Create an Aquatic Macroinvertebrate

Adapted from: An original Creek Connections activity.
Creek Connections, Box 10, Allegheny College, Meadville, Pennsylvania 16335.

Grade Level: all

Duration: 45 minutes

Setting: classroom

Summary: Students draw imaginary macroinvertebrates and explain how their form fits their function.

Objectives: Students will recognize how an organism's physical features are adapted for its survival.

Related Module Resources:
- "Macroinvertebrates Parts and Pieces" activity and "Life at the Surface" activity
- Macroinvertebrate Fact Sheets
- Books/Field Sheets: Macro-invertebrates [folder and box]
- Reference Collection: bugs
- Videos: Creatures of the Pond and SOS For Americas Streams

Vocabulary: macroinvertebrate, benthic, adaptation, thorax, abdomen

Materials (Included in Module):
- Blank art page with section blocks for Head, Thorax, Abdomen, and Tail – enclosed
- Adaptation cards – enclosed

Additional Materials (NOT Included in Module):
- Blank paper
- Art supplies

ACADEMIC STANDARDS (ENVIRONMENT AND ECOLOGY)

7th Grade

4.1.7.C Explain the effects of water on the life of organisms in a watershed.
- Explain how the physical components of aquatic systems influence the organisms that live there in terms of size, shape and physical adaptations

4.6.7.A Explain the flows of energy and matter from organism to organism within an ecosystem.
- Describe and explain the adaptations of plants and animals to their environment
- Identify the relationship of abiotic and biotic components and explain their interaction in an ecosystem

4.7.7.A Describe diversity of plants and animals in ecosystems.
- Identify adaptations in plants and animals

10th Grade

4.1.10.C Describe the physical characteristics of a stream and determine the types of organisms found in aquatic environments
- Explain the habitat needs of specific aquatic organisms

4.6.10.A Explain the biotic and abiotic components of an ecosystem and their interaction.

4.7.10.A Explain the significance of diversity in ecosystems.
- Identify a species and explain how its adaptations are related to its niche in the environment

4.7.10.B Explain how structure, function and behavior of plants and animals affect their ability to survive.
- Describe an organism's adaptations for survival in its habitat

12th Grade

4.6.10.A Analyze the interdependence of an ecosystem.
- Analyze the relationships among components of an ecosystem

BACKGROUND:

There are between 5,000 and 6,500 species of aquatic insects living in different types of bodies of water and living in every part of a waterway.

Macroinvertebrates are organisms without internal skeletons that can be seen with the unaided eye (often considered larger than 0.5mm). Reference to the term "aquatic macroinvertebrates" can include arthropods (insects in all life cycle stages, nymph, larva, pupa, or adult or crustaceans or arachnids), mollusks, and worms. Examples of aquatic macroinvertebrates include mayfly nymphs, stonefly nymphs, dragonfly larvae, midge larvae, crayfish, leeches, aquatic worms, and water beetles. Some of these creatures are called **benthic** (bottom-dwelling) macroinvertebrates, which means they live in, move along, or attach themselves to the waterway bottom or substrate. Not all aquatic macroinvertebrates remain on the bottom though – some swim through the water or live on the surface.

Like all insects, aquatic insects have three main body sections. The first is the head. Next comes a three-segmented portion known as the **thorax**. This is where the legs of the insect are attached. The **abdomen** is the last body portion. Attached to the abdomen, some insects also have "tails." Within these body sections, a variety of appendages, external structures, and outgrowths perform specific functions. These body parts may have become specialized through time to better suit the aquatic organism for survival.

Just like other organisms, aquatic macroinvertebrates are specially adapted to their environment. **Adaptations** are specialized characteristics that animals and plants have developed over time in response to environmental pressures. They may be physical features or specialized behaviors. These tools help the organism to survive in specific conditions. For example the water strider and the whirligig beetle both have adaptations that help them to live on the surface of the water. Water pennies, mayflies, caddisflies, and some other insects are well adapted to life on the stream bottom. Still other insects like the water boatman have adaptations for living within the water column. Oftentimes, adaptations can be seen in the body shape and structure of insects. Yet some adaptations are behavioral rather than physical in nature.

Some adaptations are very easily seen on aquatic macroinvertebrates. Swimming insects like the water boatman have adapted hairy oar-like legs that allow them to swim easily. The whirligig beetle has a unique adaptation for life at the surface; they have two pairs of eyes, one ventral pair and one dorsal pair. This allows them to see above and below the water at the same time. The water penny and the mayfly are both adapted for life on the stream bottom. Near the stream bottom there is a thin layer of water that moves slowly due to friction; the mayfly and water penny have flattened bodies that allow them to reside within this thin layer. Caddisflies have adapted hook proleg claws that allow them to anchor to the substrate in swift water. The water strider is also adapted for life on the surface. They have preapical claws; the claws are not at the ends of the legs but rather are located higher up. This allows the water strider to skate on the surface without breaking the surface film. These are just a few examples of adaptations; the amount of adaptations present in macroinvertebrates is almost endless.

Behavioral adaptations are not as easily observed but are quite critical to the life of many aquatic insects. Hibernation is a behavioral adaptation that is present in many aquatic insects. When environmental conditions are unfavorable, the organism will slow its metabolic rate, and enter a special deep sleep until conditions improve. Many insects have adapted behaviors to respond to increasing water temperature. When the water gets too warm and dissolved oxygen decreases, the insects will move to cooler faster water. Stoneflies have a very unique behavioral response to low dissolved oxygen levels. They do push-ups to increase the amount of water flow over their gills. Some insects have developed behaviors to avoid predators. In general, a behavioral adaptation is any specialized action that aids an organism in survival.

OVERVIEW: Students create imaginary macroinvertebrates with special physical adaptations and behavioral adaptations.

PROCEDURE:

NOTE: This activity can incorporate components of the "Aquatic Insect Parts and Pieces" activity if you desire.

1. Discuss adaptations with the class. Depending on the level of the class, it may be beneficial to go over fact sheets about How Macroinvertebrates Breathe, Move, and Eat (included in the module). These fact sheets will give the class some ideas about the different adaptations that macroinvertebrates have. Brainstorm other ideas as well.

2. So students correctly illustrate an aquatic insect, you may want to review the main body regions of an insect and review some morphology at this time. Illustrative handouts of real aquatic insect body parts are included for reference. See the activity "Aquatic Insect Parts and Pieces" for background information on insect morphology.

3. Distribute a blank sheet of paper to each student. Then have them randomly draw an "adaptation" card/s/. You can decide how many adaptation cards per student. These cards can be found at the end of the activity and be copied and cut out.

4. Inform students that they are going to draw an aquatic macroinvertebrate adapted to the characteristic written on the "adaptation" card/s/ they picked. You can also choose to not have them use the cards and simply draw adaptations that they choose, but remind the students to think about how the insect breathes, moves, eats, and obtains food. Allow students to complete these to an artistic level that you want. Examples of what you may have students do are enclosed.

5. After the class has finished, have each student present his/her macroinvertebrate and explain why he/she drew it the way that he/she did (the student should have included a special physical adaptation for the characteristic on the card). You could also have the class guess at what the student's bug's "adaptation" characteristic was. You may have students reveal a behavioral adaptation. The macroinvertebrates can be named either by their team of creators or the entire class.

6. If an "adaptation" card was not used then the student should explain why his/her imaginary bug looks the way it does and what adaptation they created for it.

7. After everyone in the class has shared their newly created macroinvertebrates, give the students the names of some real macroinvertebrates that have adaptations for the characteristics on their cards (a chart with these answers is included at the end of this activity). Have them research these bugs and compare them to the ones they created or have them look at the preserved specimens.

DISCUSSION:

Discuss with the students about the different adaptations their insects have. Where would each macroinvertebrate be likely to live? A stream or a lake or a pond? In the middle of the water or on the surface or under rocks or on water plants? How is it adapted to living there?

Are the requirements for survival of each insect general or specific? Discuss how each insect might react to certain environmental changes such as in temperature, the addition or removal of other organisms, acid rain, less dissolved oxygen in the water, and various types of pollution.

How did the student insect's adaptation/s/ compare to a real specimen's adaptation/s/.

EVALUATION:

- Explain some adaptations that aquatic insects have and why they have them.
- Explain how aquatic macroinvertebrates are suited to live where they live.
- Sufficiently illustrating their selected adaptation and/or explaining it.

EXTENSIONS AND MODIFICATIONS:

- Create fact sheets for each organism. List its name, what it eats, what eats it, how it breathes, where it lives, how it moves, and how it gets its food. Include other attributes as appropriate – perhaps a drawing and explanation of its life cycle and/or human actions that affect the population of the insect.
- Have the students draw their completed aquatic insect in action. Don't forget to include a background.
- Create a banner or bulletin board of the student's artwork.

NOTES (TEACHERS, PLEASE WRITE ANY SUGGESTIONS YOU HAVE FOR TEACHERS USING THIS ACTIVITY IN THE FUTURE):

Activity Version: January 2002

Adaptation Cards

Swims through water	**Stays on top of water surface**
Clings to weeds & vegetation	**Eats periphyton (algae on rocks)**
Eats detritus (decomposing organic matter)	**Eats other insects**
Fits between rocks & crevices	**Stays just below the surface**
Eats course particulate organic matter (CPOM)	**Dives from surface of water to bottom**
Digs into silty / sandy bottom	**Filters out fine particulate organic matter (FPOM)**
Clings to top of rocks on stream bottom	**Clings to the bottom of rocks on the stream bottom**

Adaptation	Real Aquatic Insect Examples
Swims through water	Water boatman, water bugs, Diving Water Beetle, Scavenger beetle
Stays on top of water surface	Water strider, whirligig beetle
Clings to weeds & vegetation	Damselfly nymphs, dragonfly nymphs
Eats periphyton (algae on rocks)	Caddisfly larvae, water penny beetle larvae, some mayfly nymphs, snails
Eats detritus (decomposing organic matter)	Caddisfly larvae, mayfly nymphs
Eats other insects	Dragonfly nymphs, Damselfly nymphs, water striders, water bugs, larger stoneflies, beetles (larvae & adult), dobsonflies, fishflies, alderflies
Digs down into silty / sandy bottom	Burrowing mayflies,
Fits between rocks & crevices	Water pennies, flathead mayflies, stoneflies
Filters out fine particulate organic matter (FPOM)	Net-spinning caddisfly larvae, blackfly larvae, some mayfly nymphs
Dives from surface of water to bottom	Predaceous diving beetle, Scavenger beetle, water boatman, backswimmer
Clings to top rocks on stream bottom	Common stoneflies,
Burrows into mud	Burrowing mayflies
Eats course particulate organic matter (CPOM)	Cranefly larvae, case-building caddisfly larvae, small stonefly nymphs, scuds, aquatic sowbugs
Stays just below the surface	Mosquito larvae, water scorpion