THE WATERSHED

Aquatic Macroinvertebrates Field Experience

OVERVIEW

By participating in macroinvertebrate surveying in the Boise River, students will gain an understanding of biodiversity in riparian ecosystems and the importance of water quality for a healthy, diverse ecosystem. Students will collect macroinvertebrates, sort and identify, and learn about how they may indicate a healthy or polluted river. Students will come away with a basic understanding of biodiversity in a complex ecosystem and the importance of river health to animals and plants as well as humans. We will also introduce the concept of climate change and how it affects water quality in the Boise River.

OBJECTIVES

Students will understand:

- The Boise River provides habitat for a rich variety of plant and animal life.
- Biodiversity is integral to the health of ecosystems.

LENGTH OF LESSON

60-90 minutes.

GRADE LEVELS

K-12th Grade – this lesson plan was written for elementary age students.

STANDARDS COVERED

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MATERIALS

MacPack – free loan from The WaterShed

Kit contents can be found at boisewatershed.org/learn/lending-library/

Macro-invertebrate Identification Sheets

Optional:

- Whiteboard and marker to record results
- Table
- Folding wagon for supplies
- Water Rescue rope
- Boots/Water Shoes (enough for all students in the group)
- Bug spray, sunscreen

SET-UP

Identify a safe location to wade into a water body with children.

It's helpful to stage the equipment at that site in advance, if possible.

ACTIVITIES

Orient the students to your site– we're located at X (segment) of the Boise River.

- What do you notice about the Boise River? (various observations)
- Does the water appear to be clean? (various observations)
- Did you know that what lives in the river can be an indicator of how healthy the river is?

Water quality scientists often can assume how polluted an area is by looking at the amount of biodiversity of macroinvertebrates in the water. "Macroinvertebrate" is a scientific word for a large groups of insects, crustaceans, worms and mollusks. They are organisms that are big enough to be seen without a microscope (macro), and they have no backbone (invertebrates). Some examples of macroinvertebrates are fly larvae like caddis flies, stone flies, may flies, and worms, leeches, snails and crayfish!

So now that we know what macroinvertebrates are…why are we interested in them anyway? Macroinvertebrates are a critical part of the river's food web. They are what some fish, birds, amphibians and mammals like to eat! They break down dead plant matter and turn it into usable energy in the food chain. The presence of a diverse community of macroinvertebrates in a stream is often a more sensitive indicator of water quality than the physical or chemical tests because of their short life cycles, sedimentary lifestyle, and varying tolerance to pollution.

Aquatic macroinvertebrates have different tolerance levels to water pollution. Some macros are sensitive to pollution, which means if the waterway was to become polluted they will die or move elsewhere. Other macroinvertebrates are tolerant to pollution, meaning they can survive in polluted water. What does this mean for the stream? Over time, pollution tolerant organisms would replace the tolerant ones.

Macroinvertebrates also require suitable habitat for food, shelter and protection. Suitable habitat includes a good selection of rocks, logs, silt and plants in and along the edge of the waterway. So by sampling a waterway for macroinvertebrates and identifying what's there you will get a good indication of water quality and habitat condition – although we can't have macroinvertebrates without habitat, we are focusing today on water quality.

This brings up both the advantage and disadvantage of the biosurvey. The advantage of the biosurvey is that it tells us very clearly when the stream ecosystem is impaired, or "sick," due to pollution or habitat loss. It is not difficult to realize that a river full of many kinds of crawling and swimming "critters" is healthier than one without much life. The disadvantage of the biosurvey, on the other hand, is that it cannot definitively tell us *why* certain types of creatures are present or absent.

Once the introduction has finished, divide students into two groups (if greater than 25 kids) in order to complete macroinvertebrate surveys in two areas on the river.

Decide with your teaching partner what time to meet back at the outdoor classroom.

Ask the kids who would like to wade in the river to collect macro-invertebrates? Is there anyone who does not want to go in? Any child who doesn't want to go in may be the 'chief entomologist' or the person who first identifies the bugs.

Safety Talk

- Choose a buddy! You and your buddy will look out for each other and stay near each other.
- Move slowly and carefully in the river. Rocks are slippery!
- Only go in the water up to your knees. (or below the top of the boot)
- Anyone who disobeys these rules will be taken out of the river and forced to sit on the log bench.
- Also, note, if anyone has a cell phone or electronic device on them that they should leave it on the shore
- (note to instructor) It's recommended to have a rescue rope nearby in case of emergency
- Students should change into water shoes, boots or waders. No flip flops.

Introduce collection techniques:

Option 1: Pick up large rocks and see what's clinging to them. Carefully peel off any macro-invertebrates with your fingers and place them in a white tub with about an inch of water in the bottom.

Option 2: Use a kick net. You and your partner only need one net. Face each other about two feet apart. The partner who is downstream holds the net and places on end of the net on the bottom rocks/sediment. The upstream partner kicks the sediment/rocks toward the net. Lift net occasionally and check for anything moving. Carefully peel off any macro-invertebrates with your fingers and place them in a white tub with about an inch of water in the bottom.

It's a good idea to place a few white tubs with an inch of water in them along the bank of the river rather than having students carry tubs into river for less potential loss of tubs.

The students should stay close to the riverbank in shallow water only. A group discussion about where to sample and why it's important in our study could be lead – will it matter if the water is clear? Moving? Deep? What can we tell from our observations of the river? Where do we suspect macroinvertebrates will be?

When collecting macroinvertebrates the students should be sure to try and stir up the water in order to get macros which may be located under rocks and within the sediment at the bottom of the river. The macros in the tubs should be brought further on shore periodically if there is a student(s) who are not going in the river.

On the shore, the students can count out the total amount of macroinvertebrates in that sample and transfer them into ice cube trays (official sorting trays). Then they should use identification keys/charts to identify the species of macroinvertebrates in that sample. The students should also try and count how many macroinvertebrates of each species there are in that sample. The students can use hand lenses to correctly identify the species.

After all identifying of macros has been done, point out that the organisms on the green side of the ID chart are intolerant to pollution and the organisms on the red side of the ID chart are tolerant to pollution. Discuss which ones were found at your site and what that may mean about river health.

Have students change back into their shoes/socks and help you pick up the site. Return the macroinvertebrates to the river.

All of the students should be brought back together for a discussion and analysis of the health of the Boise River.

Discussion Questions:

- What did we find at each location? (take some answers for upstream, and then for downstream)
- We know that these organisms need clean, cold water. What sort of things would make the water warmer and dirtier?
- How could pollution and climate change affect our water quality and macroinvertebrates?
- What does the presence of those particular macroinvertebrates tell us about the health of the Boise River? Refer to red and green ID sheets.
- How does the location of macroinvertebrate populations affect where fish are located in the river? Can we assume that there would be a lot of fish, birds, etc. in this section of the river based on the macroinvertebrates we found?
- How could our data collection have been more effective? Do you think our data is representative of the entire river?
- How could human activities affect the macro populations?
- How can we help protect the Boise River and the animals/plants that live there? Some ideas: don't litter, pick up dog poop (germs impact the river health), don't dump anything down storm drains because they all lead untreated to the river.

EVALUATION

The facilitator can assess student learning by using Walk-Talk lines on the way back to the "home-base". The students should line up in two lines. The students should each have another student to "discuss" with during the walk. Before starting the walk, the facilitator should teach the student how Walk-Talk lines work if they students are not familiar with this method. Before leaving, the students should turn and great their partner by giving him/her a "high five" – this is to make sure that each student has a partner, and if there are an odd number of students, the facilitator can participate in the walk-talk line. Each pair will be given a question to discuss during their walk. Each question should be given 2-3 minutes to answer, or

until discussion wanes/ceases. Once that question has been discussed, the students will be given a new question to discuss, and one of the lines will rotate (the person in the very front will go to the back, ensuring that everyone now has a new partner). By participating in a large group discussion before participating in a walk-talk discussion, the students should have plenty to talk about and should feel less afraid of coming up with something to say. Every so often, or at the end – whichever is preferable – the facilitator should ask the group as a whole "Is there anything interesting that you and your partner discussed that you would like to share with the group?" – this way, the facilitator can see what the students have been talking about.

Some questions which would make good walk-talk conversation for this lesson:

- Is the Boise River important to you? Why or why not?
- If you were an animal in or near the Boise River, which one would you want to be and why? How do you think humans affect your animal's survival (habitat, food resources, etc.)?
- How can you help to better protect the Boise River? Who else will you tell about protecting the river?

EXTENSIONS AND MODIFICATIONS

There are several pre- and post-activities that can introduce students to the river ecosystem and macroinvertebrates. You can refer to the Project WET curriculum guide for the 'Macro-invertebrate Mayhem' game or 'Ask the Bugs.' Additionally, conducting a stream walk prior to this activity allows time for students to make observations and form a hypothesis about the stream's health prior to this activity.

Finally, a few online resources that are recommended are:

https://www.macroinvertebrates.org/

https://www.tu.org/wp-content/uploads/2019/04/Macroinvertebrate_Key.pdf