

Explore and Restore Maryland Streams

Welcome to an Explore and Restore Maryland Streams Workshop



Thank you to the
Oregon Ridge Nature Center
for hosting us!



Basic Stream Ecology

Presented by

Dan Boward and Sara Weglein

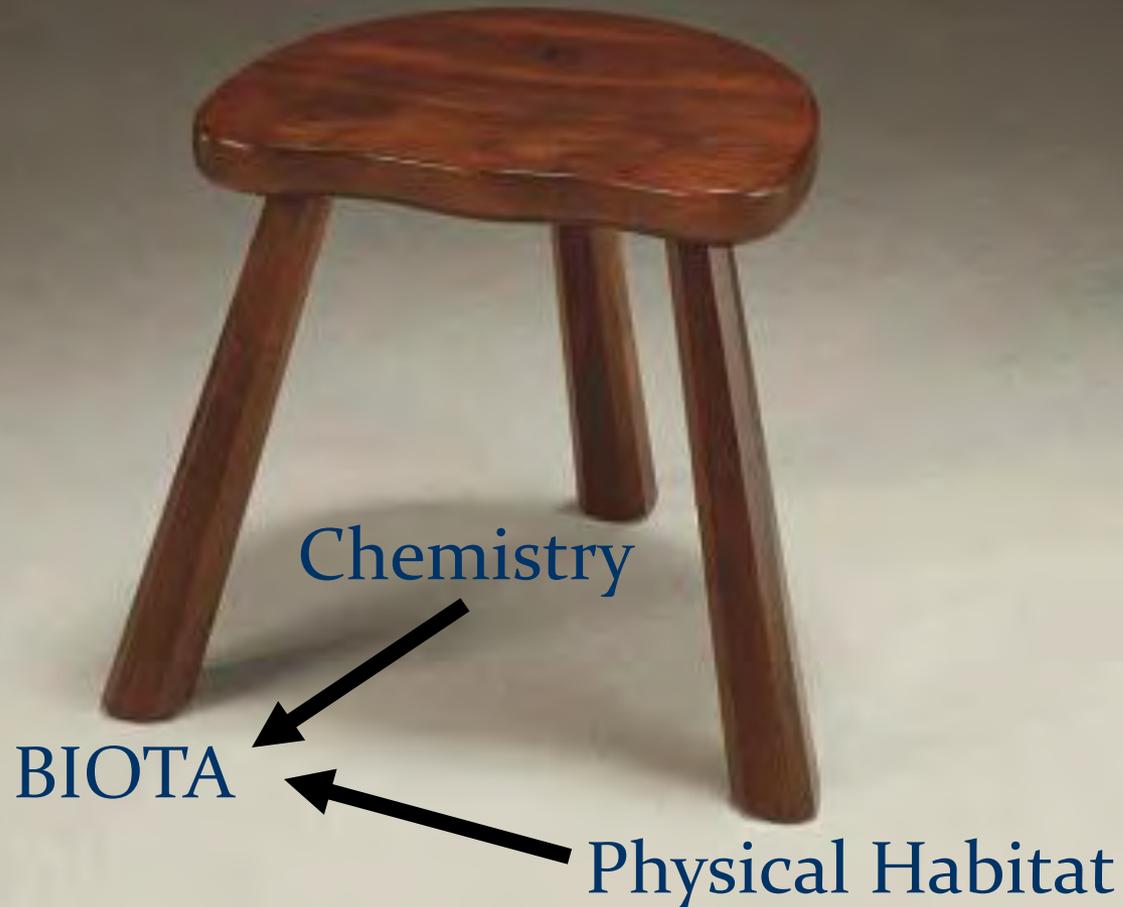
MD DNR Resources Assessment Service

Stream Ecology:



The study of the, physical, chemical and biological attributes of streams and the transitional areas adjacent to them.

A Healthy Stream Ecosystem



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Stream Functions Pyramid

1 Biology: *Amount, diversity, and life history* of animals and plants in the stream: Insects, fish, salamanders, algae.

2 Physiochemical: What are the *chemical* and *physical* characteristics of the *water*?
Temperature, oxygen, conductivity, nutrients, pH.

3 Geomorphology/Habitat: The *physical environment* in and around the stream. Are diverse habitats available? How stable is the stream channel? Embeddedness, bank height, bank stability, amount of wood and rocks in the stream, riparian buffer width.

4 Hydraulics: The way the *water behaves* in the stream. Depth and speed of the water over time. How does the water interact with groundwater and the floodplain? Depth, flow, speed, volume.

5 Hydrology: *How much water* drains from the watershed into the stream. What is the land cover in the watershed? How much rain fell? Amount of pervious versus impervious surface in the watershed. Hydrograph.

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- Sedimentation/siltation

- Underground piping of streams

- Exotic/invasive species

- Flood control

- mining

- toxics

- logging

- Watershed imperviousness

- Eutrophication/nutrient enrichment

- construction

- Water withdrawals

- Acid rain

- Migration barriers

- Thermal impacts

- Road salt

- Road maintenance

- Riparian zone destruction

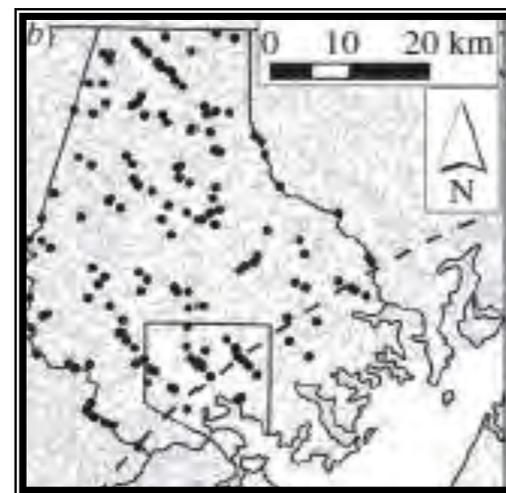
- Recreational/commercial harvestation

- Stream "improvements"



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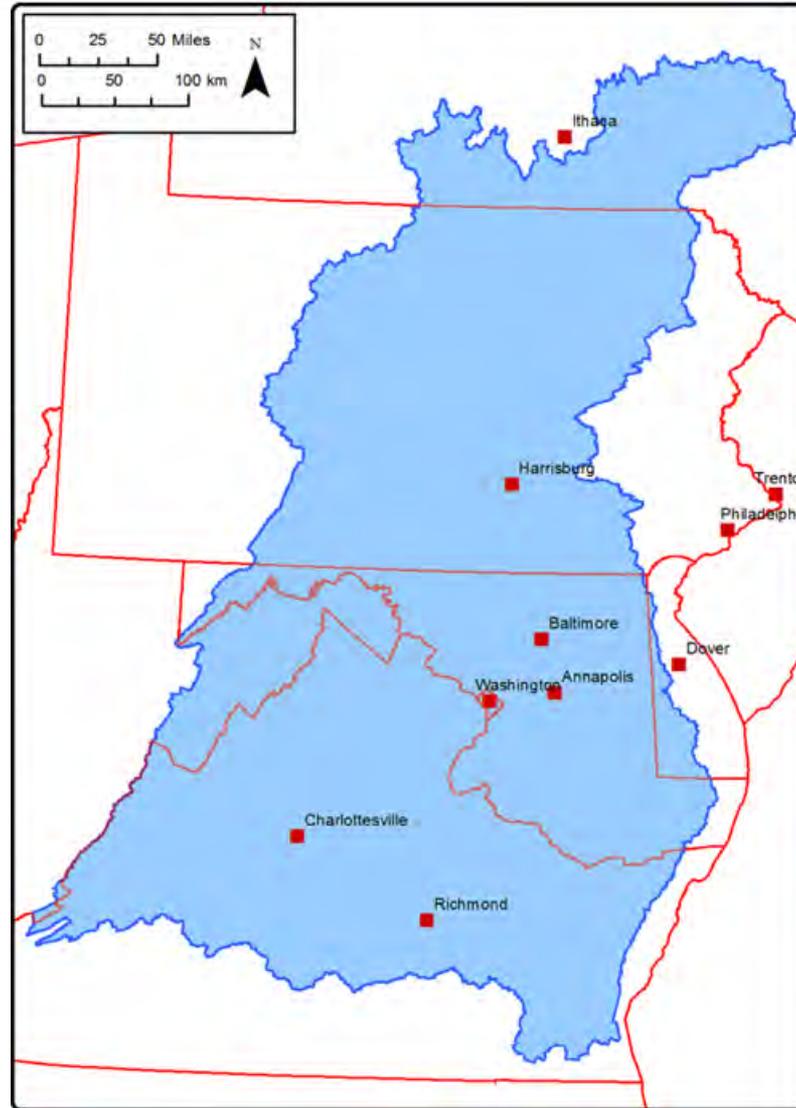


Geology and Scale

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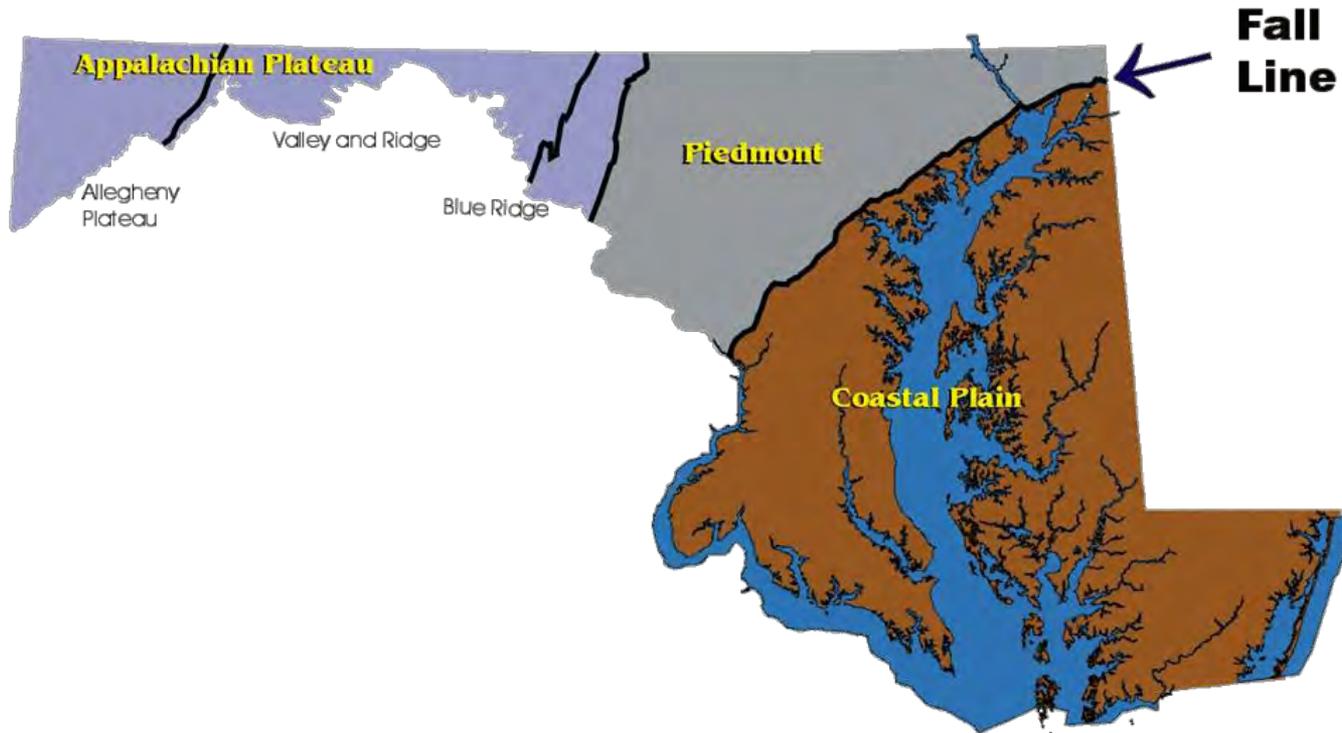
Watershed-
the area
drained by
a river or
stream

<http://techalive.mtu.edu/meec/module01/whatiswatershed.htm>

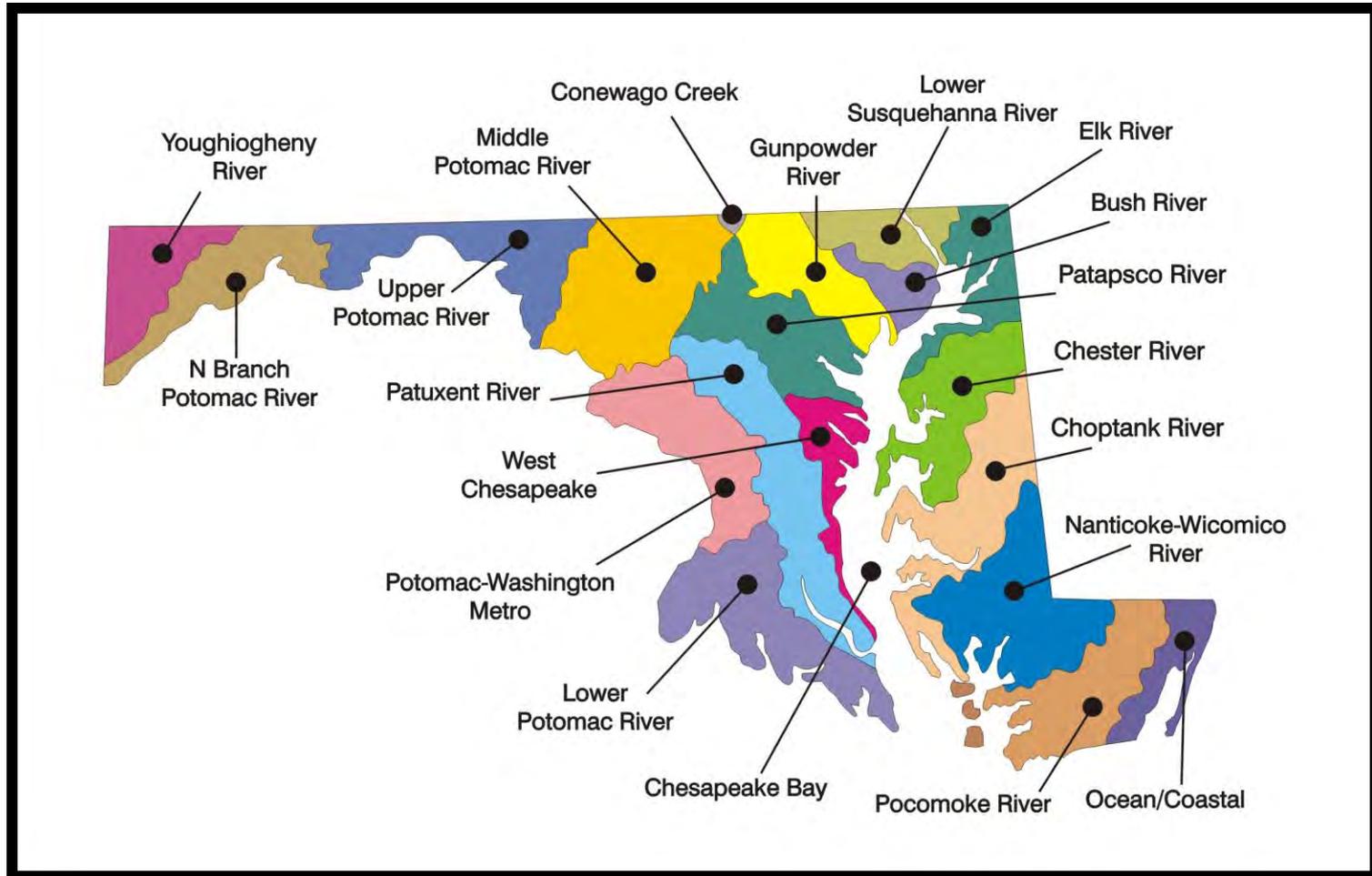


Chesapeake
Bay
Watershed

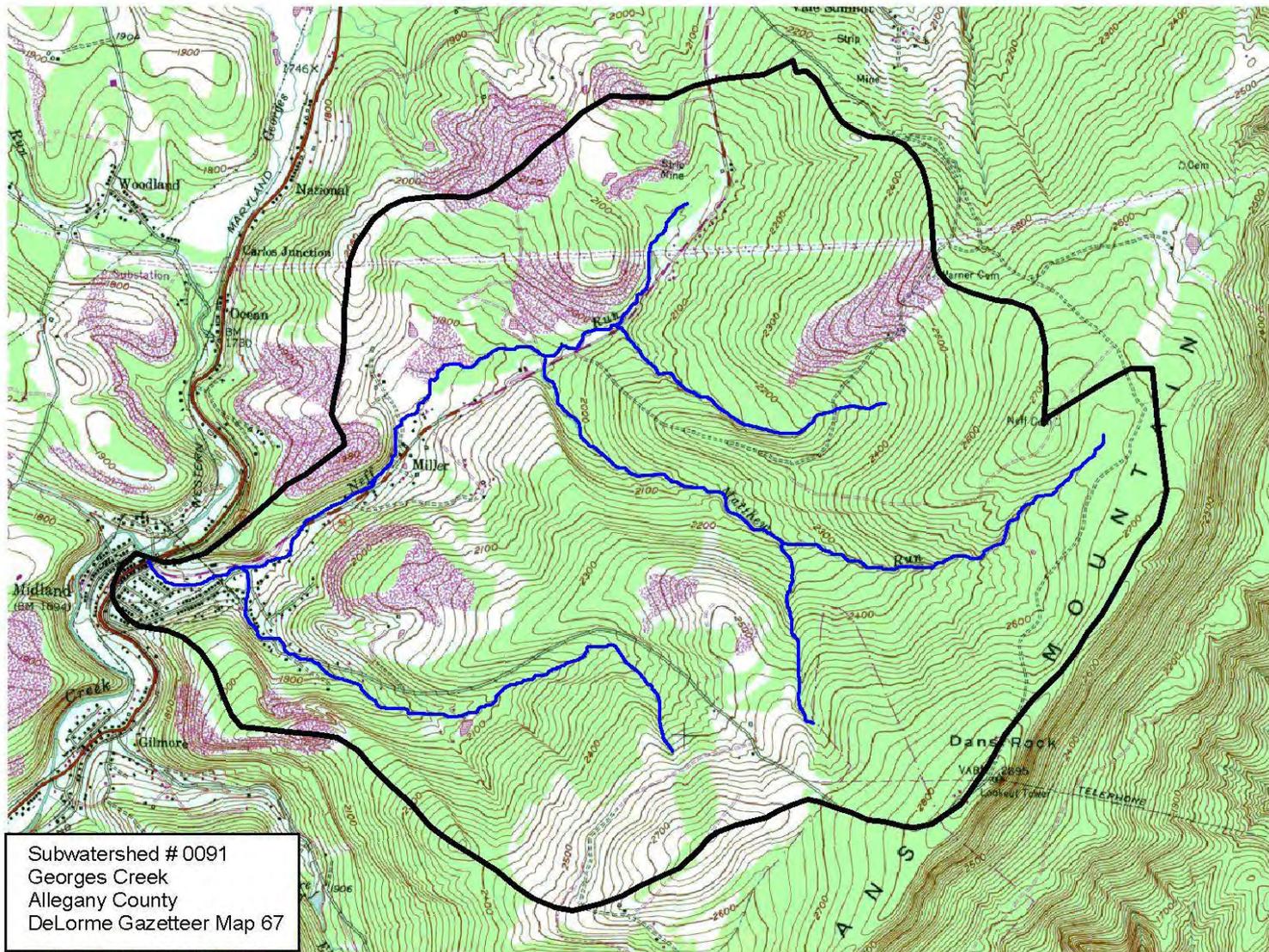
MARYLAND PHYSIOGRAPHY



Maryland's River Basins



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Chemistry

Chemical Factors

- *Temperature*
- *Dissolved Oxygen (DO)*
- *pH/Buffering Capacity*
- *Conductivity*
- *Nutrients*
- *Sediment*

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- Higher water temperature = lower dissolved oxygen
- More canopy cover = lower water temperature = higher dissolved oxygen
- More riffles = higher dissolved oxygen



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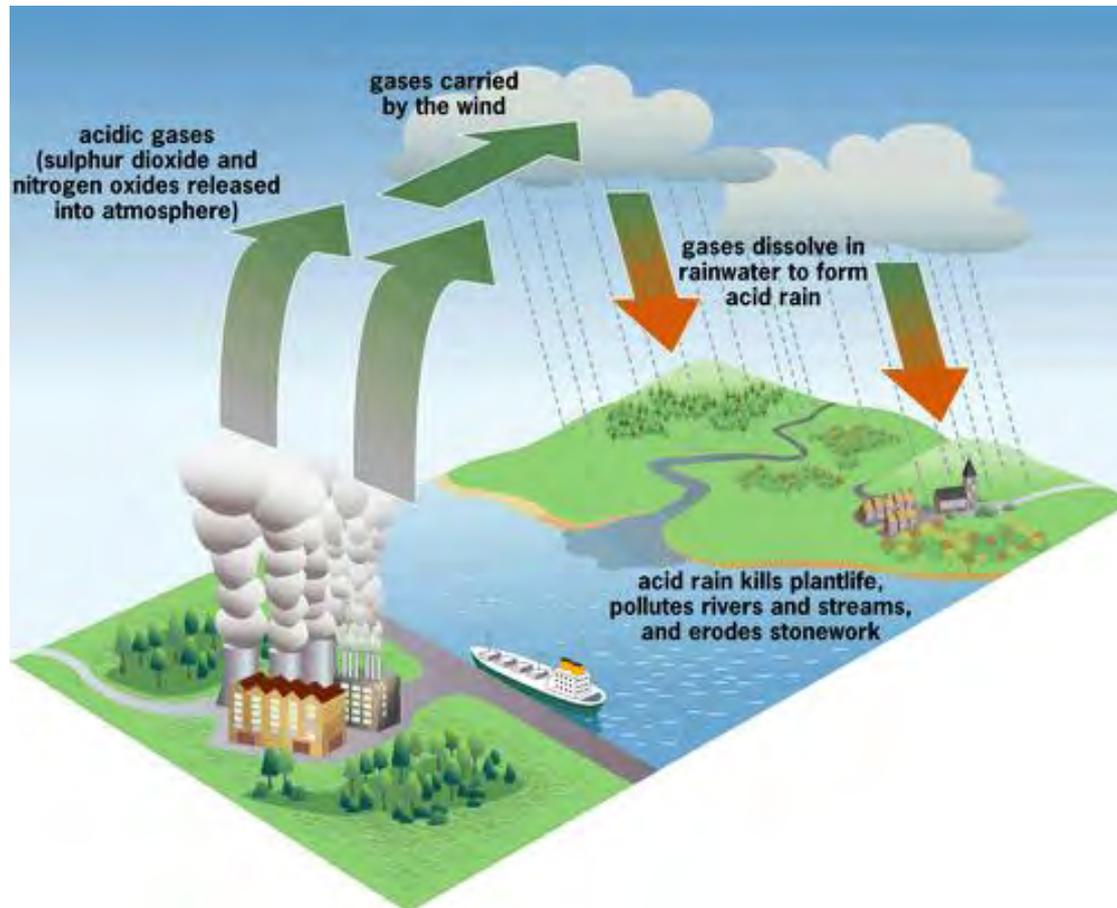


Stonefly (needs high DO)



Eastern mudminnow
(tolerant of low DO)

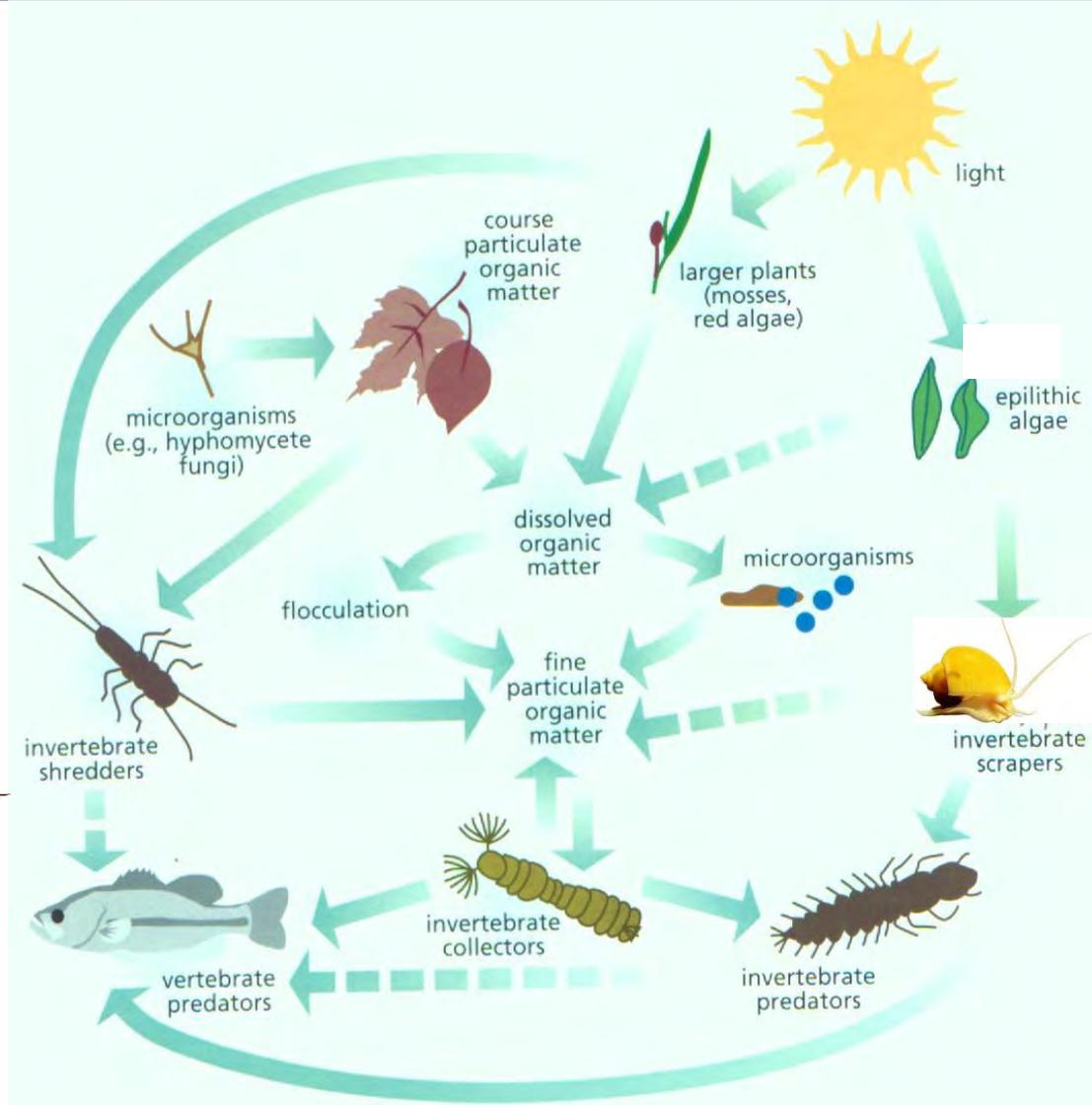
Acid Rain affects a stream's pH



Biology



Stream Food Web





**External (allochthonous)
vs Internal
(autochthonous) Energy
Sources**

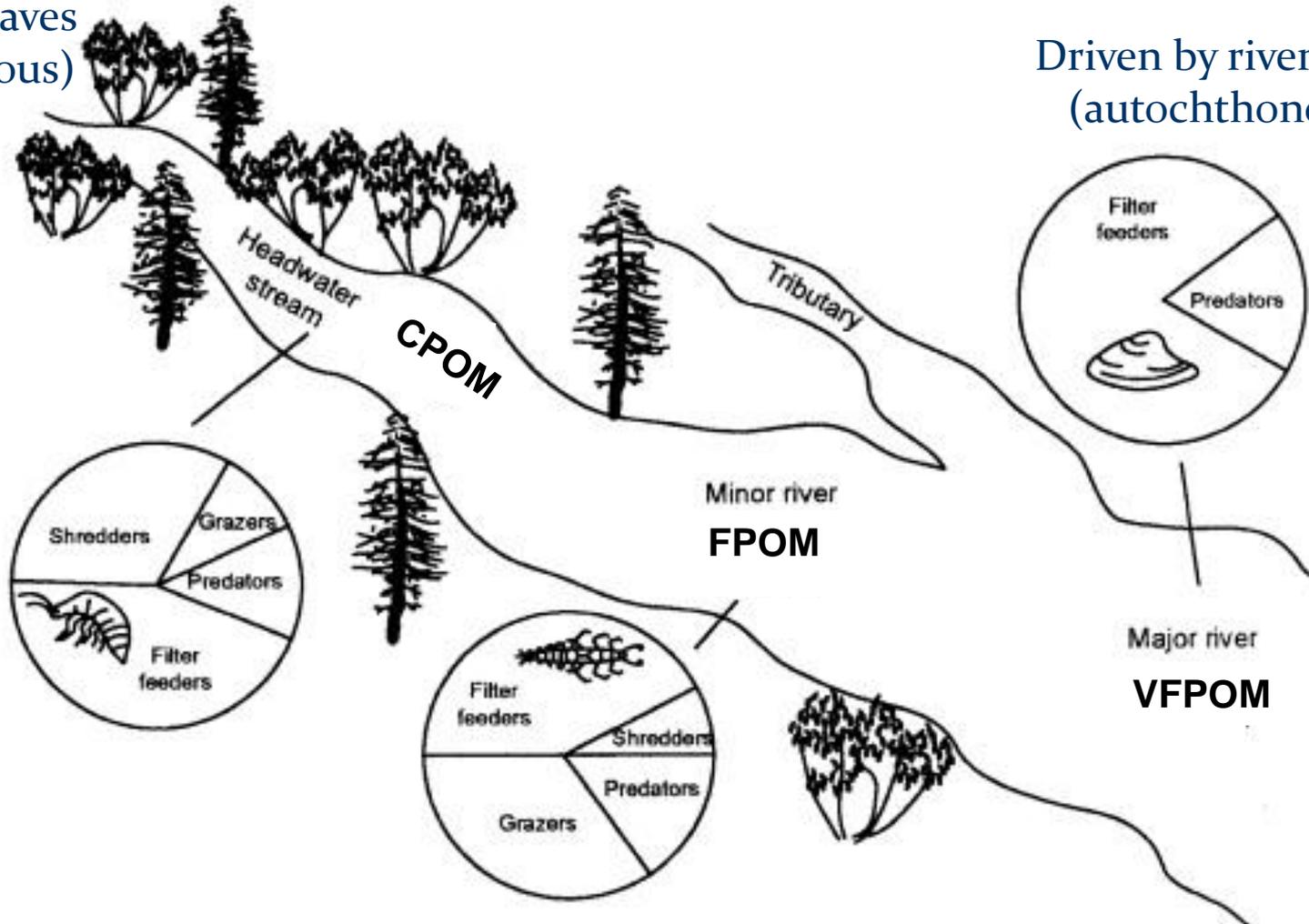


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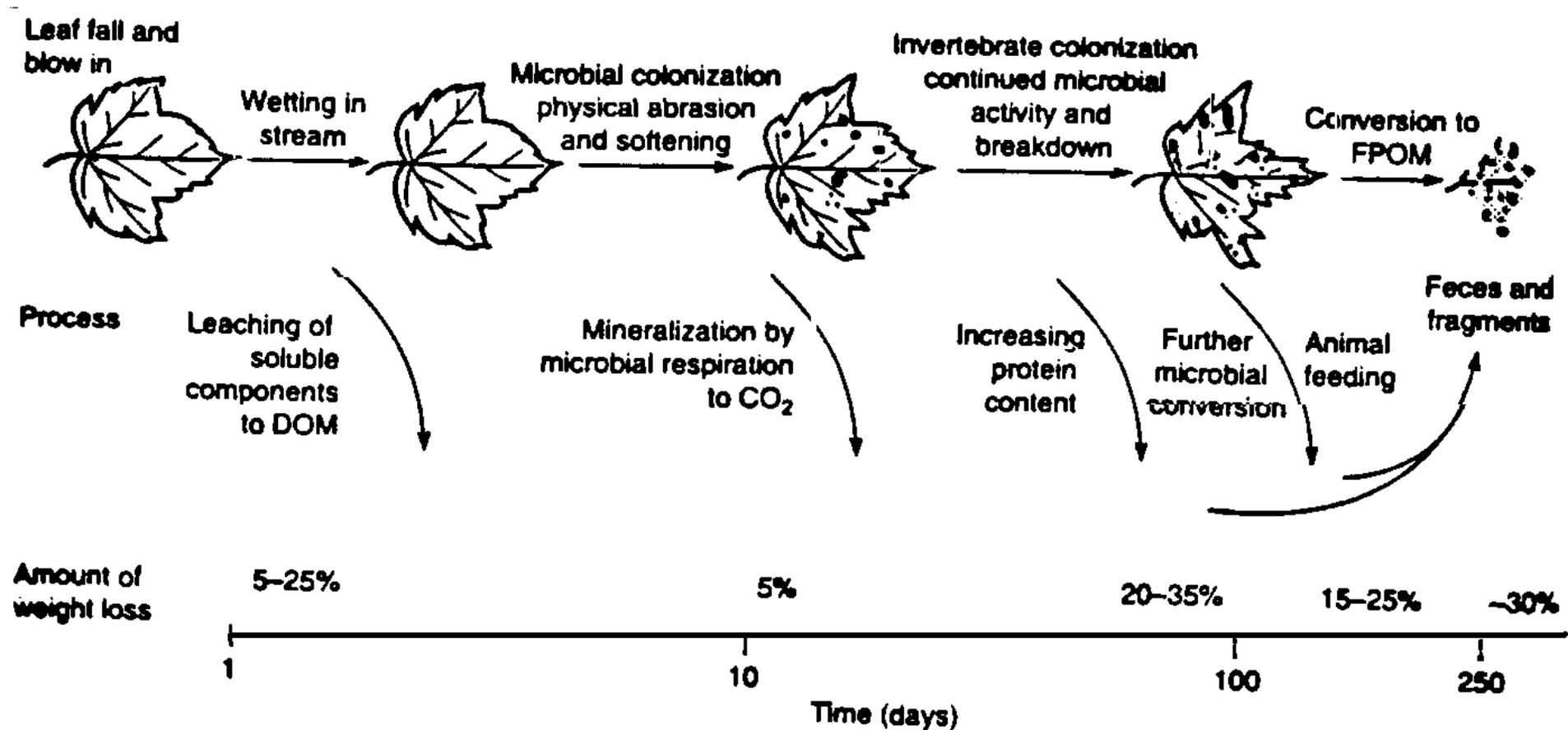
The River Continuum

Driven by
terrestrial leaves
(allochthonous)

Driven by river algae
(autochthonous)



Leaf Processing Sequence



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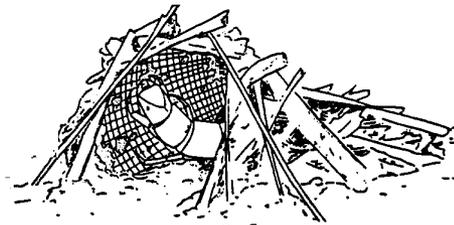
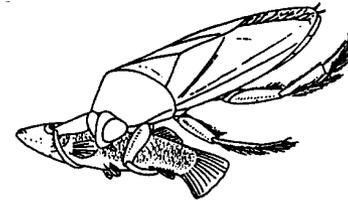


Benthic Feeding Groups

Borer

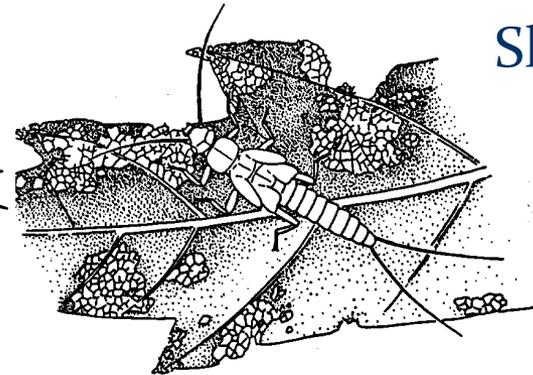


Piercer

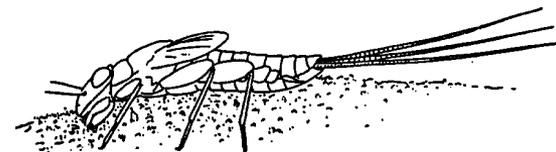
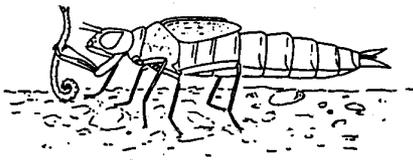


Filterer

Shredder

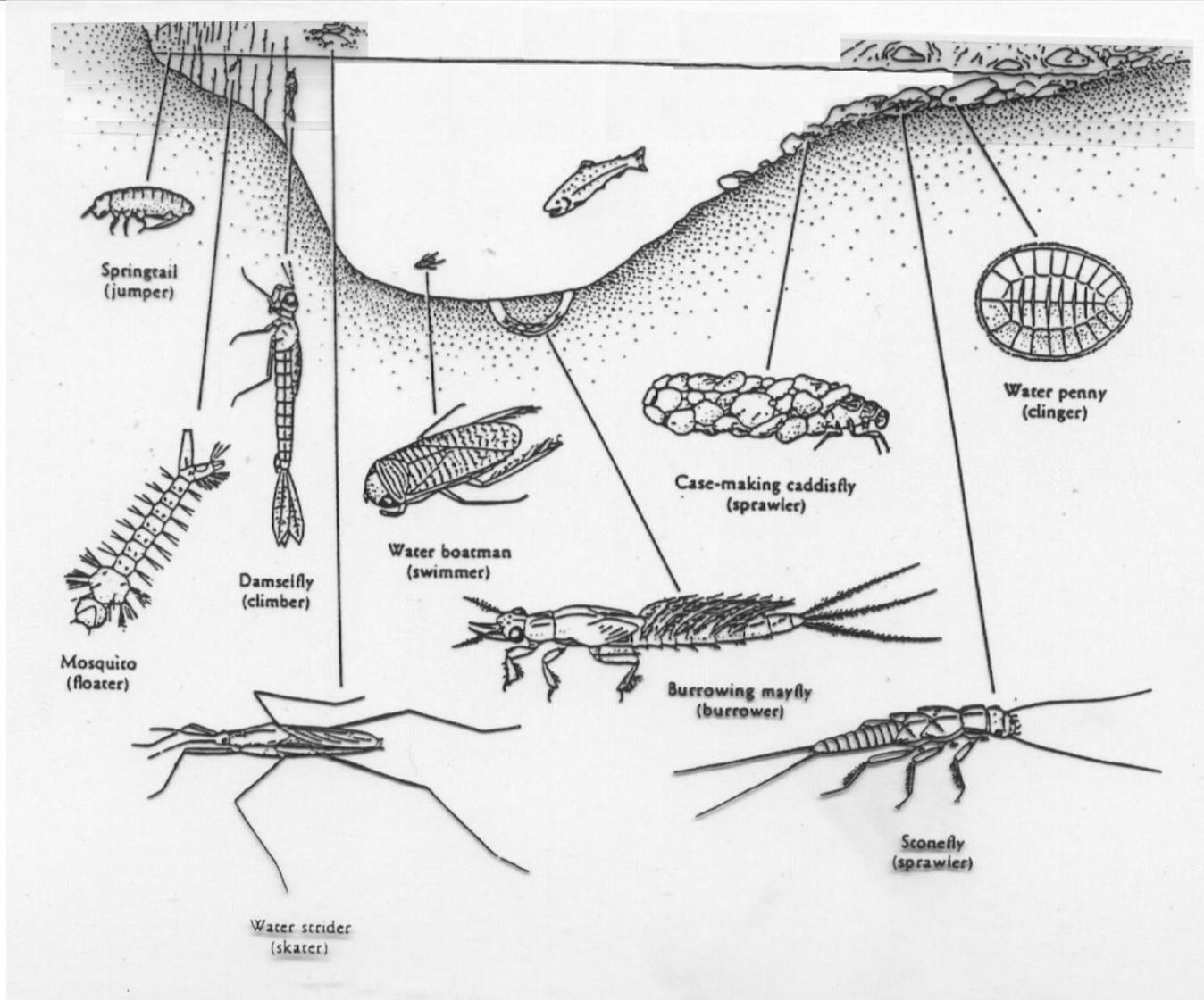


Predator



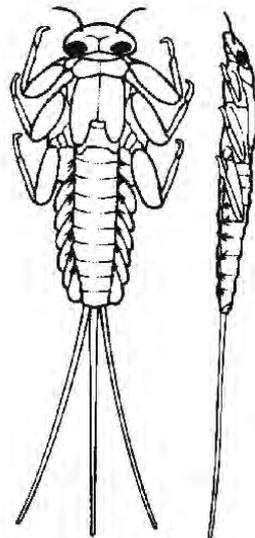
Scraper

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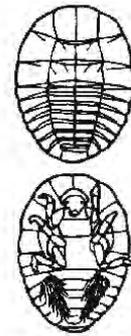


Habitat

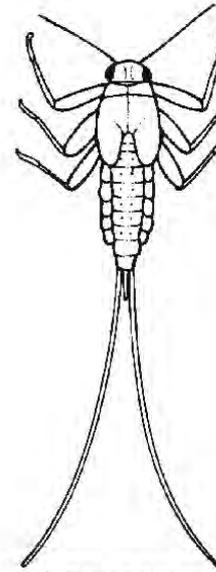
Invertebrate Adaptations to Life in Running Water



(a) *Rhithrogena*



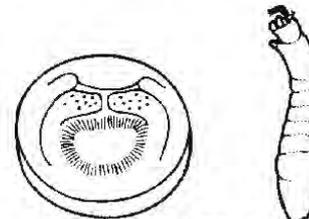
Psephenus x3



(b) *Baetis subalpinus*

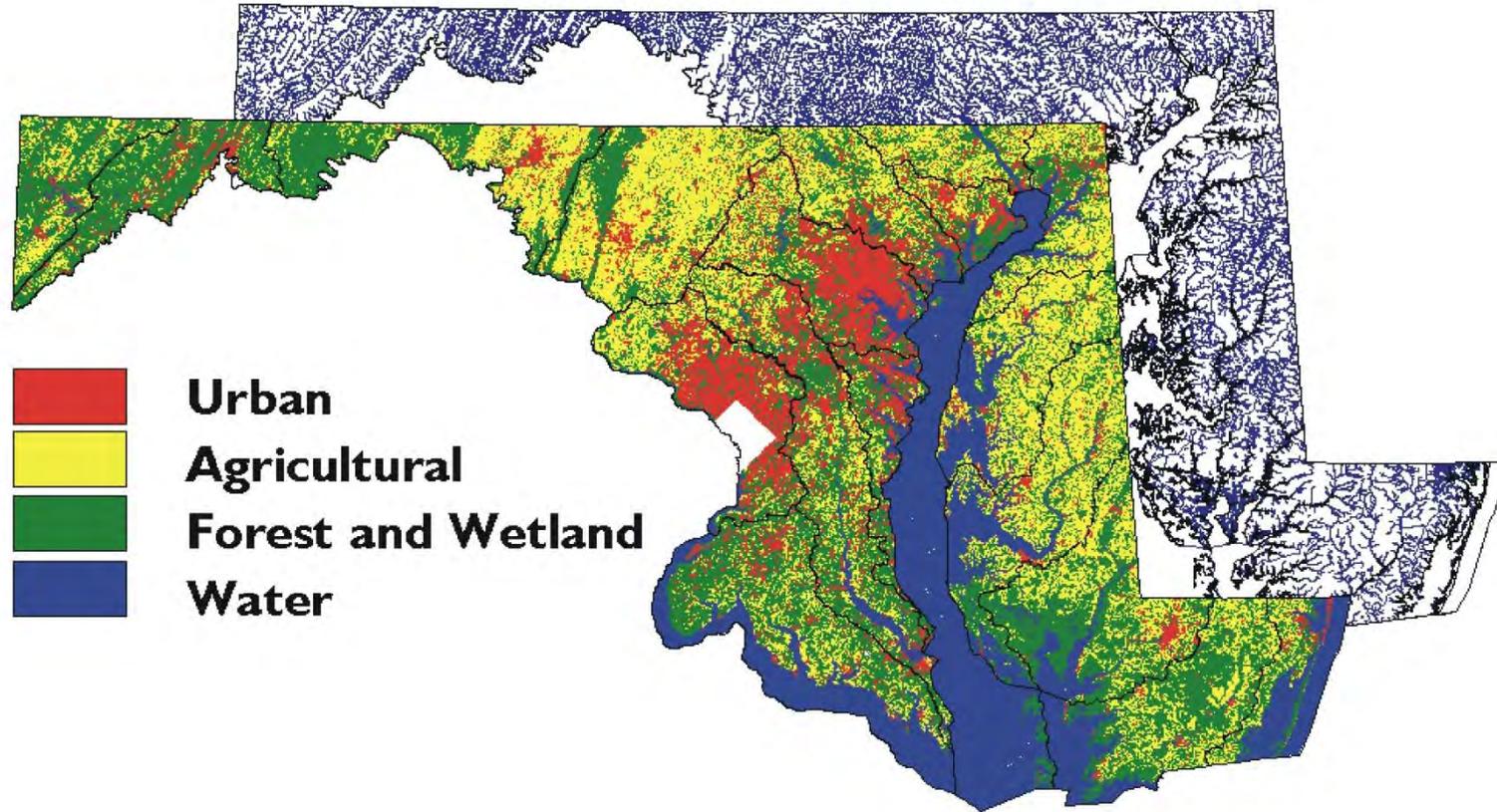


(c) *Phlorus*



(d) *Simulium*

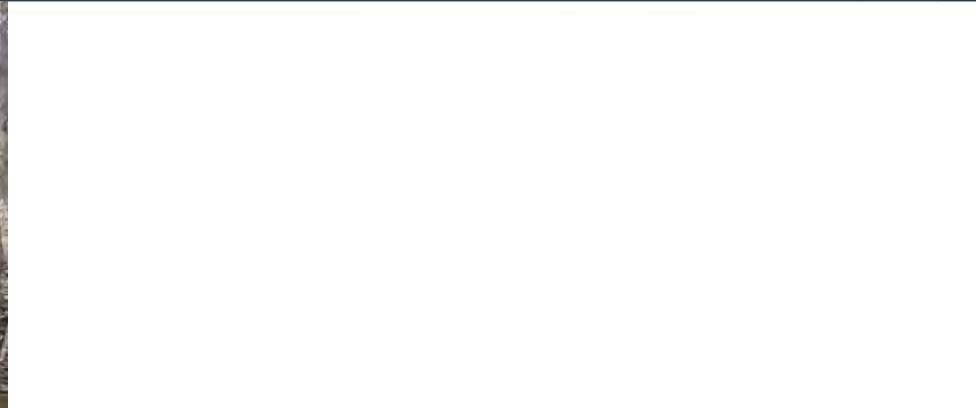
Land Use in Maryland



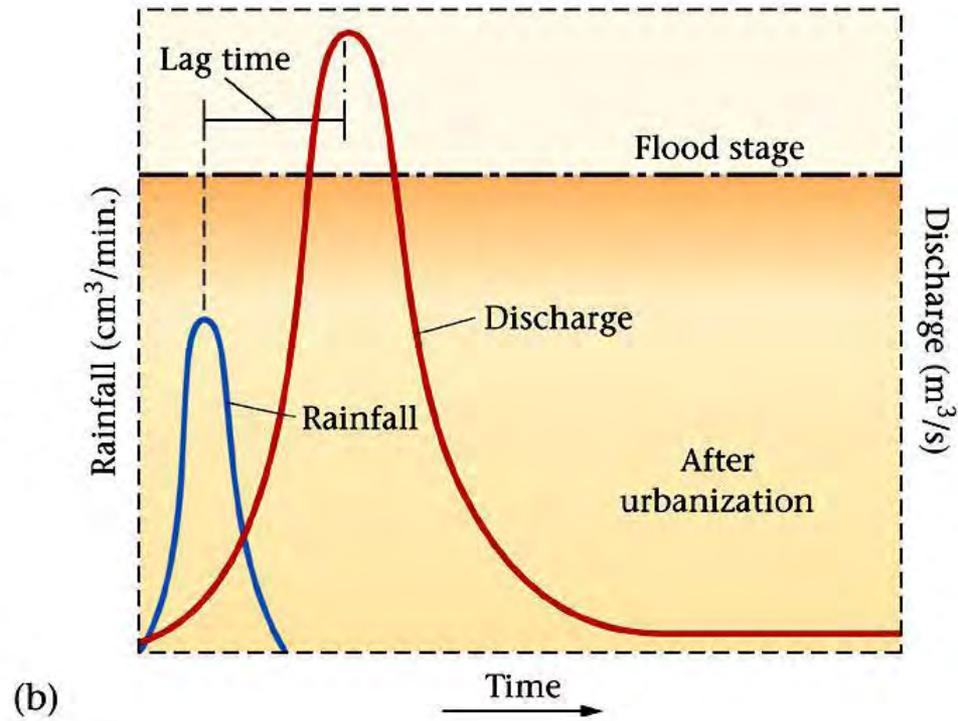
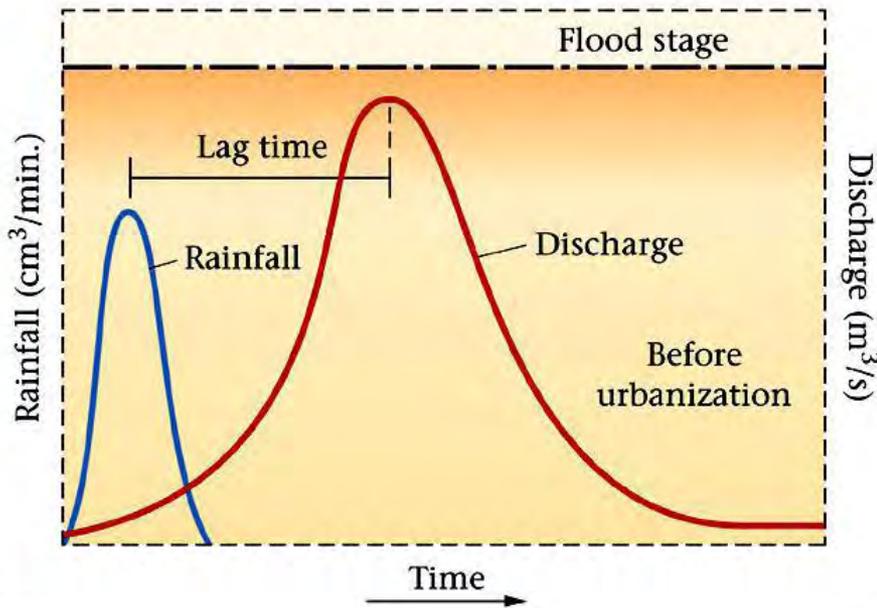
MBSS 1995-1997

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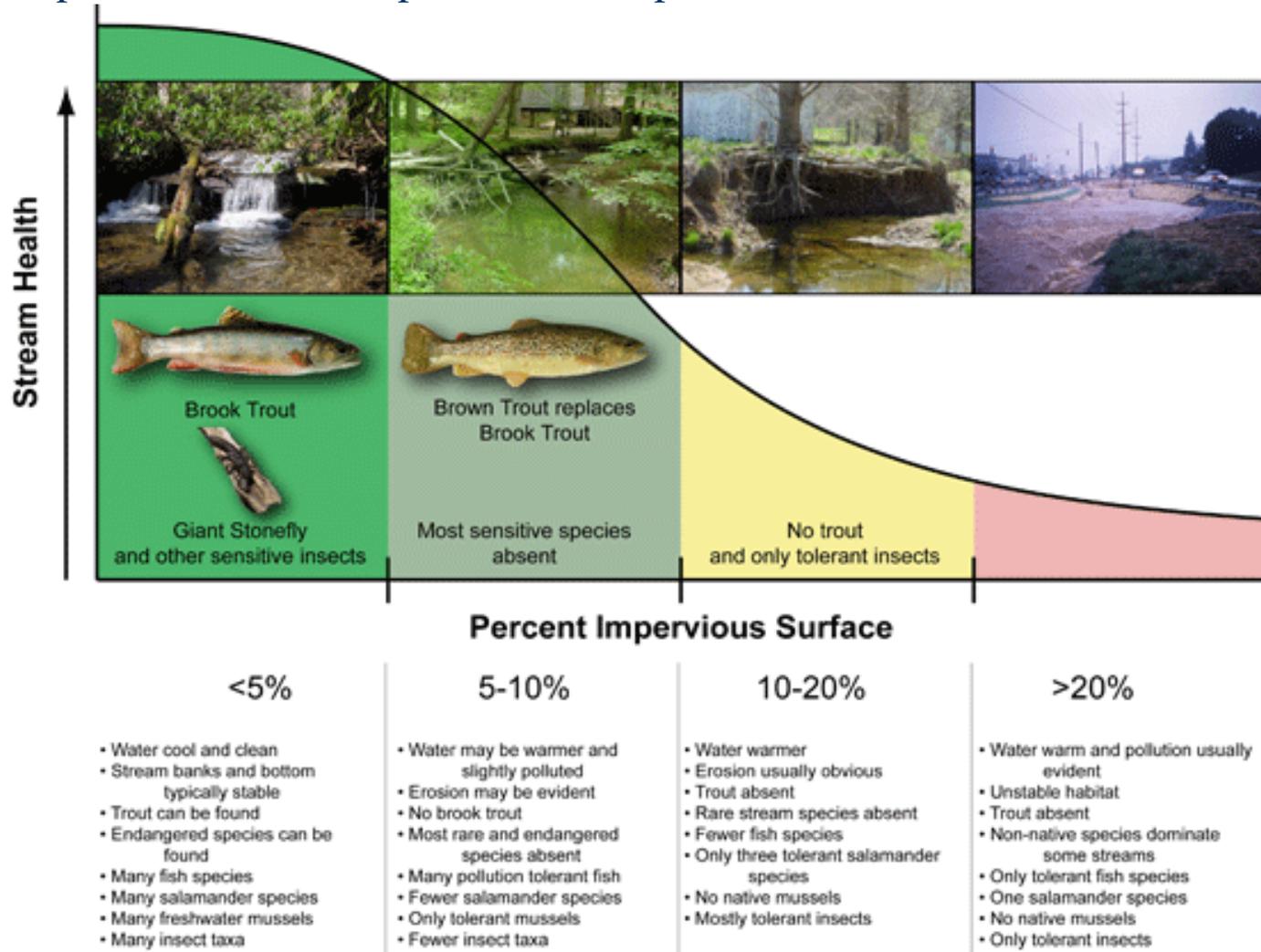


Effects of impervious surfaces on streams



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Expected relationship between impervious surface and stream health



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Getting to know your...



BUGS!

What are Benthic Macroinvertebrates?

- Associated with "bottom"*
- Visible to the naked eye
- >500 microns
- Fish food

*
during some part of life cycle

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Systematics (taxonomy) – the branch of Biology that deals with classification and nomenclature.

Kingdom

Phylum

Class

Order

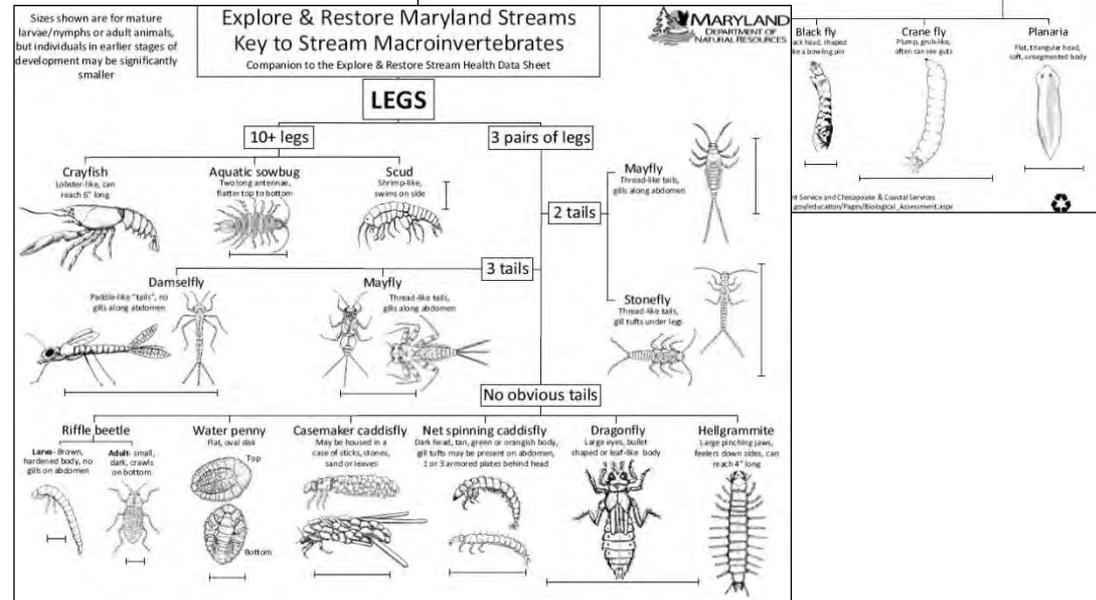
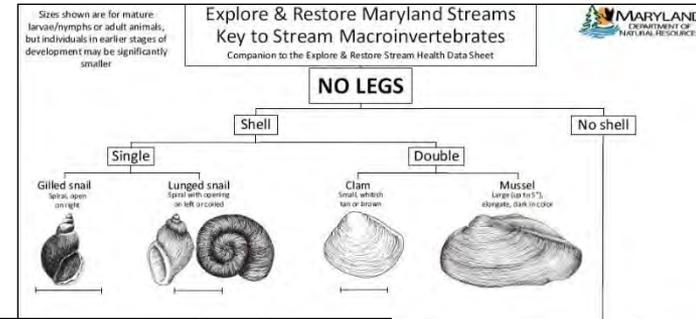
Family

Genus

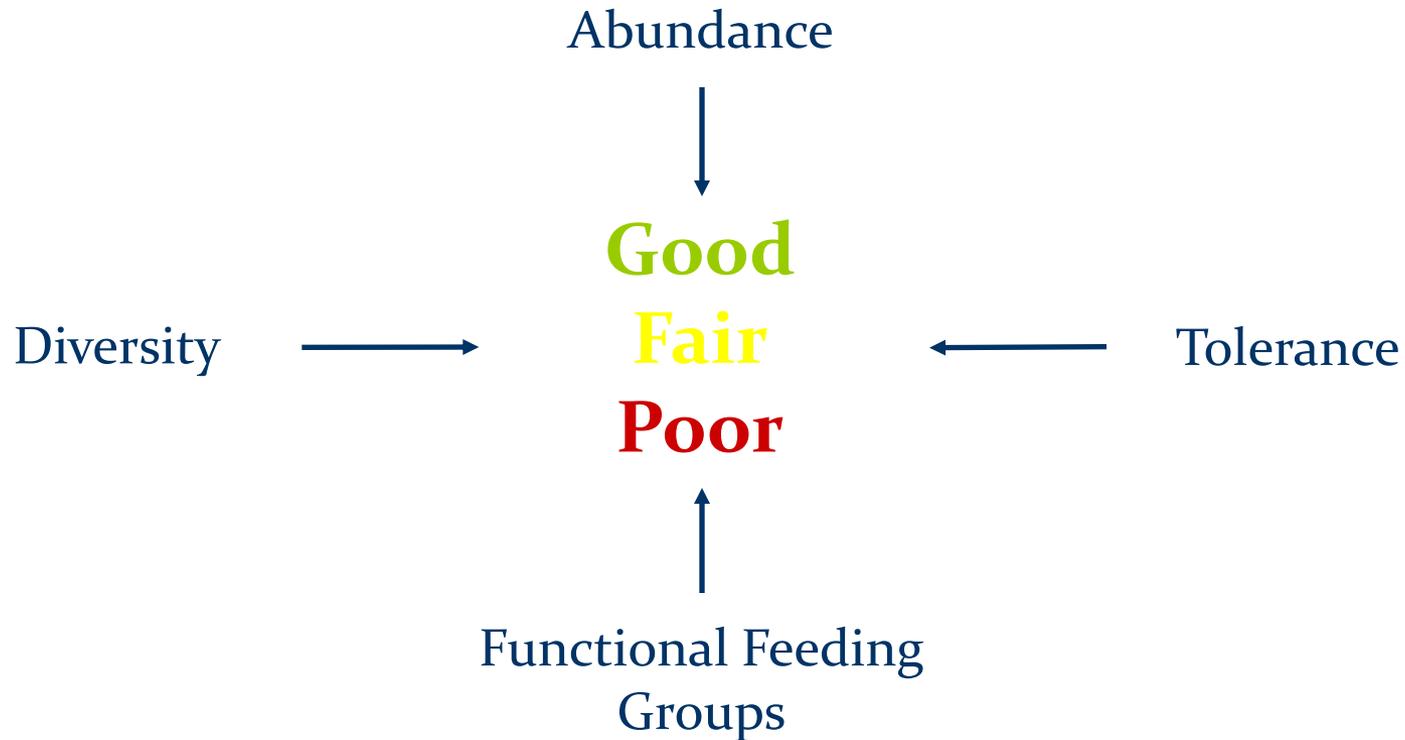
Species

Role as Bioindicators

- Pollution sensitive
 - Dissolved oxygen, temperature, turbidity, etc.
- Easy and inexpensive to collect
- Useful in long-term monitoring



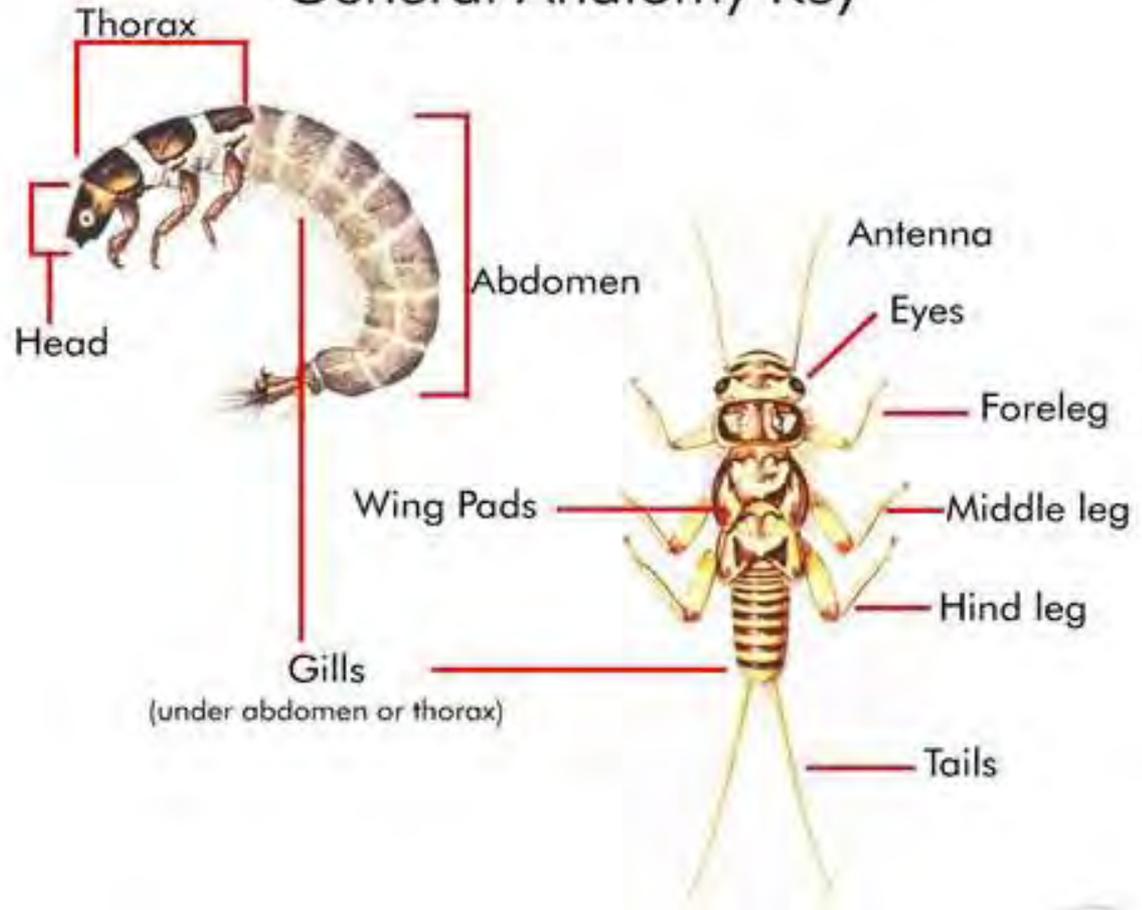
Index of Biotic Integrity (IBI)



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- 3 Major Body Parts
- Diagnostic Features:
 - Mouthparts
 - Legs
 - Abdomen length
 - Wing pads
 - Tails
 - Gills
 - Overall Shape

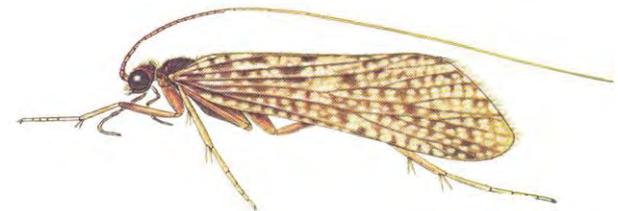
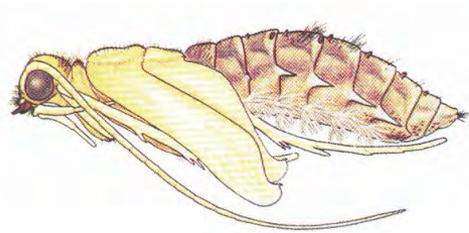
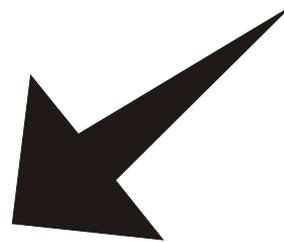
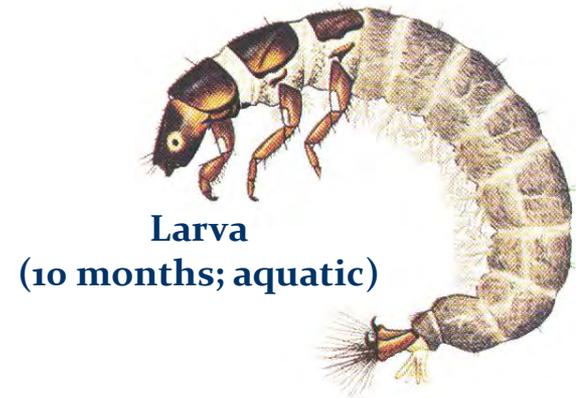
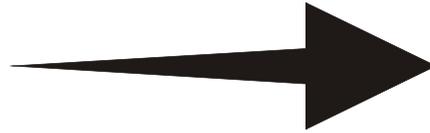
Stream Macroinvertebrate General Anatomy Key



Life History of a Caddisfly (Complete Metamorphosis)

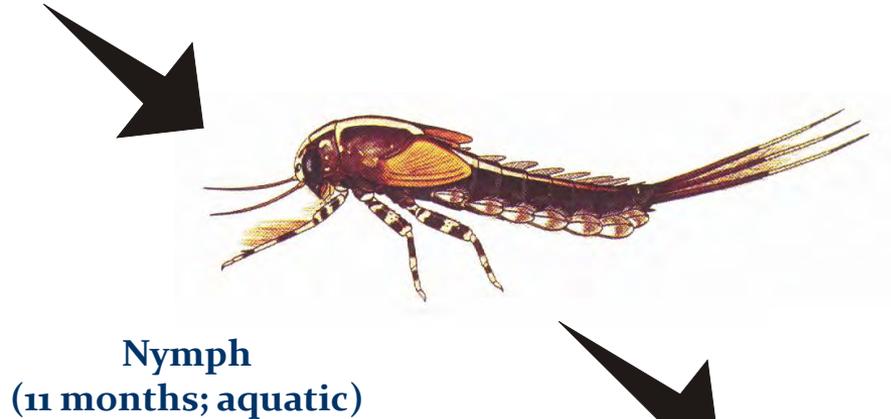


Egg
(1 week; aquatic)



Life History of a Mayfly (Incomplete Metamorphosis)

●
Egg
(2 weeks; aquatic)



Benthic Macroinvertebrate Identification



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This presentation only covers the benthic macroinvertebrates on the Explore and Restore Maryland Streams' Macroinvertebrate Survey. These are the most common benthic macroinvertebrates found in Maryland freshwater streams, but there are thousands of others you could encounter.

Biological Assessment: Macroinvertebrate Survey

Collection method:
Kick-Seine or D-Net (circle method used).
 If using a kick-seine, collect samples 3 times.
 If using a D-net, collect 20 scoops and record the number of scoops taken from each of the habitat areas in the table →

Benthic Habitat Sampled	
Habitat	# scoops
Riffle	
Rootwads/ woody debris/ leaf pack	
Submerged Vegetation	
Undercut Banks	
Other (specify):	
TOTAL	20



Thank you to Howard County Public Schools System biology students for their contribution to the development of this tool. 

Check all of the macroinvertebrates that you find in your stream and calculate the stream's water quality rating (you may also record the number of each captured, but to calculate the rating at the bottom, only count each kind of animal once, regardless of the quantity found).

<input checked="" type="checkbox"/> Sensitive to pollution	<input checked="" type="checkbox"/> Less Sensitive to pollution	<input checked="" type="checkbox"/> Somewhat Tolerant to pollution	<input checked="" type="checkbox"/> Tolerant to pollution
<input type="checkbox"/> Casemaker caddisflies	<input type="checkbox"/> Net spinning caddisflies	<input type="checkbox"/> Clams	<input type="checkbox"/> Aquatic sowbugs
<input type="checkbox"/> Mayflies	<input type="checkbox"/> Crane flies	<input type="checkbox"/> Mussels	<input type="checkbox"/> Black flies
<input type="checkbox"/> Stoneflies	<input type="checkbox"/> Dragonflies	<input type="checkbox"/> Planaria	<input type="checkbox"/> Midge flies
<input type="checkbox"/> Water pennies	<input type="checkbox"/> Riffle beetles	<input type="checkbox"/> Gilled snails	<input type="checkbox"/> Leeches
<input type="checkbox"/> Hellgrammites		<input type="checkbox"/> Crayfish	<input type="checkbox"/> Lunged snails
		<input type="checkbox"/> Scuds	<input type="checkbox"/> Damselflies
			<input type="checkbox"/> Aquatic worms
# of check marks	# of check marks	# of check marks	# of check marks
# above x 3 = ____	# above x 2 = ____	# above x 1 = ____	# above x 0 = ____

Biological Water Quality Rating:
 Add up the numbers you calculated for all three categories, above. Write the total # here: _____
 Circle the rating that corresponds to the total of your columns.

Good: > 22 Fair: 17 - 22 Marginal: 11 - 16 Poor: < 11

Explore and Restore Maryland Stream ratings correspond with the Maryland Biological Stream Survey and Maryland Stream Waders ratings of streams found on the Stream Health website. Stream sites rated Good are shown there in green, Fair sites are yellow, and Marginal/Poor sites are red. 

**STONEFLY-
Nymph**
Sensitive

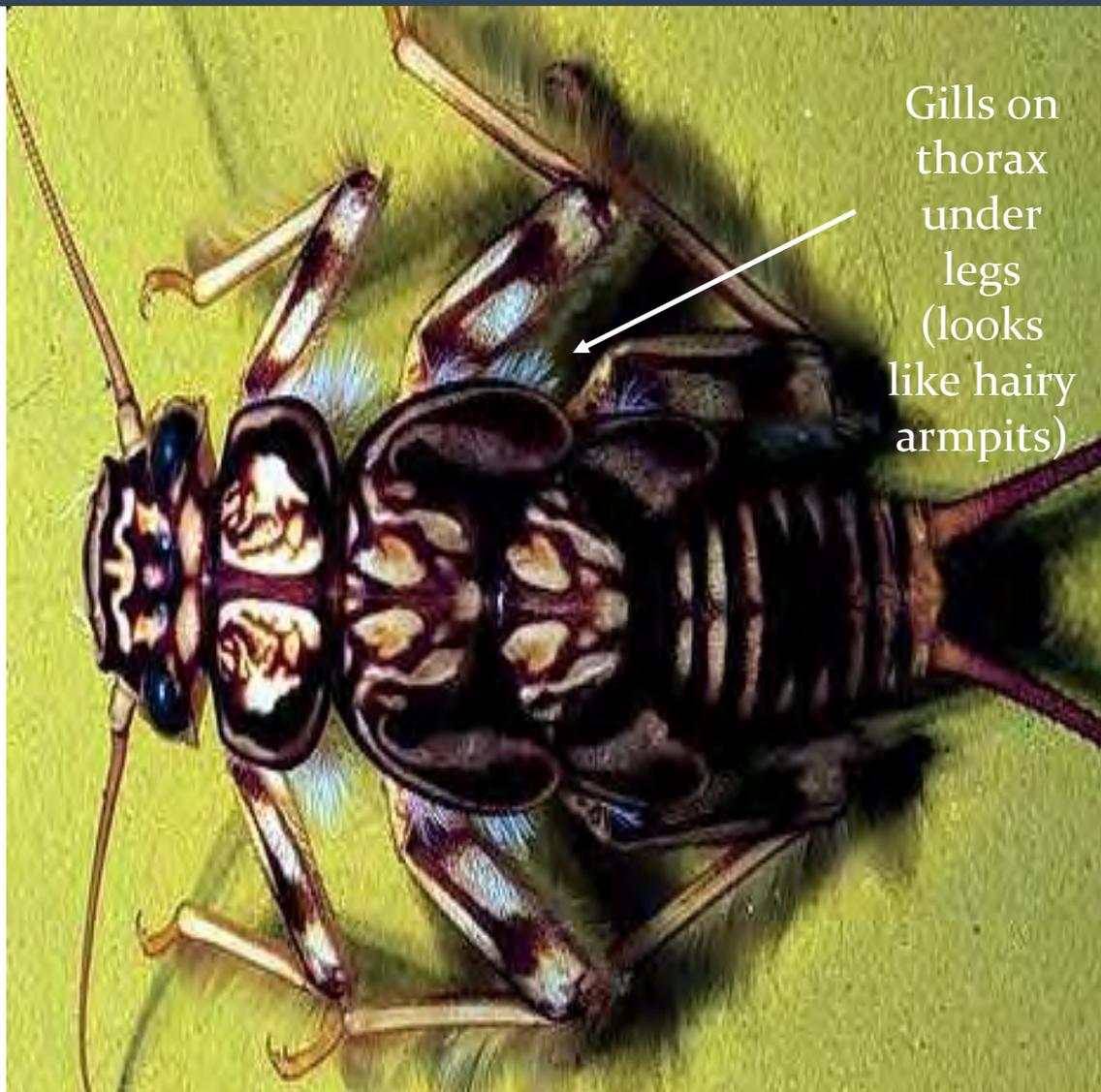


2 tails

**Order –
Plecoptera**

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Gills on
thorax
under
legs
(looks
like hairy
armpits)



©David H. Funk

STONEFLY - Adult

Order –
Plecoptera

<http://vimeo.com/90024767>

**MAYFLY-
Nymph**
Sensitive



3 tails (in most species, but not all)

**Order –
Ephemeroptera**



In classical mythology nymphs were nature spirits often inhabiting rivers, streams and lakes.



<https://www.youtube.com/watch?v=kB6RmFCmBoE>



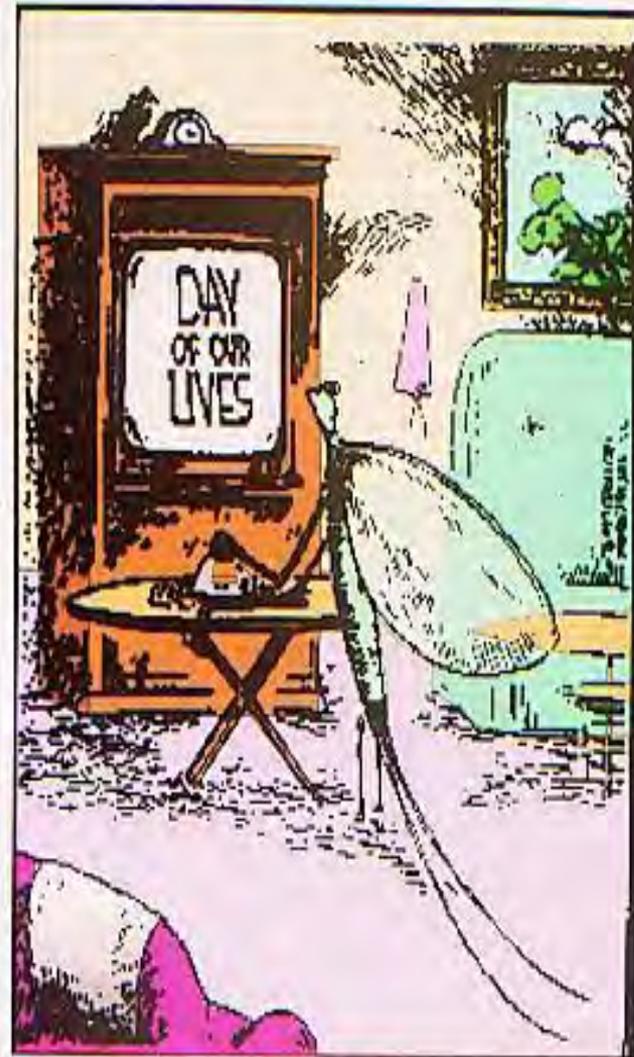
MAYFLY – Adult

**Order –
Ephemeroptera**

<http://vimeo.com/90024047>

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The order name Ephemeroptera translates to “short winged life”. Though they may spend over a year as a nymph, most species only live a day or two as adults, so they must find a mate quickly and reproduce before they die.



MAYFLY SOAP OPERAS

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When insects hatch in large swarms they overwhelm their predators so that many escape to reproduce. In 2014, there was a particularly large mayfly hatch in Wisconsin.



The hatch showed up on radar...



caused headaches for locals...



and was even blamed for a 3-car pile up.

http://www.huffingtonpost.com/2014/07/23/mayfly-hatch-wisconsin-photos-radar_n_5614449.html

Stonefly

vs.

Mayfly





CADDISFLY-

Case builder

Sensitive

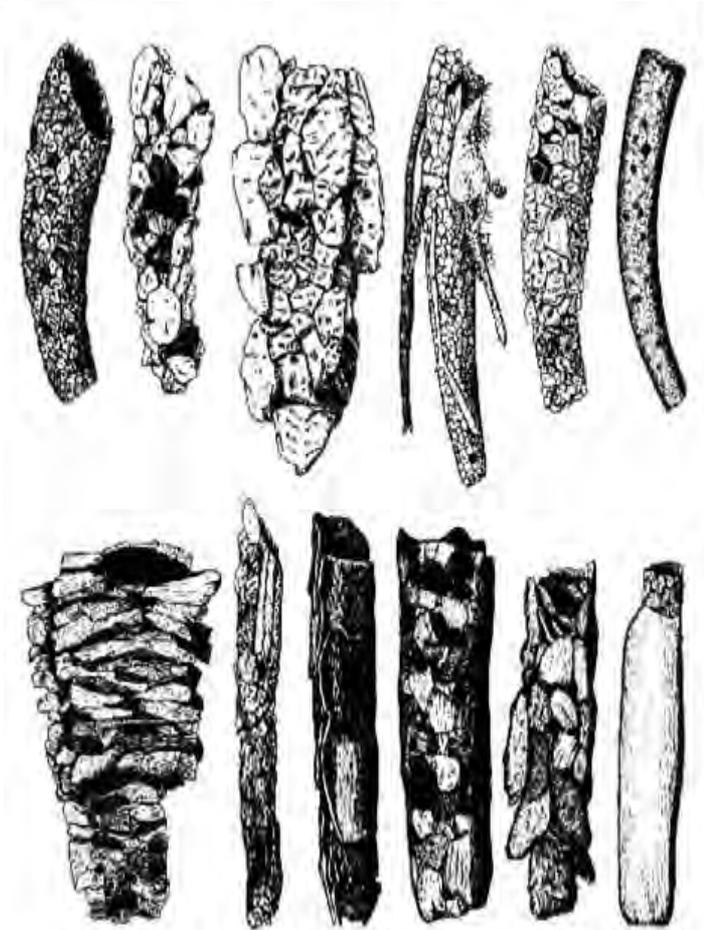
Order –
Trichoptera

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The structure of the case and the materials used in its construction varies among species.



CADDISFLY-

Net spinner

Less Sensitive

Order –
Trichoptera

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Some species of caddisflies build nets instead of cases. They use these nets to catch food (plankton, smaller insects). One caddisfly may build several nets which it will travel between to collect and eat its catch.



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Fingernet
caddisfly





CADDISFLY - Adult

Order –
Trichoptera

<http://vimeo.com/90025213>



HELLGRAMMITE

Less Sensitive

Order- Megaloptera

AKA: toe biters

Large predators. Some species reach 5 inches long. Capable of delivering a strong pinch. Feelers on abdomen are for respiration.

DOBSONFLY

(ADULT
HELLGRAMMITE)



Water Penny – Larva

Sensitive



Order – Coleoptera



Adult

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Water penny larvae generally like cold, fast moving water and are usually found in riffles where their flattened shape allows them to cling to the rocks without being swept away.



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RIFFLE BEETLE

Moderately
tolerant



Order – Coleoptera

Riffle beetles are one of the few benthic insects that live in the stream in both larval and adult form. The adults are lunged and are capable of carrying bubbles of air under their elytra (wing covers) and will replenish their air supply from bubbles in riffles and on aquatic vegetation. They must leave the water when they emerge as adults in order for their exoskeleton to harden, but they may never have to return to the surface again after that.

Riffle beetle larva vs. Net spinner caddisfly



G



DRAGONFLY – Nymph

Order – Odonata

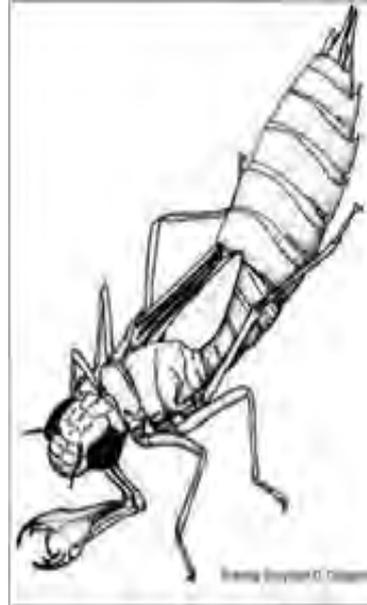
Less Sensitive

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**This is the
stuff that
nightmares
are made of**

Dragonfly and damselfly nymphs have a hinged mask over their mandibles that they can shoot out with remarkable speed to grab prey.



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Adult

Voracious
predators as
nymphs and
as adults

Nymph



A persistent hunter with slow motion
footage...

https://www.youtube.com/watch?v=pkOpWKyM_go

Amazing!



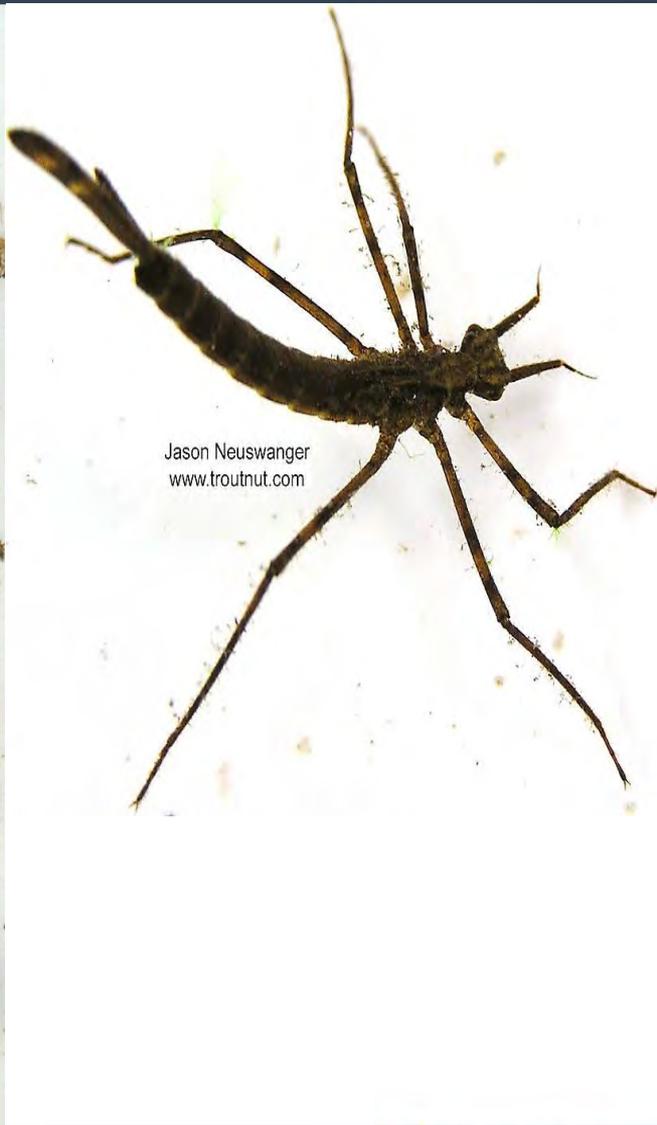
DAMSELFLY - Nymph

Order - Odonata

Tolerant

3 paddle-
like “tails”
are actually
the
damselfly’s
gills.

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Mayfly nymph vs. Damselfly nymph



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DAMSELFLY – Adult

Order – Odonata

Order – Diptera



Cranefly- Larva

Less Sensitive

©MARLIN E. RICE



Adult

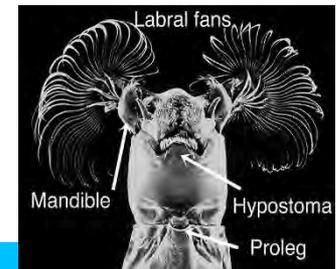




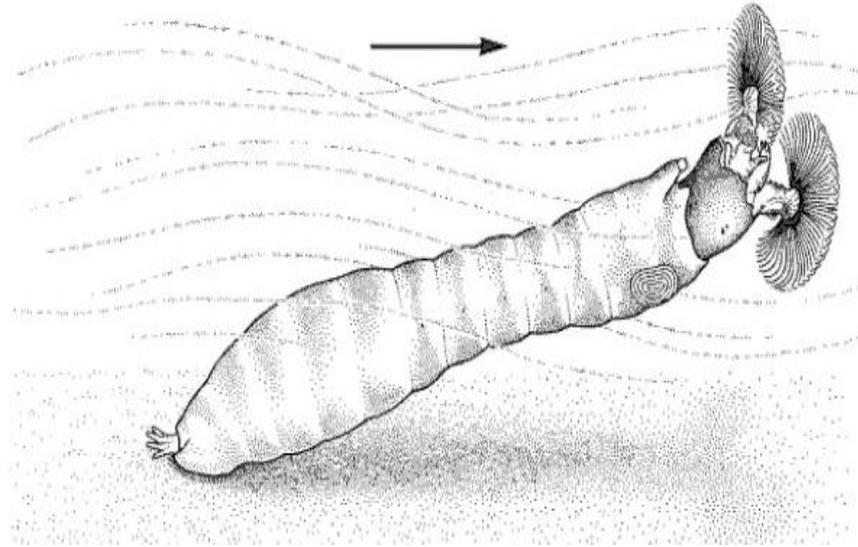
Blackfly- Larva

Tolerant

Order – Diptera



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Blackfly larvae make a sticky silk pad on their posterior to anchor themselves to the substrate. They will open their labral fans to filter their food out of the water and then sweep their fan through their mouth to eat it.

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NON-BITING MIDGE- Larva

Tolerant

Order – Diptera



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Adults look like
mosquitoes,
but do not bite.





Increased pollution in Lake Victoria, Africa has led to drastic population decreases in fish species in the lake. With their predators removed, non-biting midges have been experiencing population explosions resulting in swarms of horrific proportions. The midges emerge from the lake as adults in massive smoke-like clouds that bring misery when they make landfall

...but also have a surprising upside.

<https://www.youtube.com/watch?v=YcXsx8gpN9M>

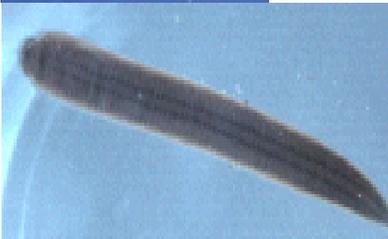


Awesome Resource!

<http://macroinvertebrates.org/>

Other Phyla

- Subphylum **Crustacea**
 - Crayfish, Isopods, Amphipods
- Phylum **Mollusca**
 - Snails, Clams, Mussels
- Phylum **Annelida**
 - Segmented Worms



Crustaceans

SCUDS →
(AMPHIPODS)
Somewhat Tolerant



← CRAYFISH
Somewhat
Tolerant

AQUATIC
SOWBUG →
Tolerant



Mollusks



CLAM
Somewhat
Tolerant

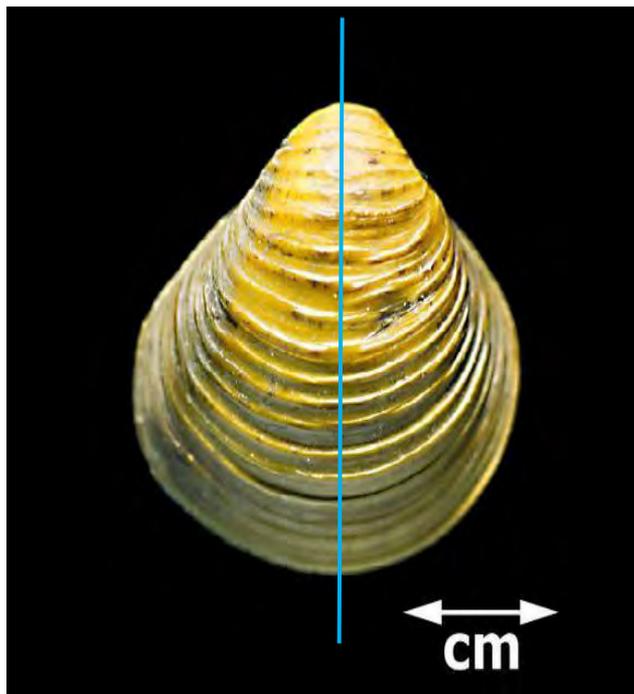


FRESHWATER MUSSEL
Somewhat
Tolerant

Clam

vs.

Freshwater mussel



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Freshwater mussels:

Deceptively fascinating

Almost all species of freshwater mussels use a fish host to spread their larvae, called glochidia (gluh-**kid**-ia). Their methods of transmission range from passive to deceptive to aggressive. By using a fish host as a vector of dispersal, the mussel increases the chances that its offspring will not be too near to a parent and so will not be competition for resources.



Left: A freshwater mussel displays a lure that bears an incredible likeness to a darter, enticing predatory fish to attack the lure and rupture the sac containing the glochidia. Right: The Northern Riffleshell mussel (not native to MD) clamps onto its intended host and holds it lightly while it inoculates the fish's gills with glochidia.

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A female mussel uses her lure to attract her host fish species

<https://www.youtube.com/watch?v=31qBrRawDK8>

Interesting work going on right here at home!

Bloede Dam on the Patapsco River is planned for removal! Removing Bloede Dam, the lowermost dam on the river, will open up more than 44 miles of spawning habitat for blueback herring, alewife and American shad, and more than 180 miles of habitat for American eel. The American eel is the host for Eastern elliptio mussel glochidia, so removal of the dam will open up all that habitat to the mussels as well.

<http://www.dnr.maryland.gov/streams/pdfs/patpascoFishPassageFactSheet.pdf>



American eel
(*Anguilla
rostrata*)



Eastern
elliptio
(*Elliptio
complanata*)

Identifying Right-handed vs. Left-handed snails

- Place the snail in your palm with the opening facing up and the umbo (spiral tip) pointing towards your fingers.
- If the opening is oriented to the right, it is a right-handed gilled snail and is sensitive to pollution.
- If the opening is oriented to the left, it is a left-handed lunged snail. The lunged snail has a sac-like lung, so it can escape out of the water for a short time if conditions are especially poor. This adaptation makes it pollution tolerant.



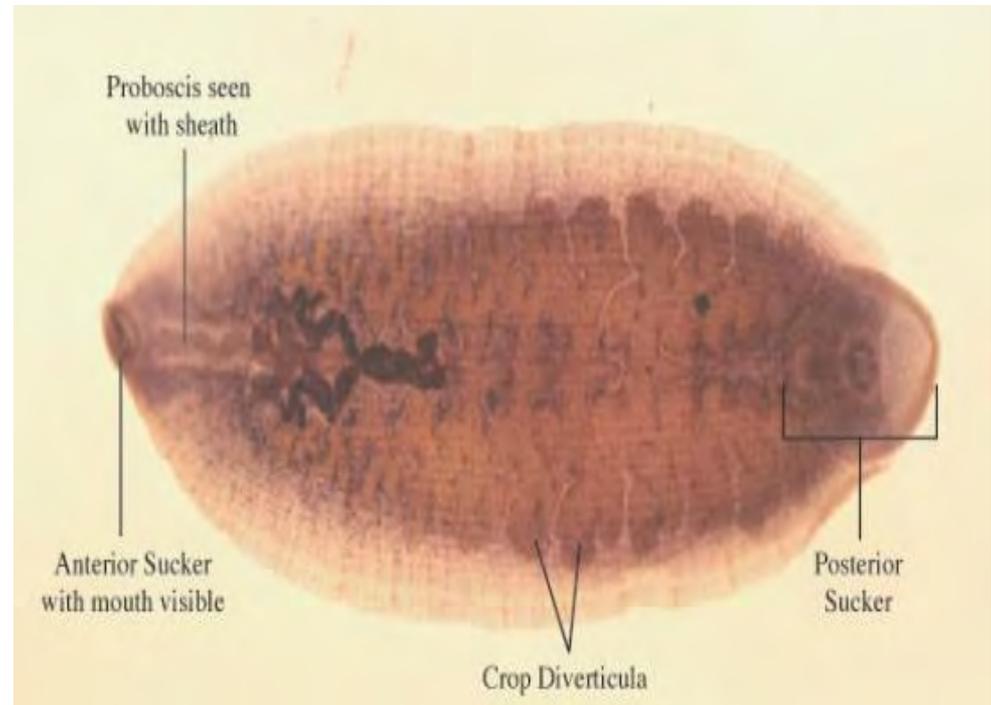
Gilled snail
(right-handed)
Somewhat
Tolerant



Lunged
snail
(left-handed)
Tolerant

LEECH

Tolerant



MARYLAND DEPARTMENT OF NATURAL RESOURCES

Explore and Restore Maryland Streams



This leech is pictured with young. While some species of leeches do care for their young, this is not a common trait.

Leeches can often be observed using an “inch-worm” type motion to get around. They will hold on with the posterior sucker while they sense and search out a direction with their front end. Then they’ll hold on with their anterior sucker while they catch their back end up.

AQUATIC WORM

Tolerant



aquarium-kosmos.de

Non-biting midge vs. Aquatic worm



Planaria

Somewhat Tolerant



Planaria move by slowly and steadily “gliding” over the surface of rocks or leaves.