

Shared Waters: Making a positive impact on our local watershed



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Lesson 8: Identifying Aquatic Macroinvertebrates

(1 day)

Overview:

Did you know there is a whole living world underneath the surface of a stream? The variety of organisms that live in a stream tells us whether a stream is healthy! Aquatic macroinvertebrates are "bugs" that live in water; some are very sensitive to pollution and can't survive in polluted streams. **If you find these pollution-sensitive aquatic macroinvertebrates in your stream, it indicates that the stream is healthy.**

Let's break down exactly what an aquatic macroinvertebrate is.

- **Aquatic** = Lives in the water.
- **Macro** = Large enough to see without a microscope. Macroinvertebrates may be as small as your eyelash or as big as your thumb!
- **Invertebrate** = Does NOT have a backbone.

Some macroinvertebrates are highly sensitive to pollution and environmental changes, making them valuable **bioindicators** of stream health. The presence or absence of highly sensitive organisms in a stream can help determine the water's quality. Some macroinvertebrate species are tolerant of pollution, surviving in both high- and low-quality water. If you **only** find pollution-tolerant macroinvertebrates in the water, the water is likely not healthy. Unpolluted, healthy waters have a variety and diversity of pollution-sensitive and pollution-tolerant macroinvertebrates!

In this lesson, we will see what aquatic macroinvertebrates live in the stream we tested for chemicals in lesson 7. We know about the chemicals in the water; now, we get to explore what living organisms call the stream home. Studying what lives in the water will give us additional information about the health of our stream.

Materials:

Materials provided in the lesson 8 kit:

- **Activity 1:** n/a
- **Activity 2:** mesh bags
- **Activity 2:** ice cube trays, paint brushes, hand lenses, spoons
- **Activity 2:** one [bio indices data sheet and Macroinvertebrate identification key](#) for each group of students.
- Reading Connection: [Creek Critters by Jennifer Keats Curtis with Stroud Water Research Center](#)

Materials you will need to gather:

- [Lesson 8 slide show](#)



- **Activity 1:** Laptop/tablet with internet access
- **Activity 2:** dried native leaves
- **Activity 2:** stream water to place your leaf in 3-4 weeks BEFORE the lesson
- **Activity 2:** 5-6 plastic wash basins or large bowls for sorting

Websites:

- Virtual Leafpack: <https://leafpacknetwork.org/virtual-stream-study/>

Additional resources you can choose to purchase:

- ***Activity 2:** [Leaf Pack Kit®](#) - this is a great all-in-one kit for leaf packs that you may consider purchasing.

Learning Objectives:

At the completion of the lesson, students will be able to:

- Identify aquatic macroinvertebrates
- Estimate the health of the stream by identifying what aquatic macroinvertebrates live there.

Preparation Before the Lesson:

Unlike other lessons in this unit, this lesson requires a lot of preparation.

Please review all local and State laws regarding the collection of macroinvertebrates.

Pennsylvania Teachers will need the following:

- [Valid fishing license](#)
- [Type IV Special Permit Educational Exemption to Fishing License](#)

Read the [Where to Sample](#) (page 70) for the necessary background on distributing, collecting, and storing your prepared leaf packs. **Note – you need to put your leaf packs in the stream 3-4 weeks before doing the activity, so plan ahead!**

You can carry out this activity either at the stream or in your classroom. If you opt for the classroom setting, you will need to collect the leaf packs in a 5-gallon bucket filled with stream water on the morning of the activity. It's important to keep the leaf packs cool and away from direct sunlight. Additionally, we suggest using an air pump or aquarium bubbler to maintain the dissolved oxygen levels in the water. If you're doing this activity in the classroom, take a picture of the stream where the leaf packs were collected and insert it into the presentation to give students an idea of the habitat.

Macroinvertebrates need water to breathe. Keep the leaf packs completely submerged in water from the creek. Store the leaf packs in the 5-gallon bucket before and after sorting. Remind students to add water from the bucket to the sorting trays when they are working to identify the macroinvertebrates.



Activity 1 (30 min): Leaf Pack Simulation® from the Leaf Pack Network®

Introduce the essential question to the class: "What do the tiny creatures called macroinvertebrates living in the stream tell us about how clean and healthy our stream is?" Encourage students to share their ideas before explaining that macroinvertebrates can provide valuable insights into the health of a stream within our watershed because different species of macroinvertebrates have different levels of tolerance to pollution and environmental changes. Their presence or absence can indicate the water quality and overall condition of the stream. For example, the presence of pollution-sensitive species such as mayflies, caddisflies, and stoneflies suggests good water quality, while an abundance of pollution-tolerant species like certain worms and leeches and an absence of sensitive macroinvertebrates might indicate poorer conditions. By studying the diversity and abundance of these organisms, we can assess the stream's health and, by extension, the overall health of our watershed.

Explain that all kinds of pollution come into our waterways, from plastics to nutrients to chemical wastes. However, these waterways can be sources of drinking and recreation water and are home to many kinds of wildlife. It is very important to know if streams are healthy, and macroinvertebrates are a great indicator of this! Mention that we will look at the macroinvertebrates today through a study of leaf packs. Using the [Leaf Pack Simulation](#), students can do a virtual stream study. The webpage for the simulation provides [simple instructions](#) directly below the simulation for easy use. In the simulation, students can choose from four different types of streams to study. For this activity, students only need to complete the "Habitat" and "Macroinvertebrate" tabs in the simulation.



Activity 2 (45 min): Leaf Pack Experiment

Start by tapping into students' prior knowledge about living things. Ask them to name three basic things that all organisms on Earth need to survive. The answer is food, water, and shelter. Explain that leaf packs in the stream provide macroinvertebrates with all three of these essentials: food, water, and shelter. To find out what macroinvertebrates live in our stream, we made pretend leaf packs to see who moves in. Tell the students, "We placed packs of leaves from local trees in the stream underwater for 3-4 weeks." This way, we can see which tiny creatures make these leaf packs their home."

Before starting the activity, have students make a prediction about the health of our stream, choosing from Poor, Fair, Good, or Excellent. Working in small groups, each group will receive a [bioindices data sheet and macroinvertebrate identification key](#). They will also have an ice cube tray filled with stream water, a bin containing stream water and leaves from the leaf pack, spoons, hand lenses, and paintbrushes. The paint brushes and spoons will be used to carefully transfer macroinvertebrates from the bin with the leaves into the ice cube tray for observation and identification using the key, and their findings will be recorded on the datasheet.

If you can visit a stream with your class, you can simply have students turn over rocks in the stream. If they look closely, they should find macroinvertebrates on the underside of the rocks.

Directions:

Now it's time to start sorting through the leaf packs to look for macroinvertebrates!

1. Get a **white bin** and an **ice cube tray** and carefully **add stream water** from the bucket to both.
2. **Place a small handful of leaves in the bin**. Make sure the leaves stay wet so the macroinvertebrates **stay alive!**
3. **Look carefully** through the leaves for macroinvertebrates. Use your paintbrush to gently remove each organism you find. You can see them with your eyes, a hand lens, a macro lens, or a microscope.
4. Place the macroinvertebrates into the ice cube tray, **sorting "like with like."** This means that macroinvertebrates of the same type can share the same cube in the tray, but **different types of macroinvertebrates should be placed in different cube segments**.
5. **Match** the macroinvertebrates in the ice cube tray to the macroinvertebrates **on the identification sheet**.
6. After sorting and removing all the macroinvertebrates from the leaf pack, it's time to **tally the stream's health score!**
7. On the Biotic Index Data Sheet, count the number of each type of macroinvertebrate you find and **record this number in the box** on the sheet.
8. Remember: **Macroinvertebrates that are more sensitive to pollution are worth more points!** As a class, you will combine data to determine your stream's final health score (the biotic index).



9. As a class, use the data from each group to determine if the stream's health is Excellent, Good, Fair, or Poor.

Possible Lesson Adaptations:

While not ideal, this lesson can be completed solely online using the Leaf Pack Simulation® from Activity one.

Possible Extension:

You can choose to participate in a citizen science project and share your students data by joining the [Leaf Pack Network®](#), an international network of teachers, students, and citizen monitors investigating their local stream ecosystems. To join the Leaf Pack Network® you will need to follow the instructions in the [Leaf Pack Network Manual](#) in the preparation, placement, and collection of your leaf packs.

Possible Differentiation Adaptations:

If you can access a digital microscope, project the macroinvertebrates on the screen. Students love seeing the creatures move on the screen. Drawing attention to distinguishing parts of the organisms' anatomy will also help students identify them.

Some students are squeamish around macroinvertebrates (e.g., spiders, insects, and anything slimy). One way to desensitize students is to put pictures of various macroinvertebrates around the classroom at the beginning of the unit. The photos will help to reduce the squeamish factor and incite curiosity. The macroinvertebrates.org website has excellent images in its resource tab that can be downloaded at <https://seetolearn.weebly.com/resources.html#images>

Assessment:

Students will complete the Biotic Index Data Sheet and use the data to determine if the stream health is Excellent, Good, Fair, or Poor.

Reading Connection:

[Keats, J., Stroud Water Research Center, and Saroff, P. \(2020\). *Creek Critters*. 1st ed. Mount Pleasant, SC. Arbordale Publishing.](#)



Additional Resources:

Do you want more information on aquatic macroinvertebrates or wish to extend this lesson beyond a single class period? Explore the Leaf Pack Network® (LPN) (<https://leafpacknetwork.org/>), the international network of teachers, students, and citizen monitors investigating their local stream ecosystems using artificial leaf packs. Resources on the LPN website (<https://leafpacknetwork.org/resources/>) include manuals with a deeper background on macroinvertebrates, free extension activities, and various webinars/videos!

- Leaf Pack Network Manual ([Leaf Pack Network Manual](#))
- [Dichotomous Key Macroinvertebrate Identification Presentation](#)
- [Clickable Macroinvertebrate Dichotomous Key](#)
- The Water Quality Mobile App (<https://wikiwatershed.org/water-quality-app/>)
- Macroinvertebrates.org Website (<https://www.macroinvertebrates.org/>)

