

Macroinvertebrate Adaptations

A Supplemental Activity to Macroinvertebrates.org

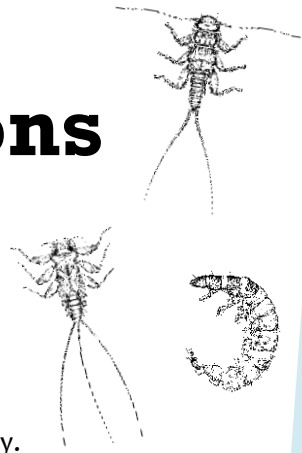
Suggested Grade Level: 4th – 6th grade, but may be adapted for other learning levels.

Suggested Time Duration: 30 minutes, but may be part of a longer stream study.

Materials:

- Printed Macroinvertebrate Adaptation Cards – 1 set per class. Lamination optional for durability.
- Adaptations of a Mayfly Student Handout - 1 per student. Alternatively, project on board for all to see.
- Computer and Projector for Large-Group Viewing of Macroinvertebrate Adaptation PowerPoint *
- Live Specimen and Sorting/Identification Materials *

*Optional expansion of activity



Introduction:

This activity introduces students to the unique adaptations of **benthic aquatic macroinvertebrates**, or “stream bugs” that 1.) inhabit the bottom (*benthic*) substrates of bodies of water (*aquatic*); like streams, rivers, lakes, or ponds; 2.) are big enough to see with the naked eye (*macro*, 0.2 – 0.5 mm); and 3.) lack a backbone (*invertebrates*). Aquatic macroinvertebrates play important roles in freshwater food webs and can also be living indicators of water quality. Although macroinvertebrates include non-insect animals like crayfish and mussels, many macroinvertebrates are insects that spend the first part or all of their lives underwater. Aquatic macroinvertebrates have evolved many **adaptations**, or changes to their physical body (how they look) or behavior (how they eat, move, breathe, etc.) to make them a good fit for their underwater environment. These adaptations can be defining characteristics for species and families, and the diversity of adaptations reflects the incredible diversity of macroinvertebrates!

Educators may utilize this adaptations-focused activity alone, or use it as an introductory component of a 50+ minute stream study with live macroinvertebrates. If macroinvertebrate specimens are available, either preserved for demonstration or live as part of an interactive stream study, these help students concretely connect concepts. The activity may also help reinforce students’ existing understanding of insect anatomy (e.g., head, thorax, abdomen) and life cycles (e.g., egg, larva, pupa, adult).

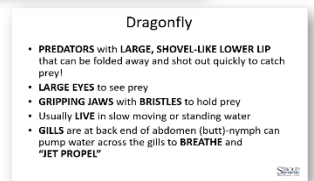
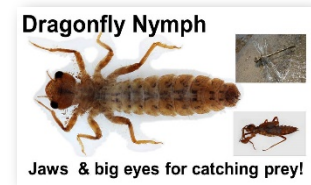
Learning Objectives:

Students will be able to...

- **Observe** how adaptations in body and behavior help macroinvertebrates survive life in a stream.
- **Communicate** how adaptations vary among different kinds of macroinvertebrates as important identifying features.
- **Evaluate** why biodiversity, or the variety of life (organisms) in a particular habitat or ecosystem, is important to healthy streams.
- * **Analyze** how changes to a macroinvertebrate’s habitat, including through human land use, pollution, and stewardship, can affect the organism’s ability to survive.
- * **Identify** macroinvertebrates in a local body of water and **calculate** water quality using a biotic index.
- * **Evaluate** positive impacts humans can have on their watershed, including their schoolyard and surrounding habitats, to support the needs of a wide variety of aquatic macroinvertebrates.

Preparation:

1. Print Macroinvertebrate Adaptation Cards (recommended on 11"x17" paper) double-sided. To increase durability for re-use, laminate cards. For each of the 7 macroinvertebrates (Caddisfly Larva, Black Fly Larva, Mayfly Nymph, Dragonfly Nymph, Water Penny Larva, Stonefly Nymph, Crane Fly Larva), one side should feature images of the animal, and the other should be text on their adaptations.
2. If needed to support students' unique learning needs, plan in advance your student small groups. Groups should consist of 3-6 students to ensure all groupmates actively participate, with each group assigned 1 of the 7 macroinvertebrates. Depending on how the number of macroinvertebrates divide among the number of students in your class, you may choose to use fewer (e.g., 5) of the macroinvertebrates available.



Activity:

STEP 1: Class Discussion: Introduce "Aquatic Macroinvertebrate." (5-10 minutes)

1. Drawing on students' prior knowledge, discuss what kinds of animals are "bugs." Students typically think of insects, but they may also mention worms, spiders, or "roly-poly" pillbugs. Do these bugs have backbones? No, so they are **invertebrates**.
2. Explain that today we are studying invertebrates, but the type of invertebrates we're studying live underwater for some or all of their lives, and they aren't teeny-tiny microorganisms or microbes that require a microscope to see them. Today's animals are the opposite of MICRO; they are MACRO! We call them **aquatic macroinvertebrates**. There are many different kinds of macroinvertebrates that call streams and rivers home, where they each tell a very important story about the stream. Some are so sensitive to pollution, their presence or absence in a stream may tell us whether the stream is healthy!
3. Macroinvertebrates include non-insect invertebrates like worms, crayfish, snails, and mussels/clams, but many of them are young insects. What process will they go through one day to change from a larva or nymph into an adult? (*metamorphosis*) What insects do you already know of, perhaps on land, that go through metamorphosis (*ladybugs, butterflies, etc.*)? Brainstorm names of familiar insects. The educator should point out any insects from this brainstorm that live their larval and/or adult stages in streams (*dragonfly nymphs and some kinds of caterpillars/butterfly larvae*).
4. If time allows, draw a generic insect body with help of participants. If age-appropriate, identify the insect anatomy together: head, thorax, abdomen. What adaptations do insects share to help them survive (e.g., 6 legs in adults, antennae, many are winged). Discuss the unique life cycles and common larval stages of aquatic macroinvertebrates.

STEP 2: Small Groups: Observe Adaptations. (10 minutes)

5. Split students into small groups of 3-6 individuals and distribute one macroinvertebrate card to each group. Each card is a macroinvertebrate that is an insect in its juvenile or larval stage (larva or nymph).
6. Ask each group to look at which macroinvertebrate they have and read the back to find out what kinds
7. of adaptations it has. Some key words are in BOLD for them to remember. They will identify their favorite adaptations to later present these to their classmates!

8. Instruct students to work together to read the adaptations on the back side of their card and consider the images on the front. Can students identify these adaptations in the images on the front side? How do these adaptations help their animal survive life in a stream? Have they observed these adaptations in other animals before (e.g., gills in fish)?
9. As small groups complete this at their unique pace, they should decide as a team which adaptations (s) are their favorite. They will share these with the class!
10. Educator should “float” to ensure all groupmates are participating. Participation may include non-verbal active listening and observing with team members, but all students should be engaged! Groups who finish early should consider who and how they will present to the class.

STEP 3: Class Presentations: Communicate Adaptations. (15 min)

11. Instruct each group, one at a time, to present their animal to the class (~2 min. each) and their favorite adaptation(s). Students should be sure their classmates can see the images on the front side of the card while sharing in their best speaking voices. All group members should help present, but this participation may not be verbal for all groupmates; educators should adapt the presentation format in a capacity that is sensitive to their students’ unique needs. One option is to bring up the corresponding presentation (where you printed the images from!) to have the macroinvertebrate large in the background for student groups to use while presenting.
12. When all groups have presented and returned to their seats, the teacher should display Adaptations of a Mayfly on a big screen or go through student handouts. As a class, moving in the order below (Legs, Gills, Antennae...) or engage students by having them call out a new adaptation, one at a time.
13. As you move through each adaptation, ask students what they think that adaptation is for. Then, reveal the answer, giving students time to fill in the information on their own paper if they are following along.
 - a. Legs for **Crawling, Holding Food, and Gripping Rocks** in fast-moving water
FUN FACT: Some macroinvertebrates do not have legs or have stubby legs that don’t bend called prolegs.
 - b. Gills for **Breathing Underwater**
FUN FACT: Many macroinvertebrates also breathe directly through their skin!
 - c. Antennae for **Smelling and Sensing**
 - d. Eyes for **Seeing Food and Predators**
FUN FACT: Some have a compound eye with contain up to 1000s of mini photoreceptors or eye-units to see! Unlike human eyes, it cannot move to accommodate and image. And some have light-sensitive spots throughout their bodies or ‘eye spots’ on their heads.
 - e. Wing Pads for **Protection & Camouflage**
FUN FACT: External wing pads are only seen in nymphs like mayflies and dragonflies that undergo “incomplete” or hemimetabolous metamorphosis. These wing pads will become their wings someday, but are not functional for flight just yet!
 - f. Tails for **Swimming**

At the end, review all adaptations quickly for class to reinforce learning for students who wrote more slowly than others so they can write down any they missed.