OHSU-EP-1537

How can small organisms be big indicators of water quality?

Plants and animals can serve as indicators of ecosystem health. Sometimes the smallest organisms are the biggest indicators of water quality. Benthic macroinvertebrates, small aquatic animals or larval forms of insects, do not have a backbone and are bottom-dwelling organisms. Because macroinvertebrates spend their entire lives in a small area, they often show the effects of environmental changes. The species and number of benthic macroinvertebrates in a habitat are indicators of the health of an aquatic ecosystem. Some macroinvertebrates are more sensitive to pollution than others; finding many of these species typically indicates better water quality.

In this lesson students will 'collect' common benthic macroinvertebrates and then analyze quantitative data to determine the health of a variety of aquatic ecosystems.

Objectives

Upon completion of this activity, students should be able to:

- list basic characteristics of and identify common benthic macroinvertebrates.
- describe how to collect and sort benthic macroinvertebrates to assess water quality.
- explain how and why benthic macroinvertebrates serve as biotic indicators of the health of aquatic ecosystems.

Grade Levels

6 - 12 Life Science/Environmental Science

Time Required

Approximately 1-2 class periods

Materials

- *Benthic Macroinvertebrates* (http://ohioseagrant.osu.edu/p/pawy4) video presentation
- *Similarities and Differences, An Introduction to Benthic Macroinvertebrates, Small Organisms Big Indicators, and Sampling Benthic Macroinvertebrates* slide decks
- *Macroinvertebrate Reference Sheet*
- Student worksheet and assessment questions

Alignment

Stone Lab Field Trip Experience

Invertebrate Collection Walk

Great Lakes Literacy Principles

Principle 5: The Great Lakes support a broad diversity of life and ecosystems.
Principle 6: The Great Lakes and humans in their watersheds are inextricably interconnected.

Ohio's Learning Standards and Model Science Curriculum for Science

HS: Environmental Science - Earth Systems: Interconnected Spheres of Earth - ENV.ES.1 Biosphere (biodiversity, ecosystems)
HS: Environmental Science - Earth's Resources - ENV.ER.3 Water and Water Pollution (water quality)

Next Generation Science Standards (NGSS)

DCI: Life Science - LS2.C Ecosystem Dynamics, Functioning and Resilience
DCI: Life Science - LS4.C Adaptation
PI: Ecosystems: Interactions, Energy, and Dynamics - MS-LS2-4
PI: Ecosystems: Interactions, Energy, and Dynamics - HS-LS2-2, HS-LS2-6, HS-LS4-5
CC: Structure and Function; Cause and Effect - Analyze complex natural structures and systems to determine how they function.
CC: Structure and Function; Cause and Effect - Use cause and effect relationships to predict phenomena in natural or designed systems.
SEP: Analyzing and Interpreting Data - MS: Analyze and interpret data to provide evidence for phenomena.
SEP: Analyzing and Interpreting Data - HS: Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims.

Lesson

Engage

Display the *Similarities and Differences* slide showing five groups of benthic macroinvertebrates. Without using the term "benthic macroinvertebrate," guide students through a discussion using the following questions. Encourage students to cite evidence from the pictures to justify their answers.

- What similarities do you see among these organisms? How are they different? *Consider shape, size, body form, taxonomic group, and quantity*
- What are some ways fish differ in appearance? How are they similar?
- Are these organisms from the same or different taxonomic classes? *Different - mollusks, annelids (worms), crustaceans, insects*
- At what stage in a life cycle are these organisms? *Mostly juvenile (larvae or nymph), aquatic worms and snails adult*
- Do these organisms have backbones? *No*
- Do you need a microscope or a hand lens to see these organisms? *Either would be helpful for the smaller organisms but all can be seen with the naked eye.*
- How big are these organisms? Would you measure them in millimeters, in centimeters, in meters? *Millimeters and/or centimeters*
- In what kind of habitat would you likely find these organisms? *Aquatic, bottom dwellers in sediment or under rocks*
- Assume each picture contains organisms from a different stream or creek; the same size area of each waterway was sampled using the same technique for 10 minutes. Which set came from a habitat with good water quality? Which set came from a habitat with poor water quality? What evidence do you have to support those predictions?

Use these questions (particularly the last one) as a segue to introduce the driving question - How can small organisms be big indicators of water quality? - as well as key vocabulary: benthic, macro, invertebrate, larva, nymph, and exoskeleton.

Explore & Explain

Content is provided in both video and slide deck formats. It is the teacher's discretion how best to use the resources to build students' understanding. One potential sequence is described here.

Students first watch the *Benthic Macroinvertebrates* video and answer the accompanying questions on the Student Page. This can be done independently or as a whole group. Teachers can then review content using the slide decks:

- *An Introduction to Benthic Macroinvertebrates*: provides background information on benthic macroinvertebrates and how they are grouped by their feeding strategies. The first minute of the *Benthic Macroinvertebrates* video contains some of this content.
- *Small Organisms, Big Indicators*: explains how benthic macroinvertebrates can be indicators of water quality. Segment 1:00 - 1:40 of the *Benthic Macroinvertebrates* video contains this content.
- *Sampling Benthic Macroinvertebrates*: describes techniques for collecting benthic macroinvertebrates in a variety of aquatic habitats. Segment 1:40 - 12:55 of the *Benthic Macroinvertebrates* video contains this content.

Answers to Student Sheet

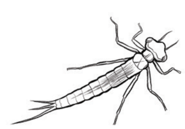
Watch, Read, Learn

1. *animal without a backbone ➔ invertebrate; on the bottom ➔ benthic*
2. *Pollution tolerant organisms can survive in a habitat that has sediment or chemical pollutants entering the body of water. Pollution intolerant organisms need a clean habitat with adequate oxygen, nutrients and shelter; they cannot survive in polluted waters. The absence of pollution intolerant organisms suggests a less healthy body of water than one where these organisms are found.*
3. *A ➔ edge vegetation; B ➔ pool; C➔ riffle*
4. *Riffle: current of relatively fast, shallow water over rocks; provides oxygen, food, and safe habitat under rocks; place the flat edge of the D-net in the sediment on the bottom with the opening facing upstream, gently kick in front of the net for 30 seconds to disturb and loosen benthic macroinvertebrates, slowly left the D-net forward and out of the water to capture organisms*
   Edge Vegetation: roots and vegetation along the edge that hang into water; provides habitat for macroinvertebrates; place roots in the D-net at the surface of the water and use your hands to squish vegetation and release macroinvertebrates into the net
   Pool: lack of a current results in slow or barely moving area of water; provides an optimal location for algae to grow and serve as a food source for benthic macroinvertebrates; use the D-net to lightly jab the bottom sediment and loosen organisms, run the D-net with the opening facing upstream for one to two meters
5. *Benthic macroinvertebrates can be collected from rocks by simply turning them over and using forceps or your fingers to carefully pick them off. Putting a piece of dead, decaying wood in a D-net and gently scraping it in water to release macroinvertebrates that may be attached.*
6. *Simply pouring water through an inside-out D-net can help ensure all benthic macroinvertebrates are out of the net.*
7. *A white tray is intentionally used to make it easier to see benthic macroinvertebrates.*
8. *No, because fish are vertebrates and not found used in determining the cumulative index value.*
9. *D-nets are used to collect benthic macroinvertebrates from the water. A microscope allows them to be viewed at many times their actual size to be able to accurately identify the organisms.*

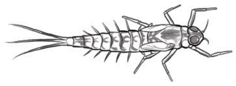
Practice

1. Name: *midge larva* Group: *C*

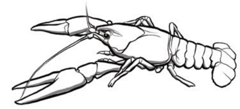
Name: *damselfly nymph* Group: *B*



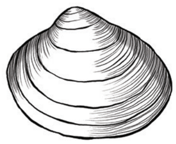
Name: *mayfly nymph* Group: *A*



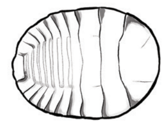
Name: *crayfish* Group: *B*



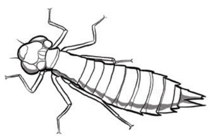
Name: *clam* Group: *B*



Name: *water penny* Group: *A*



Name: *dragonfly nymph* Group: *B*



Name: *left-handed pouch snail* Group: *C*

2. *Mayfly nymphs and water pennies are least likely to be in a pollited body of water as they are intolerant of the conditions.*
3. a mayfly nymph and a stonefly larva? *mayfly nymph - 3-section tail; stonefly nymph - 2-section tail*
a planaria and a midge larva? *planaria - unsegmented body; midge larva - segmented body*
a pouch snail and a gill snail? *pouch snail - opens to the left; gill snail - opens to the right*

Students then analyze data ‘collected’ from the Portage River. Looking at pictures of the ‘collected’ benthic macroinvertebrates, they use the *Macroinvertebrate Reference Sheet* to identify the organisms and calculate a cumulative index value.

Group A: mayfly nymph, right-handed gill snail, water penny, caddisfly larva	*(3 X 4 = 12)*
Group B: damselfly nymph, clam, crayfish, planaria, beetle larva, scud, isopod	*(2 X 7 = 14)*
Group C: midge larva, left-handed pouch snail	*(1 X 2 = 2)*
Cumulative Index Value	*28*
Water Quality Rating	*excellent (28 ≥ 23)*

Questions

1. *The Portage River has excellent water quality as its cumulative index value was 28. There were four types of macroinvertebrates from Group A, seven types from Group B, and only two types from Group C.*
2. *Not finding caddisflies (3 points), planaria (2 points), or scuds (2 points) would have lowered the cumulative index value to 21 which indicates good (not excellent) water quality.*
3. *Finding leeches in addition to the other Group C macroinvertebrates would not have changed the overall stream quality assessment rating. Without leeches, the cumulative index value was already over 23. Finding leeches would only add one point bringing the value to 29. The cumulative index value would still suggest an overall stream quality assessment rating of excellent.*
4. *Finding only macroinvertebrates from Groups B and C could suggest that some form of pollution (chemical or sediment) is in the waterway sampled. Group A macroinvertebrates are the least tolerant of pollution; the water quality is not good enough to support the Group A organisms.*

5. *It is possible to find no change in water quality. However if pollutants such as motor oils, gasoline, or cleaning chemicals enter the waterway, then it is possible that fewer types of Group A or B macroinvertebrates will be found. Fewer types of any macroinvertebrates in any group will lower the cumulative index value and could reduce the overall stream quality assessment rating.*
6. *Benthic macroinvertebrates are small organisms that live near the bottom or in the sediment of a body of water, or in the vegetation along the edge of it. They tend to stay in a general area for their entire life cycle which is relatively short. Benthic macroinvertebrates are relatively easy to collect and identify, and they are very sensitive to changes in their habitat or the water. Certain benthic macroinvertebrates are pollution tolerant and others are pollution intolerant. Knowing whether an organism is pollution tolerant or intolerant can provide insight into water quality. The more types of pollution intolerant species (e.g., mayfly nymphs, water pennies) found suggest better water quality. The absence of those and the presence of more types of pollution tolerant species (e.g. left-handed pouch snails, midge larvae) suggests water of lower quality.*

Elaborate and Evaluate

The following questions can be used to extend students' thinking, integrated into teacher-created assessments, or given to students as an exit slip (provided).

1. A stream was analyzed to determine the quality of its water. The organisms found in the stream are listed below. Use the data and reference sheet to determine the quality of the water in the stream.

Macroinvertebrate Data

GROUP A (pollution intolerant)	**Present**	**GROUP B** (exist in a wide range of conditions)	**Present**	**GROUP C** (pollution tolerant)	**Present**
Water Penny larva		Damselfly nymph	X	Blackfly larva	
Mayfly nymph	X	Dragonfly nymph	X	Aquatic worm	X
Stonefly nymph	X	Cranefly larva		Midge larva	X
Dobsonfly larva		Aquatic beetle larva		Left-handed pouch snail	
Caddisfly larva	X	Crayfish	X	Leech	X
Right-handed gill snail		Amphipod (scud)	X		
		Planaria			
		Isopod			
		Clam			
Number of species		Number of species		Number of species	
Number of species X 3		Number of species X 2		Number of species X 1	

Cumulative Index Value (Sum of group A, B and C totals) =

Stream Quality Assessment Rating: excellent (≥23), good (17-22), fair (11-16), poor (<11)

Answer: Water Quality Rating = (3x3) + (4x2) + (3x1) = 20 (Good)

2. Jillian missed school the week you were learning about how to determine water quality by identifying macroinvertebrates in the water. She looked at the data below and concluded that pond 1 had better water quality because it had so many more organisms in it than pond 2 did. Evaluate her statement. Is she right or wrong? Why?

Pond 1	Pond 2
8 Leeches 9 Midges 20 Scuds 8 Damselfly Nymphs	3 Stonefly Nymphs 2 Crayfish 5 Water Pennies 1 Leech

Answer: Jillian is incorrect. Just because there are more organisms does not mean Pond 1 has better quality water. The organisms collected from Pond 1 are more likely to be tolerant of pollutants than those found in Pond 2. The organisms in Pond 2 (particularly the stonefly nymphs and water pennies) are pollution intolerant suggesting better water quality.

3. Scientists have been studying water quality in three creeks for more than a decade. Cricket Creek runs through a schoolyard with practice soccer fields next to it. Midline Creek runs along a major road that cuts through the town. Meadow Creek is in a park near an undeveloped area just outside of the town. Macroinvertebrates are collected monthly from March through October at the same location in each stream. The average cumulative index for each stream is noted here:

Creek	Average Cumulative Index
Cricket	18
Midline	9
Meadow	24

Growing up Sara played in Cricket and Meadow Creeks every summer. She would regularly find mayfly and dragonfly nymphs, as well as water pennies. Years later she brought her daughter back to visit Meadow Creek. They found dragonfly nymphs and water pennies, but Sara noticed they were also seeing lots of crayfish, scuds and even aquatic worms. What do Sara's findings suggest? What might have caused these changes?

Answer: Sara's observations suggest the water quality of Meadow Creek is deteriorating. Crayfish, scuds and aquatic worms are more tolerant of pollutants than mayfly nymphs and water pennies. No longer seeing mayfly nymphs could suggest that the water in Meadow Creek is a lower quality now than in the past. Meadow Creek is near land that was undeveloped in the past. If development has happened since Sara was a child, runoff (e.g., sediment or chemical pollutants) could have contributed to the suggested lower water quality.

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How can small organisms be big indicators of water quality?

Name____

Plants and animals can serve as indicators of ecosystem health. Sometimes the smallest organisms are the biggest indicators of water quality. Benthic macroinvertebrates, small aquatic animals or larval forms of insects, do not have a backbone and are bottom-dwelling organisms. Because macroinvertebrates spend their entire lives in a small area they often show the effects of environmental changes. The species and number of benthic macroinvertebrates in a habitat are indicators of the health of an aquatic ecosystem. Some macroinvertebrates are more sensitive to pollution than others; finding many of these species typically indicates better water quality.

Procedure

1. Watch, Read, Learn: Watch *Benthic Macroinvertebrates* video (http://ohioseagrant.osu.edu/p/pawy4) and/or review the slide decks to complete the questions.
2. Practice: Use the *Macroinvertebrates Reference Sheet* to practice identifying benthic macroinvertebrates.
3. Analyze and Interpret: Analyze data to determine water quality.

Watch, Read, Learn

1. What word means …

… animal without a backbone? ____

… on the bottom? ____

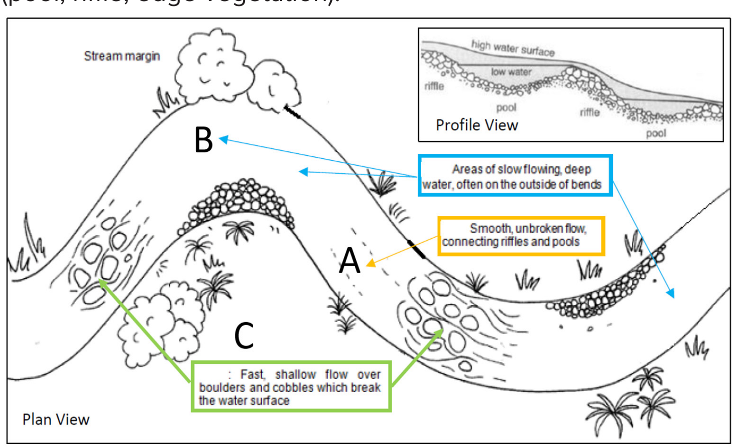
2. What is the difference between pollution-tolerant and pollution-intolerant organisms? What can they tell us?

3. Identify the various types of aquatic habitats typically sampled (pool, riffle, edge vegetation).

A ______________________________

B ______________________________

C ______________________________



4. Complete the chart. The information can be found from 2:40 - 6:15 in the *Benthic Macroinvertebrates* video.

	Riffle	**Edge Vegetation**	**Pool**
Physical Characteristics			
Benefits to Organisms			
Sampling Method			

5. Describe how to collect benthic macroinvertebrates from rocks and decaying pieces of wood.

6. Describe a simple technique for making sure all macroinvertebrates are out of the D-net.

7. What do you notice about the color of the tray where the macroinvertebrates are sorted? Why was that intentional?

8. Ian collected a few small fish while sampling. “Should we keep these for determining the cumulative index?” he asks. Finish this answer to Ian: “No, because . . . “

9. Explain the functions of D-nets and microscopes when sampling for benthic macroinvertebrates.

Practice

1. Identify the macroinvertebrates and their level of pollution tolerance.

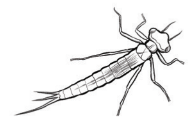
Group A: pollution-tolerant
Group B: somewhat pollution-tolerant
Group C: pollution-intolerant

Name: ________________________

Group: ________________________

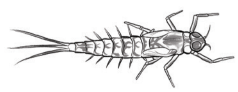
Name: ________________________

Group: ________________________



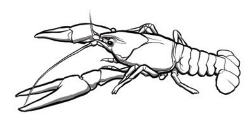
Name: ________________________

Group: ________________________



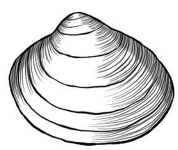
Name: ________________________

Group: ________________________



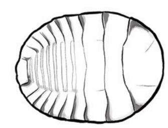
Name: ________________________

Group: ________________________



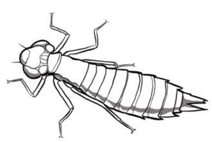
Name: ________________________

Group: ________________________



Name: ________________________

Group: ________________________



Name: ________________________

Group: ________________________

2. Which benthic macroinvertebrates are you least likely to find in a polluted stream?

3. What obvious characteristics would help differentiate between...

... a mayfly nymph and a stonefly larva?

... a planaria and a midge larva?

... a pouch snail and a gill snail?

Analyze and Interpret

Aquatic biologists collected benthic macroinvertebrates from the Portage River.

Use the *Macroinvertebrates Reference Sheet* to complete a water quality assessment for the Portage River.

Images of benthic macroinvertebrates found in the Portage River can be seen from 12:55 - 13:45 of the *Benthic Macroinvertebrates* video.

GROUP A (pollution intolerant)	**Present**	**GROUP B** (exist in a wide range of conditions)	**Present**	**GROUP C** (pollution tolerant)	**Present**
Water Penny larva		Damselfly nymph		Blackfly larva	
Mayfly nymph		Dragonfly nymph		Aquatic worm	
Stonefly nymph		Cranefly larva		Midge larva	
Dobsonfly larva		Aquatic beetle larva		Left-handed pouch snail	
Caddisfly larva		Crayfish		Leech	
Right-handed gill snail		Amphipod (scud)			
		Planaria			
		Isopod			
		Clam			
Number of species		Number of species		Number of species	
Number of species X 3		Number of species X 2		Number of species X 1	

Cumulative Index Value (Sum of group A, B and C totals) = _______

Stream Quality Assessment Rating excellent (≥23) good (17-22) fair (11-16) poor (<11) ________________

1. Describe the overall water quality of the Portage River. Provide evidence to support your claim.

2. How would the stream quality assessment rating of the Portage River have been affected if the caddisfly nymph, planaria, and scud were not found?

3. Would also finding stonefly nymphs in the Portage River change the overall stream quality assessment rating? Why or why not?

4. What could finding macroinvertebrates from only Groups B and C suggest?

5. Consider the impacts of a used car sales center that opens upstream from the sampling sites. If returning to analyze water quality one year later, what might you expect to find? What prediction could you make about the cumulative index value?

6. How can small organisms be big indicators of water quality? Be sure to describe the basic characteristics of benthic macroinvertebrates and their habitats, how identifying and classifying benthic macroinvertebrates are related to quantifying water quality, and what these values tell us about changes in water quality. Be sure to cite examples from the collected data.

How can small organisms be big indicators of water quality?

Name____

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Dobsonfly larva		Aquatic beetle larva		Left-handed pouch snail	
Caddisfly larva	X	Crayfish	X	Leech	X
Right-handed gill snail		Amphipod (scud)	X		
		Planaria			
		Isopod			
		Clam			
Number of species		Number of species		Number of species	
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excellent (≥23) good (17-22)
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9 Midges	2 Crayfish
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8 Damselfly Nymphs	1 Leech

3. Scientists have been studying water quality in three creeks for more than a decade. Cricket Creek runs through a schoolyard with practice soccer fields next to it. Midline Creek runs along a major road that cuts through the town. Meadow Creek is in a park near an undeveloped area just outside of the town. Macroinvertebrates are collected monthly from March through October at the same location in each stream. The average cumulative index for each stream is noted here:

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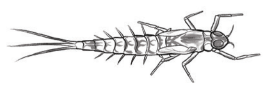
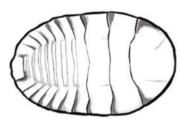
Macroinvertebrates

Examining the macroinvertebrates living in an area is one way we can assess the water quality of the lake. Using the following macroinvertebrate groupings, calculate the water quality of the sampled area.

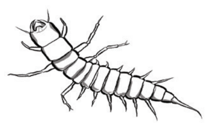
Group A (3 points for each kind found):

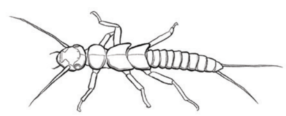
These organisms are generally intolerant of pollution, so their dominance in the water generally signifies good water quality. They do not survive in polluted water.


Mayfly nymph


Water penny (beetle larva)


Caddisfly nymph

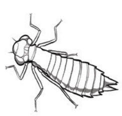

Dobsonfly larva

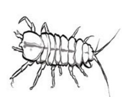

Stonefly larva


Right-handed gill snail

Group B (2 points for each kind found.):

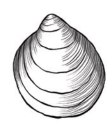
[illegible] ns car [illegible] rang [illegible] ity cor [illegible]


Dragonfly nymph


Isopod (sow bug)


Damselfly nymph

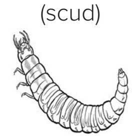

Amphipod (scud)


Clam


Dreissenid mussel


Cranefly larva


Planaria


Aquatic beetle larva

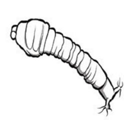

Crayfish

Group C (1 point for each kind found.):

These organisms are generally tolerant of pollution. Their dominance in the water usually signifies [illegible] ity.


Leech


Aquatic worm


Blackfly larva


Midge larva


Left-handed pouch snail

OHIO SEA GRANT AND STONE LABORATORY

An Introduction to Benthic Macroinvertebrates

Sea Grant
Ohio Sea Grant College Program

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

NOAA

Invertebrates

- Animals without a backbone
- Includes crustaceans, worms, arachnids, mollusks, and insects
- No internal skeleton → maintain body shape with
  - exoskeleton
  - fluid-filled sac
  - calcareous shell secreted by the organism

Benthic Macroinvertebrates

- **Macroinvertebrates** → larger-bodied invertebrates that can be filtered out of water and sediment using a sieve or net; often easy to identify with a hand lens or dissecting scope
- **Benthic Macroinvertebrates** → community of macroinvertebrates that spend all or portions of their life cycle living on the bottom of a water body buried in the sediment or living upon another organism

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Classifying Benthic Macroinvertebrates

Grouped by the type of food resource a particular species uses

Collectors

filter and gather food (black fly larvae, riffle beetles, clams, planaria)

Scrapers

scrape and feed on algae from surfaces of rocks and stream plants (mayfly nymph, snail)

Shredders

feed on pieces of organic matter (sowbug, scud, cranefly larvae)

Predators

feed on other water species of invertebrates (dobsonfly larvae, damselfly nymph, dragonfly nymph)

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Photo Credits

Slide 2

Stonefly nymph: Justin Wolbert

Aquatic worm: David H. Funk

Calcareous shell: Brian Alford

Slide 3

Caddisfly larvae: David H. Funk

Slide 4

Black fly larvae:

Mayfly nymph: Justin Wolbert

Cranefly larvae: R. Heringslack

Damselfly larvae/aquatic worm: Jan Hamrsky

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Sampling Benthic Macroinvertebrates

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College of Food, Agricultural, and Environmental Sciences

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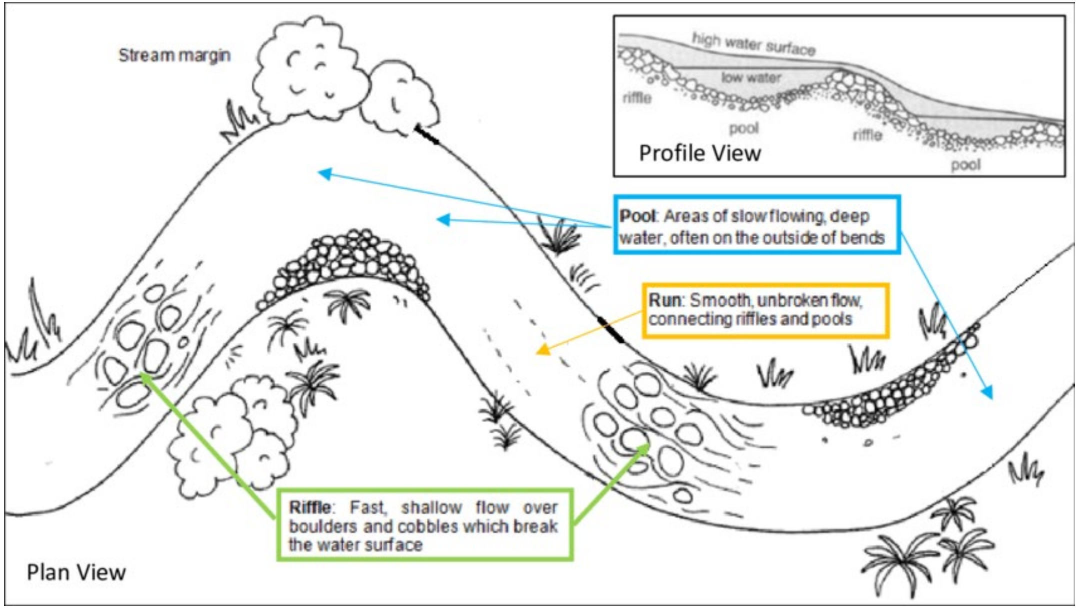
Where to Sample



How to Sample

D-frame dip net

forceps

white paint tray liner

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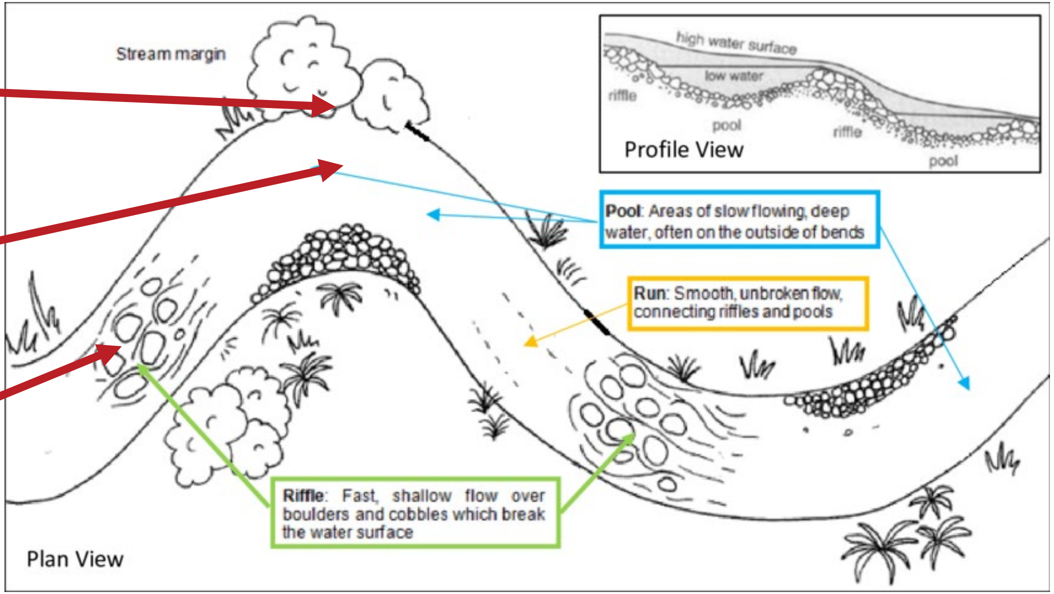
How to Sample

In Rootwads

In a Pool

In a Riffle



Sampling in a Riffle

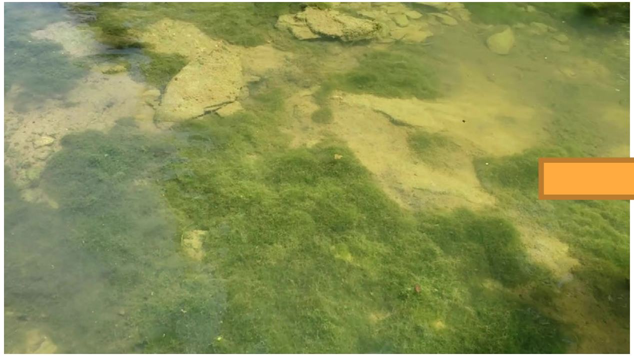
1. Place the dip net on bottom of the stream (opening facing upstream).
2. Kick in front of the dip net opening for 30-45 seconds.
3. Scoop forward and lift the dip net out of the water.

Sampling in a Rootwad

1. Place the dip net under the roots.
2. Squeeze and comb through the roots for 20-30 seconds.
3. Scoop forward and lift the dip net out of the water.

Sampling in a Pool

1. Lightly jab the bottom of the stream with the dip net while moving forward.
2. Scoop forward and lift the dip net out of the water.
3. Turn over rocks to look for benthic macroinvertebrates on the underside.



Sampling Under Rocks

1. Turn over rocks or pieces of wood to look for benthic macroinvertebrates on the underside.
2. Pick off macroinvertebrates using forceps; be sure to look at all sides of the rock or piece of wood.

Photo Credits

<u>Slides 2 and 4</u>

Fuller, J.E., 2018, Defining Ordinary and Natural Conditions for State Navigability Determinations. Arizona Geological Survey Contributed Report CR-18-B, 135p.

<u>Slides 5, 6, 7, 8</u>

Brian Alford

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Similarities and Differences

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Ohio Sea Grant College Program

Source: Freshwater Benthic Macroinvertebrate Services

Source: G. Carter via NOAA/GLERL

Source: Environment Canada

Source: Roaring Fork Conservancy

Source: West Virginia Department of Environmental Protection

Driving Question

How can small organisms
be big indicators
of water quality?

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Small Organisms, Big Indicators

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College of Food, Agricultural, and Environmental Sciences

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Why Collect Benthic Macroinvertebrates

1. Spend all - if not most - of their life in a relatively small area
2. Relatively stationary compared to most fish
3. Typically complete their life span in 1 to 3 years
4. Easy to sample and identify using a hand lens or dissecting scope
5. Respond rather quickly to changes in their habitat

Why Collect Benthic Macroinvertebrates

Some species are highly intolerant to chemical and sediment pollution (meaning they will die or move out of the area).

Some species are tolerant of chemical and sediment pollution (meaning they can survive in those conditions).

All of these organisms can be found in healthy, pristine ecosystems.

When habitats become degraded by pollution:

- the pollution-tolerant species will become the dominant species in the community
- the pollution-intolerant species will be very uncommon or completely absent from the community