

Introduction

Bugs Don't Bug Me is a series of lesson plans designed to assist teachers, 4-H leaders, scout leaders, and other educators in teaching about water quality and aquatic macroinvertebrates. Aquatic macroinvertebrates are small animals without backbones that live in water and are big enough to see with the naked eye. These animals include many types of insects as well as worms, mollusks, and crustaceans. Because aquatic macroinvertebrates are really fascinating for many students, they can be used to introduce concepts about adaptations, body structure, feeding habits, and aquatic ecology. Aquatic macroinvertebrates also provide a platform for introducing students to the impacts of pollution and the importance of good stewardship of our natural waters.

These lessons can be used to teach about adaptations, feeding habits, life history strategies, and body parts of aquatic macroinvertebrates (mostly aquatic insects), as well as how aquatic macroinvertebrates are linked to water quality. The lessons can be taught individually or as a series (see suggested sequences below). Each lesson has a recommended grade level but all can be modified for various ages and student knowledge levels. Some lessons include STEM discipline activities, such as graphing, data summary, or data interpretation. Each lesson is aligned to the Utah core curriculum. The lessons do not require expensive materials and most materials are easily available.

Appendices following the lesson plans include an alignment to Utah's core curriculum, additional resources, frequently asked questions, definitions, sample handouts, and more.

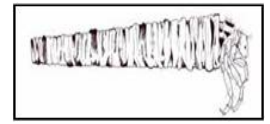
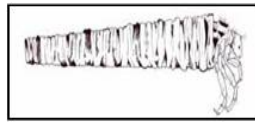
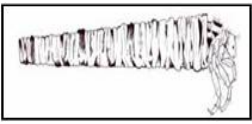
We hope you find these lessons useful. Please visit our website (<http://extension.usu.edu/waterquality/>) for updates and additional resources. We always welcome feedback or comments at:

Water Quality Extension
5210 Old Main Hill
Logan, UT 84322
(435)-797-2580
Nancy.Mesner@usu.edu

A word about outdoor classrooms

We encourage teachers to take their students to a stream or pond to explore aquatic macroinvertebrates in their natural habitat. This is the best place to learn about these organisms, their habits and adaptations. Students will benefit from the opportunity to investigate freely. Research shows that classroom experiences in conjunction with field experiences enhances student learning. It is best to conduct a field experience after students have some knowledge of what an aquatic macroinvertebrate is and their adaptations. Teachers should also plan at least one final lesson after the field experience to reinforce and revisit what students saw in the field.

Be aware that streams have higher flows during the spring season and may not be safe for young children. Collecting activities should be done in the late summer or fall if high flows are a concern.



Safety tips for macroinvertebrate sampling

Kids and water are a natural combination. To ensure the two mix well, consider the following guidelines before going to the stream site:

- If possible, have 1 adult supervisor per six students.
- If you choose to split up into groups, keep a good line of communication between groups at all times (e.g. stay within hearing distance).
- Be aware of medical considerations and have ready access to first aid.
- Know which students are allergic to bee stings and how to handle a reaction.
- Know the causes and early warning signs of hypothermia and heat exhaustion.

Be aware of these safety precautions in choosing a stream site:

- Avoid steep, slippery banks. Holes, vertical banks, and other hazards can be especially difficult to see when the banks are very heavily vegetated.
- Scout the area for dangerous trash such as broken glass, rusted wire, or metal scraps.
- Scout the area for poison ivy, poison oak, and stinging nettle.
- Moving water is deceptively dangerous. **Don't let students enter water over their knees or water that is moving very fast!**
- Never visit a stream during a lightning storm and beware of sudden storms that could produce flash floods.

Do not let students enter the water without being prepared, i.e. waders, good wading shoes, and an available change of clothing.

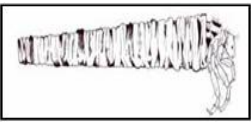
About aquatic macroinvertebrates

Aquatic macroinvertebrates are small animals that live in water, are big enough to see with the naked eye, and have no backbone. These animals include many types of insects as well as other animals such as worms, mollusks, and crustaceans.

Most aquatic macroinvertebrates make their homes in rocks, leaves, and the sediment of streambeds. These organisms have many special adaptations allowing them to live in demanding environments. Macroinvertebrates that live in riffles and fast-moving water may have features that help them hold on to rocky or hard substrates such as hooked feet or suction cups; or flat, streamlined bodies that can handle rapid water velocities.

Macroinvertebrates that house themselves deep in muddy substrates may have different sets of adaptations for low oxygen environments such as air tubes or oxygen trapping red hemoglobin in their tissue. See the "Adaptations" column in Appendix C for more examples.

These bugs are important because they are an integral part of the food chain. They provide food for fish and other aquatic organisms. Many of them are also key indicator species. They can tell us about the quality of the water where they are found. Bugs that have a low tolerance to pollution tell us that the water they are found in is relatively healthy. If we do not find these bugs, then it could possibly be due to some sort of pollutant or other impairment to the water body.



Available resources

Websites:

USU Water Quality Extension: <http://extension.usu.edu/waterquality>

Utah Division of Water Resources Water Education: <http://www.watereducation.utah.gov/>

Stroud Water Research Center: <http://www.stroudcenter.org/education/MacroKeyPage1.htm>

Video and photography:

Bugs of the Underworld DVD showcases life cycles of many aquatic invertebrates, available for purchase at <http://www.flyline.com> (clips also available for viewing on www.youtube.com)

Freshwaters Illustrated: <http://www.freshwatersillustrated.org>

USU Bug Lab: <http://www.usu.edu/buglab/Photos/bugPhotos.cfm>

Manuals and field guides:

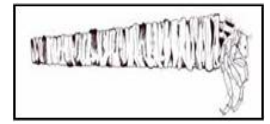
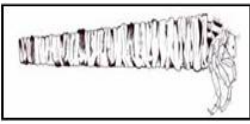
Voshell, J. Resse, Jr., 2002. A Guide to Common Freshwater Invertebrates of North America. The McDonald & Woodward Publishing Company. Blacksburg, Virginia, ISBN 0-939923-87-4

Utah Stream Team: available at <http://extension.usu.edu/waterquality>

Equipment and Supplies

Equipment and supplies used in the Bugs Don't Bug Me lessons are available for loan through USU Water Quality Extension. See Appendix G for more information.





Summary of each lesson plan

Build A Bug – Introduces students to aquatic macroinvertebrates and teaches about their unique adaptations. One student is selected to be dressed up in a bug costume. Through the help of the other students, each component is identified and added to the costume. This activity works well outdoors, or in a classroom setting.

Macroinvertebrate Simon Says – Teaches feeding habits and some adaptations for various aquatic macroinvertebrates. This is done by playing Simon Says using actions that depict the feeding habits for each bug. This activity can be done outdoors or in a classroom.

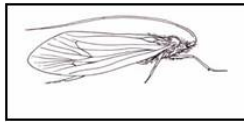
Macroinvertebrate Mix and Match – Introduces students to the 3 main body parts of a bug. Posters or pictures that show the adult macroinvertebrate are displayed and each body segment (head, thorax, and abdomen) of the corresponding larva or nymph are matched to the correct adult. This activity can be done outdoors or in a classroom.

Macroinvertebrate Graphing Activity – This activity helps students make the connection between aquatic life in a stream and water quality. Discussions include tolerant vs. intolerant species and why they are that way. Students are given a sample of “bugs” (represented by skittles) and required to sort them by “species” (color). Each student (or group) then discusses what their sample includes and what that may tell about water quality in that location. This lesson is easiest when done in a classroom setting.

Water Pollution Graphing – This activity introduces students to watersheds and the type of pollutants that can affect water quality. Discussions include the difference between point and non-point source pollution and how different land uses impact water quality. Students are given a water sample with some pollutants (represented by skittles) and required to graph the number of “pollutants” in their sample. The students then try to determine what type of land use activities are occurring in the watershed according to their water sample. This lesson is easiest when done in a classroom setting.

Macroinvertebrate Investigation – Introduces students to aquatic macroinvertebrates by allowing them to catch, observe, and identify them. This is best done in an outdoor setting near a stream, however, a teacher could also collect the invertebrates beforehand and bring them to the classroom.

If Bugs Could Talk – This lesson helps students understand the connection between land use activities, water quality, and aquatic macroinvertebrates. Two “samples” of aquatic macroinvertebrates are shown to the students, one representing a diverse sample of low tolerant species, and one representing a sample of less diverse, more tolerant species. The students then develop a hypothesis as to why the two are different. The students then learn about land use activities and pollutants; they graph the pollutants (represented by skittles) from each sample and compare the results. This can be done outdoors or in a classroom setting.



Suggested sequences

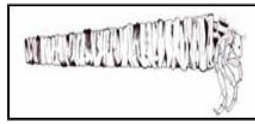
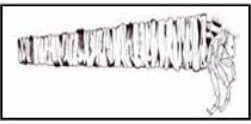
Although the lessons can be taught in any order, below are two suggested sequences, one that emphasizes animal adaptations, and another that emphasizes water quality. These sequences introduce important concepts and reinforce these concepts in a step-wise fashion.

Suggested sequence to teach about animal adaptation and diversity:

1. Build A Bug (introduction to aquatic macroinvertebrates and their adaptations)
2. Make a macroinvertebrate (an optional art project in the Build A Bug lesson)
3. Macroinvertebrate Simon Says (Simon Says game to demonstrate adaptations)
4. Macroinvertebrate Mix and Match (uses posters to illustrate the life stages and three major body parts)
5. Macroinvertebrate Investigation (allows students an opportunity to observe live macroinvertebrates)

Suggested sequence to teach how aquatic invertebrates are linked to water quality

1. Build A Bug – (introduction to aquatic macro invertebrates and their adaptations)
2. Macroinvertebrate Mix and Match – (uses posters to illustrate the life stages and three major body parts)
3. Macroinvertebrate Graphing – (teaches which invertebrates are sensitive to pollution and which are tolerant)
4. Macroinvertebrate Investigation – (allows students an opportunity to observe live macroinvertebrates)
5. If Bugs Could Talk – (requires students to synthesize information from the previous lessons to determine why their sample of macroinvertebrates changed over time)



Enhancing the experience

There are several ways you can enhance these lessons to meet a specific objective. The following are just a few examples:

Objective – introduce students to natural settings or local water bodies:

- A field trip to a local stream or river

Objective – allow students to explore living organisms:

- Catch aquatic invertebrates from a river or stream beforehand and bring them into the classroom
- Field trip to a local stream or river where students can collect invertebrates (please read safety tips on page #4).
- Creative writing about what life would be like as an aquatic macroinvertebrate.

Objective – demonstrate how macroinvertebrates function in the wild:

- Show DVD or photos of live aquatic macroinvertebrates (see available resources on page #5)
- Have students do independent/group research and create a poster/presentation to display or share with other students
- Have students write a poem/story about aquatic macroinvertebrates
- Integrate these lessons with other lesson plans found on the Utah State University Water Quality Extension website at [Water Quality - extension.usu.edu](http://WaterQuality-extension.usu.edu)