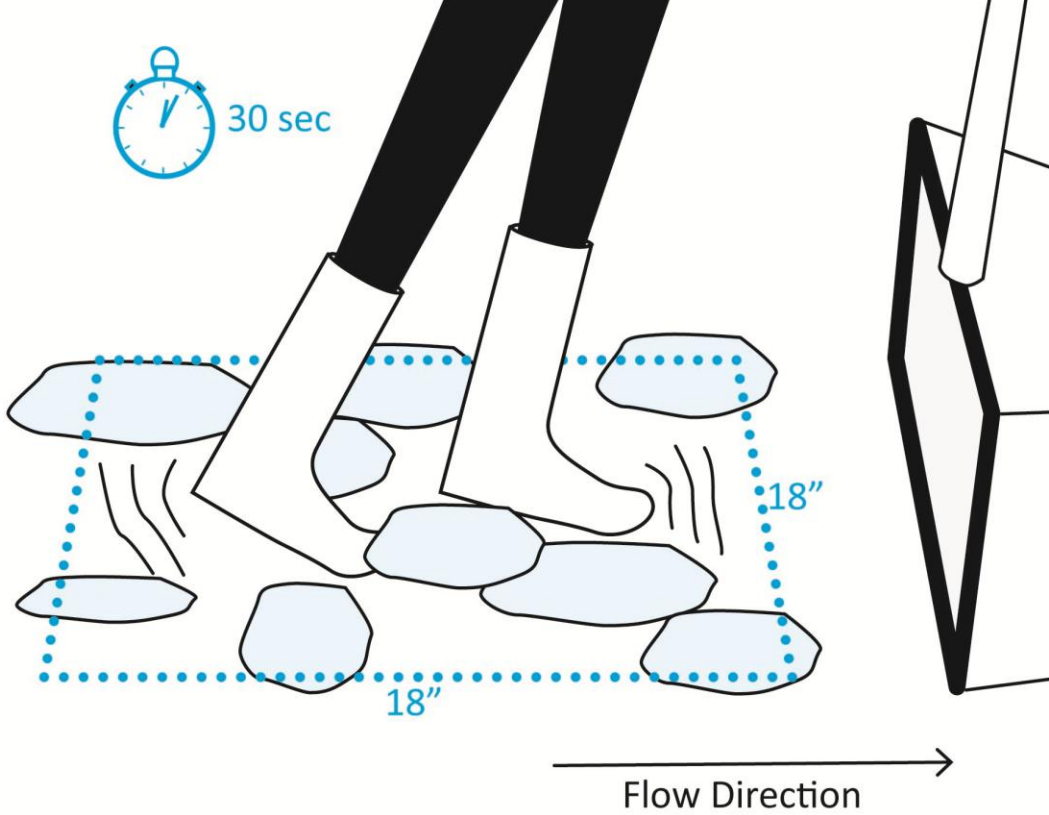
Net Holder

Timer

Assign sampling roles

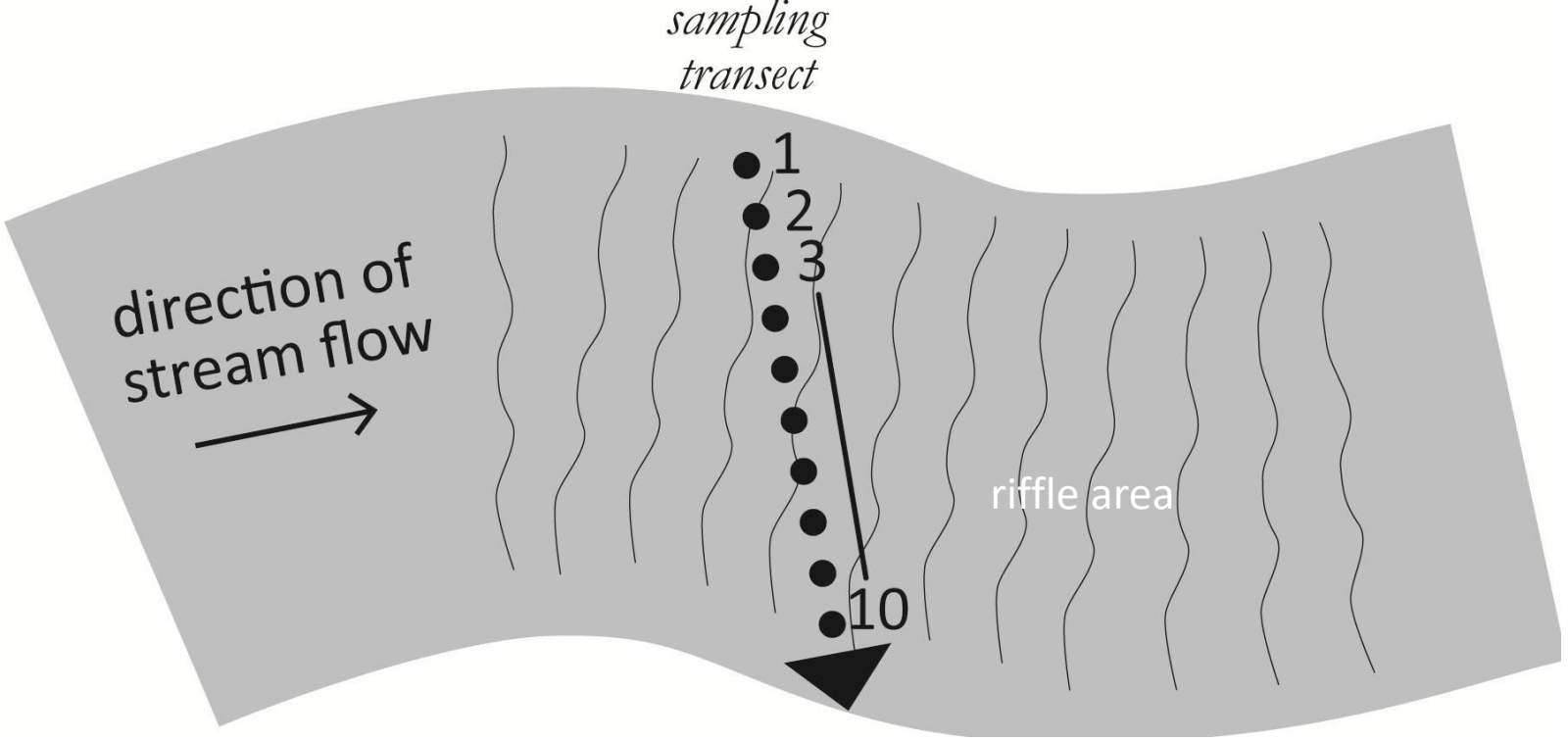
"Kicker"

And collect a sample



To collect a kick sample along a transect…

Starting at the upstream end of your 5 meter transect, disturb the stream bottom within an 18”x18” square a few inches upstream of the net opening by vigorously shuffling feet, putting toes under rocks to flip them over and generally upsetting the substrate so that any organisms hiding under rocks and deeper in the substrate (up to a few inches down) will be caught by the flow and pushed into the net. Try to avoid kicking the substrate directly into the net as much as possible. Do this for 30 seconds at each of ten locations along your transect.



After each 30 seconds of kicking at one location, move the sampling team roughly 0.5 m along your transect to repeat the “kicking” process at the next location. Do this at a total of 10 locations across the stream. (The samples collected are cumulative samples, so the results of each 30 second interval of kicking is added to the last until all 10 locations along the transect have been “kicked.” The entire process lasts 5 minutes, plus the time it takes to move from one point to the next.)


30 second kick sample...
flow

Looking at sample...

Once you've collected your sample…

Put it into a white tray (with water) for observation*.

* You may want to rinse your sample first, by allowing water in a clear part of the stream to flow through the mesh of the net while carefully holding the net opening above the surface.

Take good care of your sample!

Keep it out of direct sun and try to work with your sample as quickly as possible so that you can return it safely to the creek.


16
2
1
1
1
13
18
2
3
1
206
10
1
1
9
3
1
2
7
1
10
5
1
Tug Hollow Creek 5/1/14

So now that you've found some…

what can BMI tell us about water quality in a stream?

In New York State, the Department of Environmental Conservation (NYSDEC) has determined that non-impacted streams typically have 5 BMI characteristics in common*.

NEW YORK STATE | Department of Environmental Conservation

"Non-impacted" is basically another way to say "Healthy"

*NYSDEC Stream Biomonitoring SOP 2014, p.20

Here are the characteristics of healthy streams in New York...

1. Mayflies must be present and numerous; at least 3 species must be present

2. Stoneflies must be present

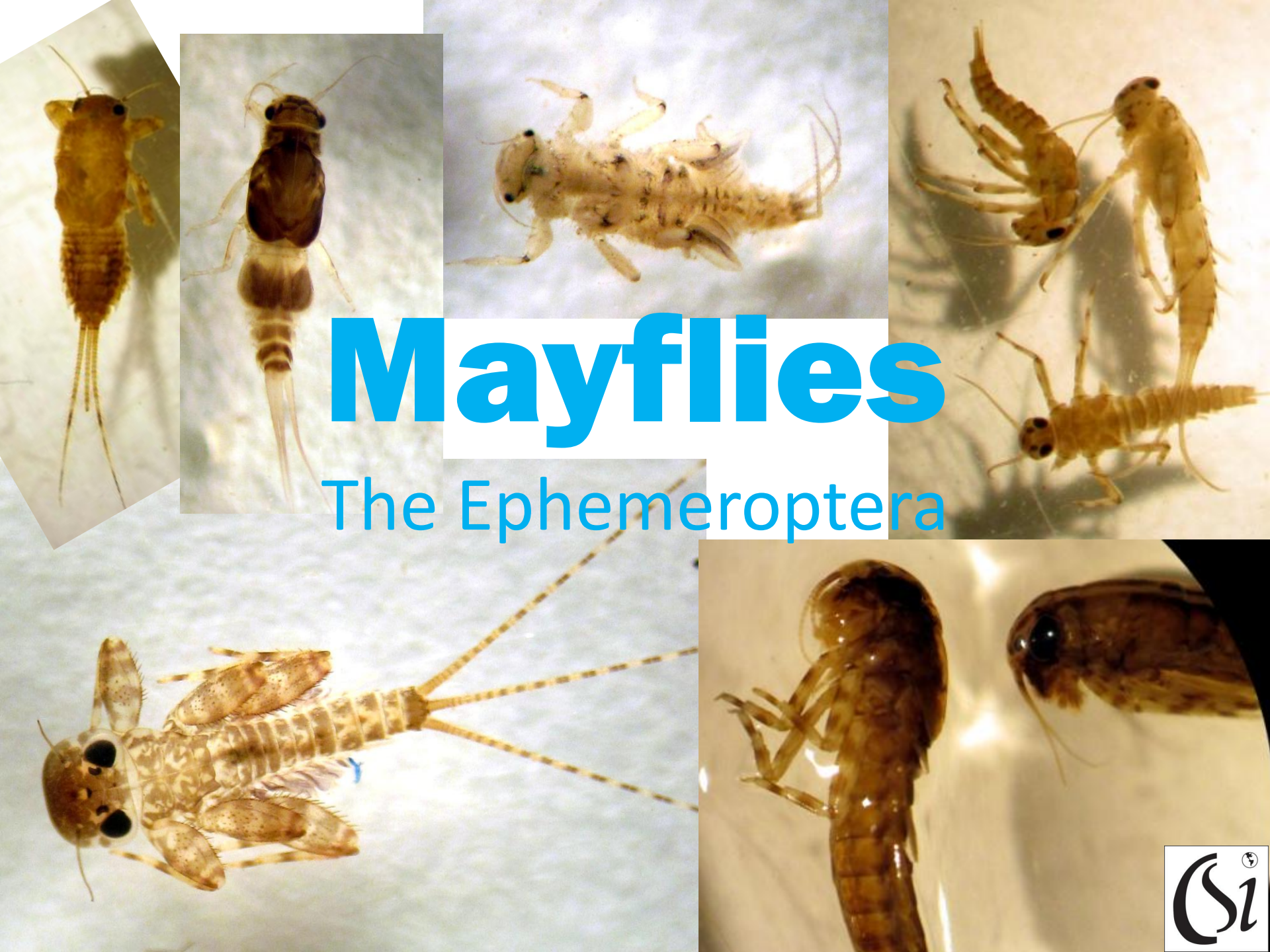
3. Caddisflies must be present, but not more abundant than mayflies

4. Beetles must be present

5. Aquatic worms must be absent or sparse.

NEW YORK STATE | Department of Environmental Conservation

So what did you find?



Mayflies

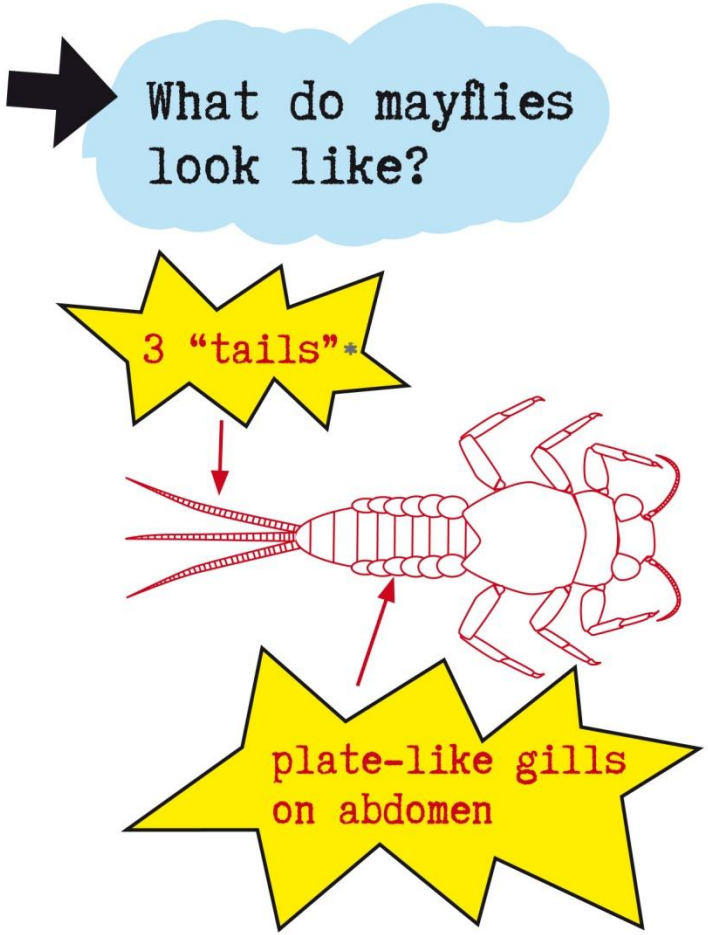
The Ephemeroptera

1. Mayflies must be present and numerous; at least 3 species must be present.

Small Squaregill

Small Minnow Mayflies

Flatheaded Mayfly



* some species only have 2 "tails" – if you only see 2 tails be sure to check for abdomenal gills

Spiny Crawler

Little Stout Crawler

Brushlegged Mayflies

Are mayflies easy to find?

Does it seem like there are at least three different kinds?

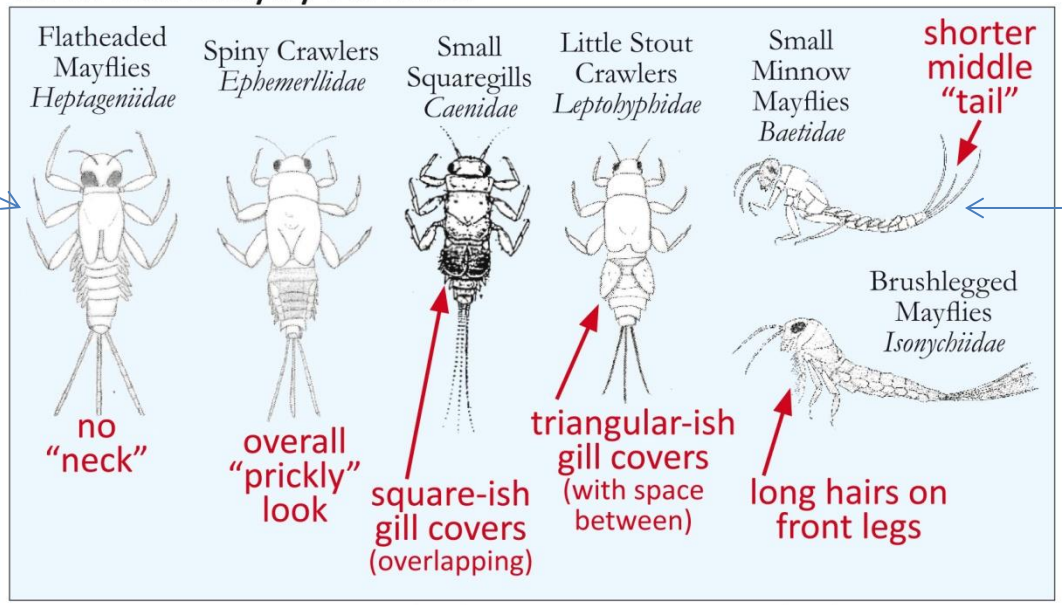
YES ☐ NO ☐

YES ☐ NO ☐

Very Common mayfly in Finger Lakes stream riffles

Some mayflies have flattened bodies and cling to rocks while others have streamlined, swimming forms. Here's a sampling of some of the different kinds of mayflies.

Common Mayfly Families



Also Common

These pictures show mayfly *families* — each mayfly *family* is made up of different mayfly *species*. If you can find 3 different mayfly families, you can confidently answer YES to this question.

Stoneflies

The Plecoptera

2. Stoneflies must be present.

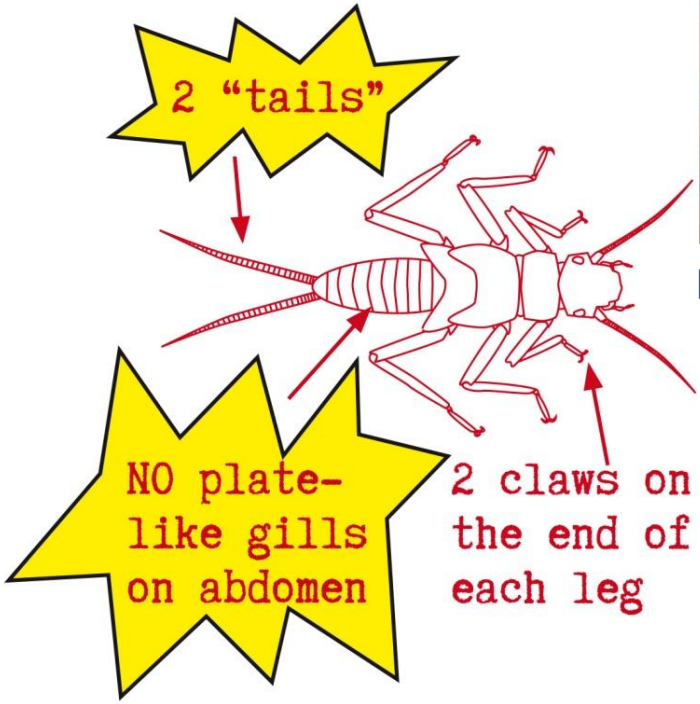
Common Stonefly

What do stoneflies look like?

Rolled-winged Stonefly

Perlodid Stonefly

Green Stonefly



Spring Stonefly

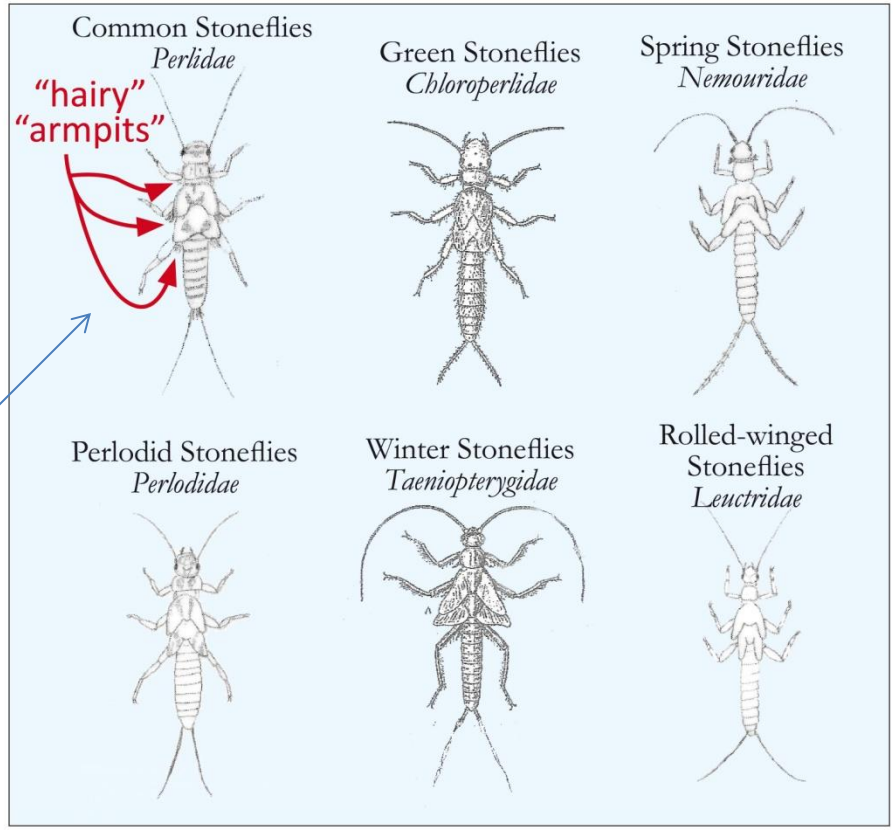
Do you see any stoneflies?

YES ☐ NO ☐

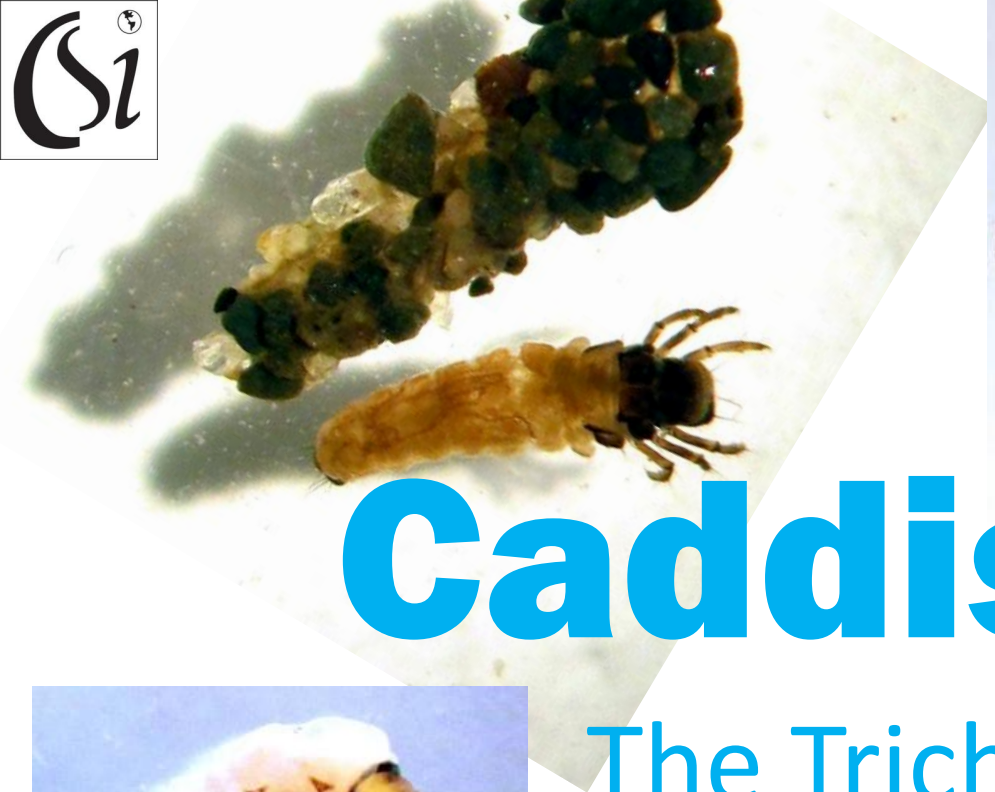
2 different species of *Perlidae*

Most common stonefly in Finger Lakes stream riffles

Some Common Stonefly Families



Different kinds of stoneflies are usually harder to tell apart (even just to family) than mayflies, but there usually aren't as many of them either. Just finding one is enough to answer YES to this question. Counting "tails" is usually the easiest way to tell the difference between stoneflies and mayflies. The most common stonefly family (common stoneflies) have finely-branched gills where each of their legs attach making them easy to recognize (it looks like they have hairy armpits).



Caddisflies

The Trichoptera

3. Caddisflies must be present, but not more abundant than mayflies.

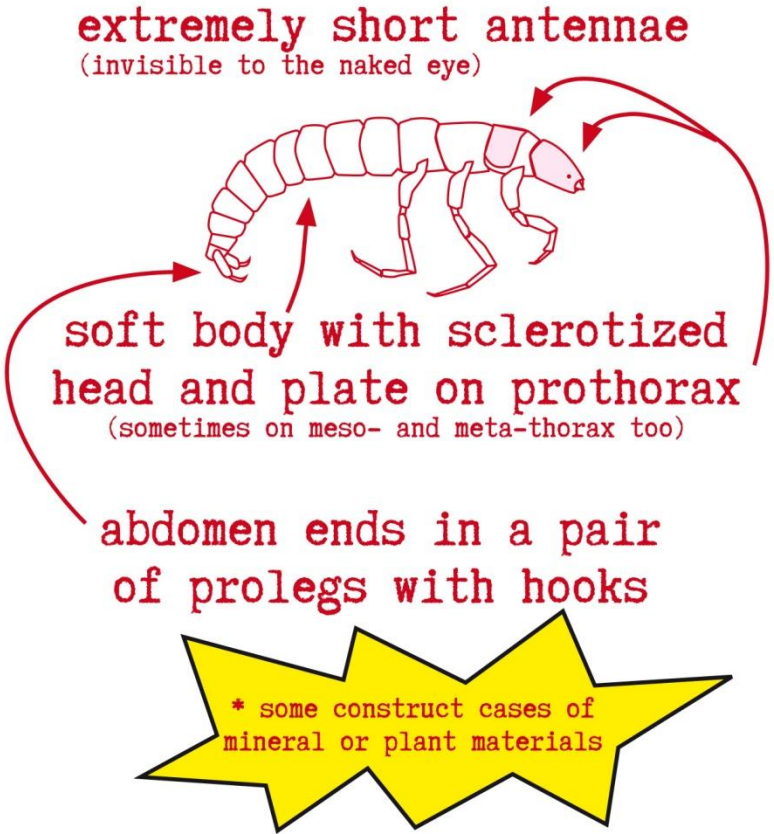
Fingernet Caddisfly

What do caddisflies look like?

Spiral Casemaker Caddisfly

Common Netspinner Caddisfly

Lepidostomatid Caddisfly



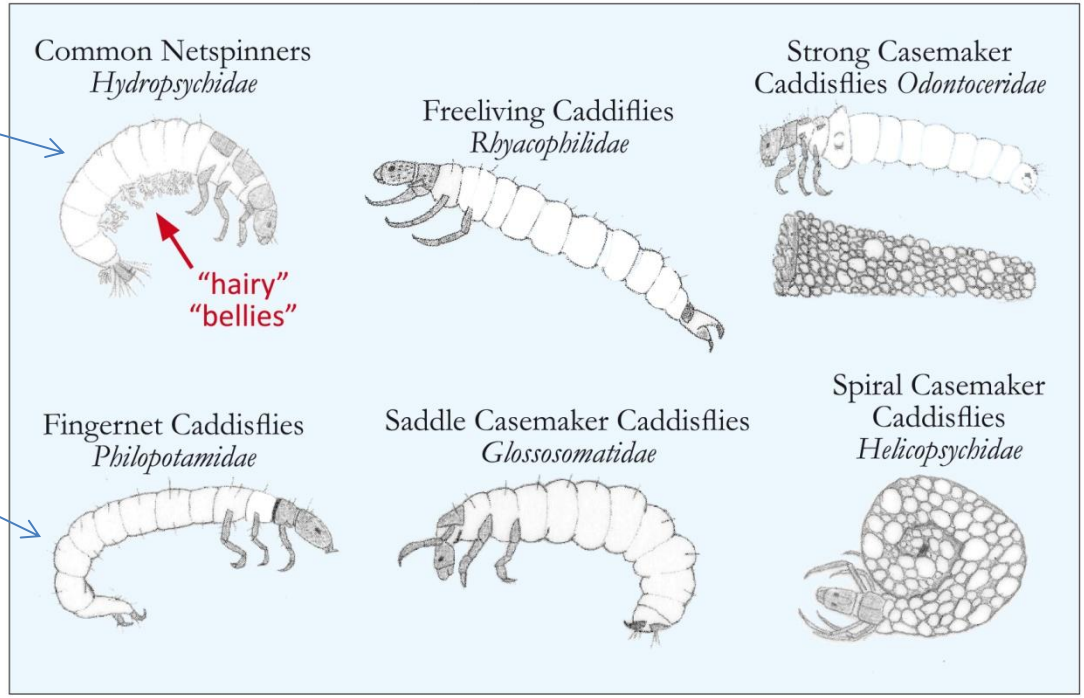
Uenoid Casemaker Caddisfly

Freeliving Caddisfly

Most common caddisfly in Finger Lakes stream riffles

	YES	NO
Do you see any caddisflies?	☐	☐
Are there fewer caddisflies than mayflies?	☐	☐

Some Common Caddisfly Families



2nd most common

Different kinds of caddisflies can be even harder to tell apart than stoneflies, but the most common family (Common Netspinners) are quite easy to identify to family due to the branched gills on the ventral part of their abdomens ("hairy bellies").

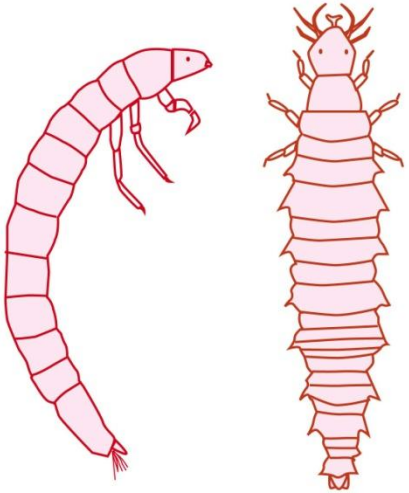
Beetles

The Coleoptera

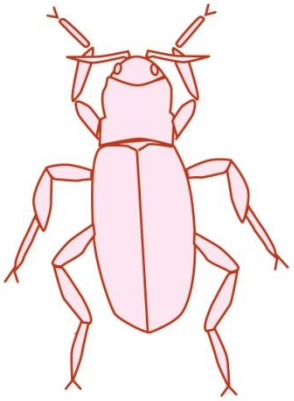
4. Beetles must be present

What do beetles look like?

Water Penny larvae



larvae have jointed legs and often have dark, stiff bodies



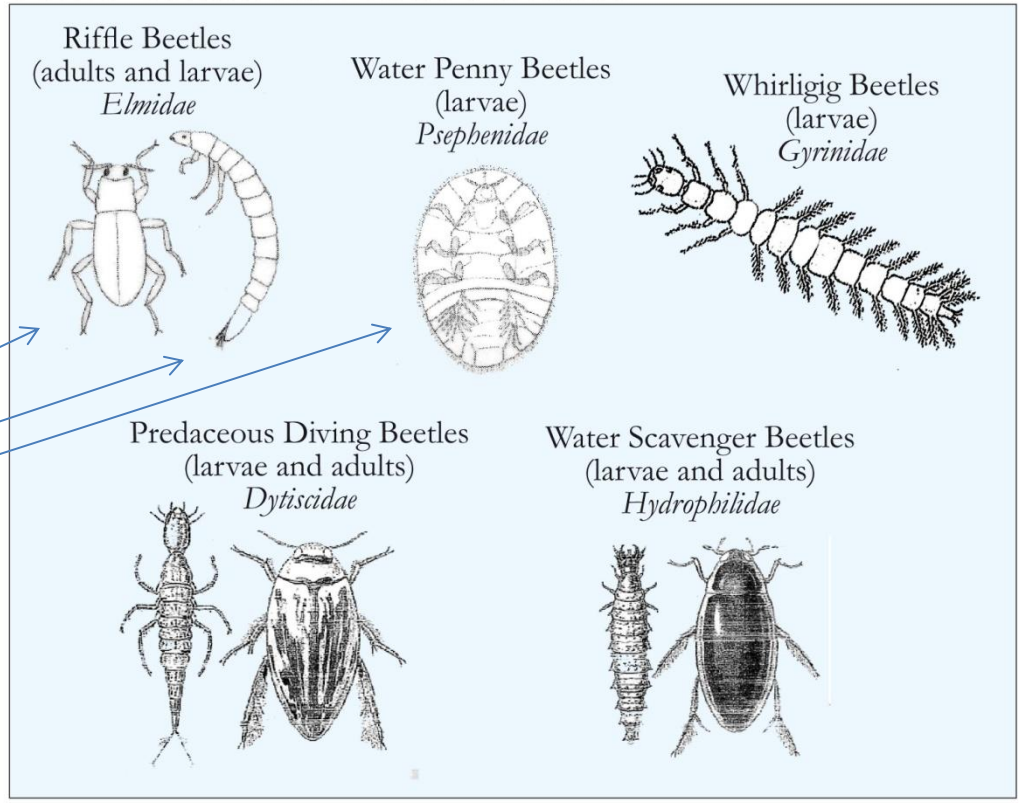
adults usually have hard, black bodies and are distinctly oval in shape

Riffle Beetle
Larva and adult

Do you see any beetles (larvae or aquatic adults)?

YES ☐ NO ☐

Some Common Beetle Families



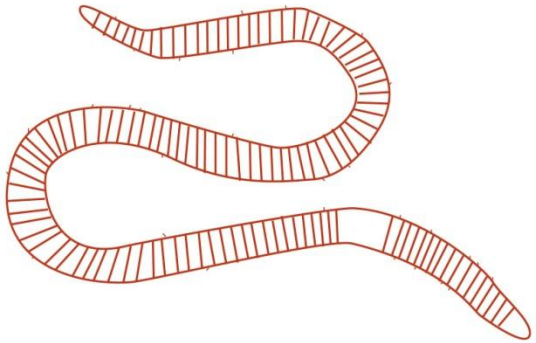
Most common beetles in Finger Lakes stream riffles

Unlike mayflies, stoneflies and caddisflies whose adults are winged insects, you may find some adult beetles living in creeks alongside their young larvae.

Worms

5. Aquatic worms must be absent or sparse.

What do aquatic worms look like?



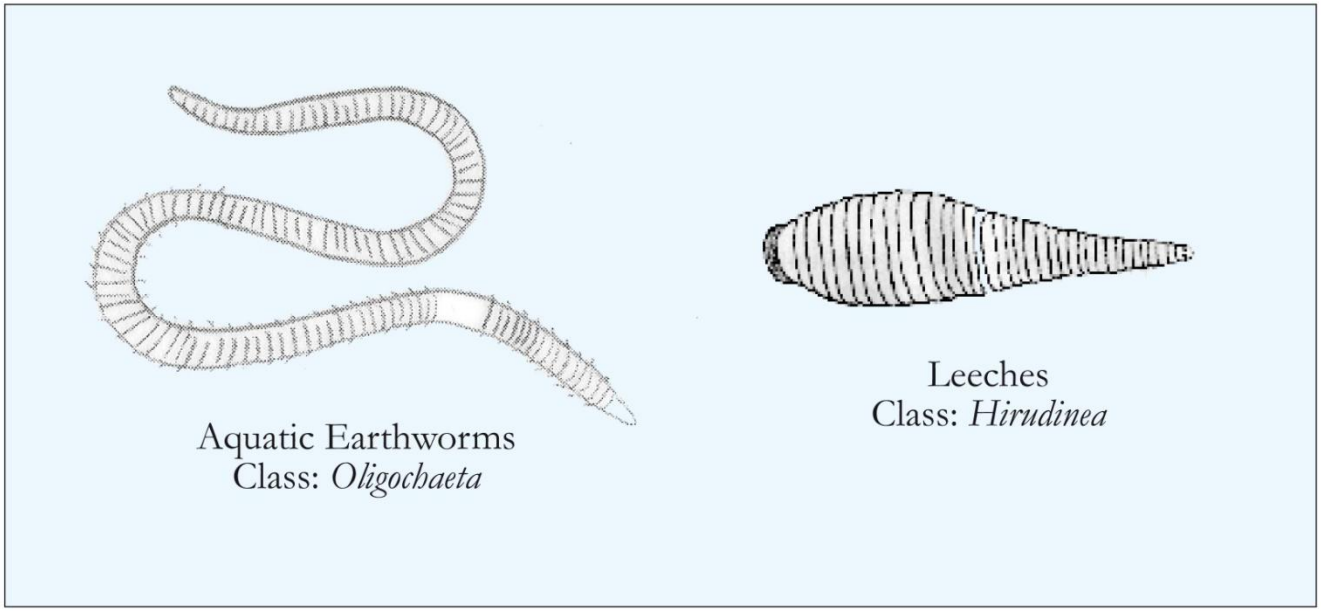
they all have segmented bodies

Are aquatic worms absent or sparse?

YES ☐

NO ☐

Some Common Aquatic Worms



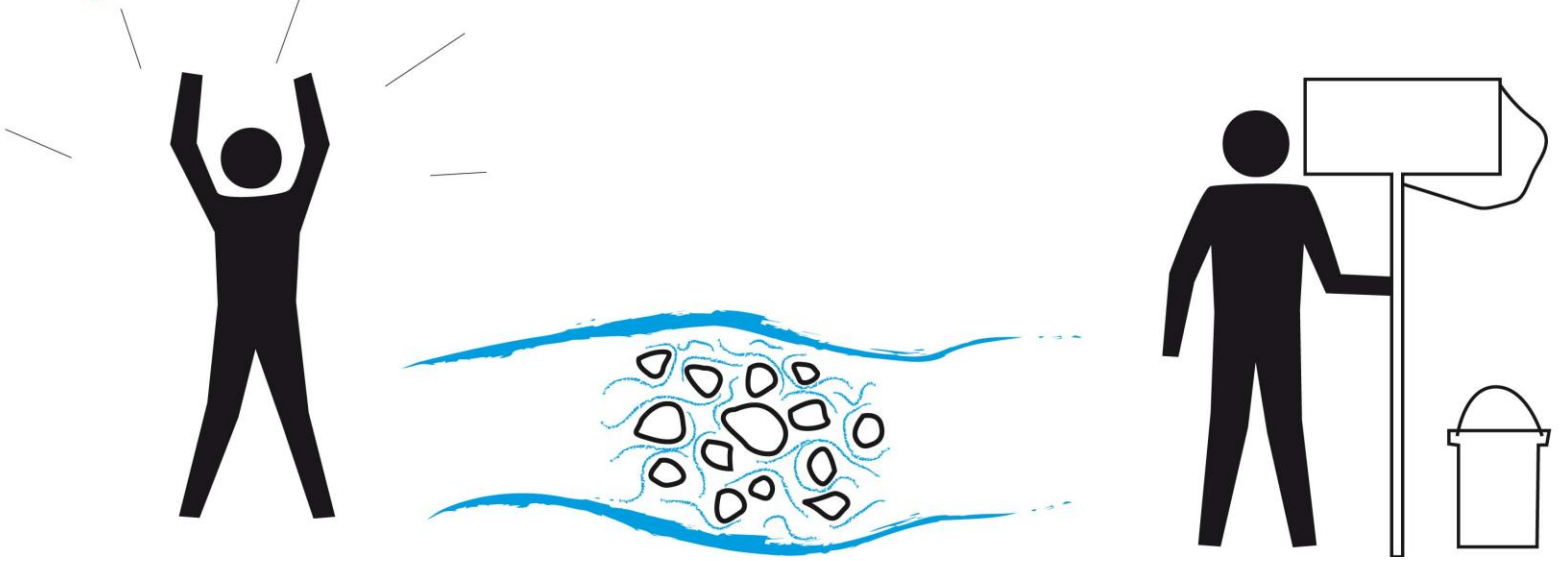
Aquatic Earthworms
Class: *Oligochaeta*

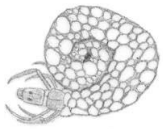
Leeches
Class: *Hirudinea*

Look back at the 7 questions you answered....

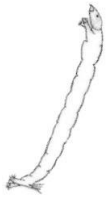
If you answered **yes** to all of them, that's fantastic! It means that your stream probably has pretty good water quality and is supporting a diversity of life.

If you answered **no** to any of them, it means that your stream *might* be impacted, but needs further study to know for sure.

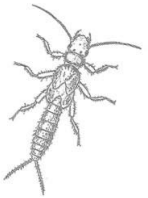









Be sure you carefully return the bulk of your sample to the creek when you're done looking at it! These organisms are food for fish, birds, snakes and other creatures AND they also consume algae and help break down fallen leaves and other organic material that falls in the water…



Preserving one of each kind of organism you find would be helpful, though!

CSI can provide verification for identification then return the organisms to you. These voucher specimens can be used to help future students learn about benthic macroinvertebrates specific to the creek you sampled and help them document any changes that might take place over time.

CSI can provide a vial with alcohol for preservation. But you can also use any sealable container that allows you to completely submerge organisms in isopropyl alcohol.

Let us know what you found!

SEND US YOUR RESULTS. If you're up for sharing any photographs of your experience, that would be great too. Send us a photo of your class at the creek you evaluated and we'll post it in the young scientist section of the Community Science Institute website***.

Send your results (and questions) to:
adrianna@communityscience.org

or Community Science Institute
Young Scientists
95 Brown Rd, Ste 283
Ithaca, NY 14850

***Let us know if you've preserved voucher specimens and we can arrange to get them from you.

Thank you!!!

THE COMMUNITY SCIENCE INSTITUTE

CSi

Partnering with communities to protect water