

Lesson 6: Analyzing a Leaf Pack

Lesson Summary:

Students will examine the leaf-packs created in Lesson 3 and discover which macroinvertebrates live in their local stream ecosystem. Students will identify and group macroinvertebrates based on feeding mechanisms. Students will use their data to create simple graphical representations and look for correlations about where different macroinvertebrates live in the stream.

Materials:

- Plastic spoons, turkey basters, and ice cube trays or petri dishes
- Buckets or dishpans for rinsing and separating invertebrates from leaves
- Hand lenses and/or dissecting microscopes
- 70% ethanol solution – used to preserve animals (optional)

Knowledge and Skills Developed:

- Students will be able to identify aquatic macroinvertebrates
- Student will be able to classify macroinvertebrates into different feeding groups based on observed characteristics
- Students will be able to analyze and interpret macroinvertebrate data

Next Generation Science Standards

Practices	Crosscutting Concepts
<input type="checkbox"/> Asking questions <input type="checkbox"/> Developing and using models <input type="checkbox"/> Planning / carrying out investigations <input checked="" type="checkbox"/> Analyzing / interpreting data <input type="checkbox"/> Math / computational thinking <input type="checkbox"/> Constructing explanations <input type="checkbox"/> Engaging in argument from evidence <input type="checkbox"/> Obtaining / evaluate / communicate	<input type="checkbox"/> Patterns <input type="checkbox"/> Cause and effect: Mechanism / explanation <input type="checkbox"/> Scale, proportion, and quantity <input type="checkbox"/> Systems and system models <input type="checkbox"/> Energy / matter: Flows, cycles, conservation <input checked="" type="checkbox"/> Structure and function <input type="checkbox"/> Stability and change
Disciplinary Core Ideas and Concepts LS2.A: Interdependent Relationships in Ecosystems <ul style="list-style-type: none"> • Organisms and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. 	

Environmental Literacy Strands

2. Physical, living and human systems
 - b. Structure, function, interaction and change in living systems. Explain the dynamic and interconnected nature of Earth's living systems

Teacher Background Information:

Stream ecosystems have many different microenvironments. The conditions in these microenvironments vary greatly which influence the necessary adaptations for success in these microenvironments. The difference is so great that it is possible to model biodiversity by measuring the species diversity in different areas of the stream.

Riffles and Pools are two microenvironments, which vary greatly. Riffles are areas in a stream where water moves very swiftly. Usually these areas are shallow; the organisms that inhabit these areas must be able to cling to the substrate. Furthermore, these areas are usually narrow and have lots of overhanging vegetation, which falls and gets caught in the riffle. Many shredders and collectors live in these areas of the stream. Pools, on the other hand, are slow moving, deep areas of the stream; in these areas there is less large organic matter and many of the macroinvertebrates are either collectors or grazers.

Preparation:

You or the students should collect the leaf-packs made in lesson 3 and store them in cold water until students are able to analyze them. Organisms can be kept alive overnight by placing them in a bucket with cool water outdoors, or by using an air bubbler indoors. If you will not be able to use macroinvertebrates right away, you can preserve them in a 70% ethanol solution.

Introduction:

Remind students of the leaf packs that they created in Lesson 3 and have them review their datasheets and hypothesis. Let them know that they are going to get a chance to analyze their leaf packs and make conclusions about their hypothesis.

Procedure:

1. Return leaf packs to students and have them open them up and visually compare them to one that did not get put in the stream (have an example leaf pack that has not been placed in the stream for them to compare theirs to).
 - How have your leaf packs changed? Why? **The leaf pack from the stream will look black and the leaves will be smaller. The black slime on the leaves is the biofilm that has developed over the past weeks. This is made up of microbes that start the breakdown of the leaf material.**
 - Why does a leaf pack make a good home for a macroinvertebrate? **In addition to providing shelter, macroinvertebrates like to eat the biofilm that has colonized the leaves. Biofilm can be compared to peanut butter on a rice cake, it contains the nutrients that the organisms need while the leaf material passes through the gut of the organism and emerges in feces as fine particulate organic matter.**
2. Have students re-weigh their leaf packs and compare to their original weight or look at how the total area has changed by matching leaves up to drawings done in lesson 3. Record onto Lesson 6 datasheet along with observations.

3. Before identifying the organisms, facilitate a group discussion that prompts students to identify factors that would affect how fast an intact leaf will decay. Initiate the discussion with questions, such as:
 - Why does food go bad faster when it is left out rather than kept inside the refrigerator? **Temperature, microbes.**
 - What might cause physical breakdown of leaves in streams? **Turbulence, abrasion.**
4. Have students explore their leaf packs. They can pick out the macroinvertebrates by using tweezers or by placing leaf packs into a dish tub with water and picking leaves apart, make sure students keep riffle and pool samples separate. Have students separate macroinvertebrates into ice cube tray and use identification charts and books to help ID macroinvertebrates. Have students record their findings onto a StreamWebs datasheet (one for riffle and one for pool).
5. Have students determine which of the four functional feeding groups their macroinvertebrates belong to. Students can use the table provided in the Lesson 6 datasheet as well as make observations that help them determine groups.
6. Discuss briefly:
 - How many different types of macroinvertebrates species did they find?
 - Is that a lot or a little for this microhabitat-the leaf pack?
 - Does this number of different types of species represent biodiversity for the leaf pack? Why or why not? **Leaf packs would need many different kinds of species to truly represent biodiversity.**
 - Which of the four functional feeding groups did they see?
 - How many shredders vs. grazers, etc. were in pools vs. riffles?
 - How can we demonstrate these differences? (Graphing!)
7. Have the students brainstorm the best way to represent the data (possibilities are pie charts, bar charts, line graphs). Demonstrate by drawing one of each on the board and explain that each bar or segment of the pie should be its own color and represent separate feeding data. Demonstrate how to label the graph, each piece, and the axes if a bar graph. Students (individually, or with a partner) should make graphs that represent at least one of their findings.
8. Have the students present their data to another group or in front of the class, depending on what data their group chose to represent, have them address:
 - Are there differences between the pools and riffles? Why?
 - Are there differences in the functional feeding groups?
 - What combination of abiotic and biotic factors might influence what we observed?
 - Why aren't all of the organisms in both environments? What are the characteristics of these microhabitats that might affect what lives there?

9. Closing discussion

- What could have affected whether, and which, organisms colonized the leaf packs? The distinguishing abiotic conditions of riffles and pools result in specialized environments that are known as microhabitats. The abiotic conditions (dissolved oxygen, turbidity, light and temperature) of these microhabitats can influence which aquatic species can survive and reproduce at that given location and time.
- How did the materials that you put in the packs affect what organisms you saw? The leaves themselves will influence what will colonize them (i.e. shape, size, type). Have students think about food they might eat. For example, deciduous leaves might be likened to a potato chip and coniferous leaves to Brussels sprouts (or some other stinky green vegetable).
- Did we get a good representation of biodiversity? Biodiversity and water quality health are determined by the different kinds of macroinvertebrates that are present, not just the number of each individual species. For example, a leaf pack from a site with poor water quality may have more macroinvertebrates than one from a good water quality site, but the number of different kinds will be low. Chances are, it will have only one or two bugs that are tolerant to more pollution, or another sort of disturbance. Having lots of different kinds of species is what provides biodiversity in a certain environment.

* At the end of the lesson have students save a few macroinvertebrates from each feeding group and put into a small aquarium with a bubbler or in a cold area to use in the following lesson. Also have students save their datasheets.

Extension 1:

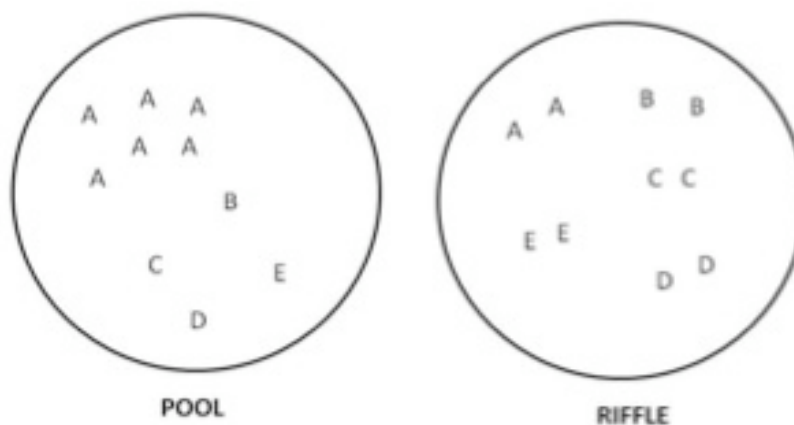
1. Remind students about how macroinvertebrate assemblages can give us insight into the water quality of a stream. Scientists use macroinvertebrates data to help them to determine the levels of pollution in streams.
2. Place a blank StreamWebs Macroinvertebrate datasheet on the overhead (use separate datasheets for riffles and pools). Let students know that scientists use these data sheets to determine the quality of the water and as a class you are going to compile data and do the same.
3. Do one data sheet for riffles and pools and have students raise their hands if they found one of the organisms that you call off. Once all of the data is listed ask students what it tells us about the quality of water.

Extension 2:

1. Assess biodiversity in riffle and pool microhabitats by compiling all of the student data. The level of biodiversity in an ecosystem can be determined using the following values:

- Species richness – the number of species in a community
- Species evenness – the relative abundance of individuals within each species

While knowing the number of different species in a community is good to know, it is also important to know the abundance of individuals in each species. For example both your riffle and pool samples may have 10 total individuals and five different species (A, B, C, D, E). In the diagram below the pool is dominated by one of the five species, while the riffle has the same five species but in equal proportions. In this case the riffle would have higher diversity.



2. Assess the biodiversity of the habitats your class explored by examining the following:
 - Do the species differ between the two microhabitats? Have the students hypothesize why there might be differences.
 - Look at the total number of individuals in the pools vs. the riffles. Did one microhabitat have more than the other? Why or why not?
 - Look at the specific numbers of individuals in each species and the numbers of different species. How do these differ between microhabitats? Why?

Resources:

Working With Data: Cary Institute of Ecosystem Studies

<http://www.caryinstitute.org/educators/teaching-materials/yes-net/young-environmental-scientists-network-stream-ecology-unit-3>



Share your field data quickly and easily using StreamWebs. Find out what the macroinvertebrates you found say about your stream, keep track of your photopoints, graph water quality data, upload a video, and much more.

www.streamwebs.org

Name: _____

School: _____ Teacher: _____

Date: _____ Time: _____ Weather: _____

Stream/Site Name: _____ Time spent sorting/identifying: _____







of people sorting/identifying: _____ ☐ Riffle ☐ Pool

Directions:


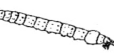







1. Record the number of each type of organism found in the # found column of each section.
2. Then circle the number in the score column (3, 2, or 1) if any of that organism was found.
3. Complete the equation at the bottom by adding up the circled numbers from each score column.

SENSITIVITY TO POLLUTION




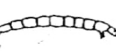


Sensitive / Intolerant

	# found	score
caddisfly 		3
mayfly 		3
riffle beetle 		3
stonefly 		3
water penny 		3
dobsonfly 		3
Sensitive TOTAL =		

Somewhat Sensitive

	# found	score
clam/mussel 		2
crane fly 		2
crayfish 		2
damselfly 		2
dragonfly 		2
scud 		2
fishfly 		2
alderfly 		2
mite 		2
Somewhat Sensitive TOTAL =		

Tolerant

	# found	score
aquatic worm 		1
blackfly 		1
leech 		1
midge 		1
snail 		1
mosquito larva 		1
Tolerant TOTAL =		

<input type="text"/>	Sensitive total
+	<input type="text"/>
	Somewhat sensitive total
+	<input type="text"/>
	Tolerant total
=	<input type="text"/> Water Quality Rating
<input type="checkbox"/>	Excellent (>22)
<input type="checkbox"/>	Good (17-22)
<input type="checkbox"/>	Fair (11-16)
<input type="checkbox"/>	Poor (<11)

Lesson 6: Analyzing a Leaf Pack Worksheet

1. Re-weigh your leaf packs and compare to your original weight. What differences do you observe? If there is less leaf matter explain why.

Pool	Riffle

2. After you have sorted and identified your macroinvertebrates using the ***StreamWebs data sheet***, determine how many macroinvertebrates you collected from the following four feeding groups.

Functional Feeding Group	Description	Pool	Riffle
Shredders Crane fly larvae, case-building caddisfly larvae, stonefly nymphs, scuds, and sowbugs	Feed on large pieces of organic matter such as leaves, twigs, fruit, and grass.		
Collectors Mussels, brush-legged mayfly larvae, some caddisfly larvae, midges, and blackfly larvae	Feed on particles that float through the water or are settled on the substrate. Many collectors use net-like structures to capture food		
Grazers Snails, flathead mayfly larvae, waterpenny, Beetle larvae, and some caddisfly larvae	Feed on algae and other microbes by scraping them off of rocks and other stream surfaces.		
Predators Crane fly larvae, dragonfly nymphs, damselfly, stonefly nymphs, dobsonfly, fishfly larvae, crayfish, beetles, water bugs	Capture other living organisms and use them as their primary food source. Predators either pierce their prey and just feed on the inside, or they engulf their prey whole.		

3. Which of the four macroinvertebrate feeding groups: grazers, shredders, collectors, and predators, did you see the most of in your leaf packs? Why might that be?

4. How did what you put in your leaf pack affect the type of macroinvertebrates that found?

5. Revisit the hypothesis that you made in Lesson 3. As a class, determine whether leaf packs put in riffles or pools had more of which organisms. Why do you think this might be?