Science Essential Standards:
- 3.E.2.1 (landforms)
- 4.L.1.1, 4.L.1.2, 4.L.1.3 (animal adaptations)
- 5.L.2.1, 5.L.2.2, 5.L.2.3 (ecosystems)

Time:
45-60 minutes

Audience:
3rd, 4th, or 5th grade

Learning Objective:
Observe organisms that live in a stream and how humans impact this ecosystem.

Materials:
- ☐ nets
- ☐ small containers
- ☐ Private Eyes or magnifying glasses
- ☐ river macroinvertebrate keys
- ☐ biotic index

Vocabulary:
macroinvertebrate, pollution, species

Preparation:

- ✓ Familiarize yourself with the area in which you will be teaching. Check for poison ivy, jagged rocks, strong currents, & other safety concerns.
- ✓ Gather the materials needed for the lesson.
- ✓ Know how many students are in your group.
- ✓ Check to be sure they are dressed properly for the water.

Background:

A **macroinvertebrate** is a small, aquatic animal that does not have a backbone and is large enough to see without a microscope. Macroinvertebrates include such organisms as insects in their larval life stage, insects in their adult life stage, worms, and mollusks (but not fish, salamanders or other vertebrates). Macroinvertebrates are often referred to as benthic macroinvertebrates as they are usually found living on, in, or near the bottom of streams, rivers, lakes, and ponds. Organisms that live in streams are adapted to their aquatic habitat. Looking closely at macroinvertebrates, one can see adaptations such as feathery gills on mayflies and specialized limbs for swimming on water boatman.

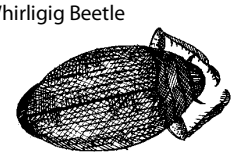
Macroinvertebrates can be used to assess the quality of the habitat in which they are found. Each unique type of macroinvertebrate is known as a **species**. Water quality is important for all aquatic species. Different macroinvertebrates have different tolerances to water quality characteristics including **pollution**, dissolved oxygen, and pH levels. For example, stonefly larva and dobsonfly larva are sensitive to pollution while bloodworm midge larva and leeches are tolerant of pollution. In the *References & More Information* section below, follow the link to a biotic index data sheet which categorizes macroinvertebrates into four groups based on their sensitivity or tolerance of pollution. Through a macroinvertebrate survey, one can get an overview of the quality of water based on number and species of macroinvertebrates found. Taking varying measurements from a sample of water, such as temperature, pH level, and oxygen saturation, can create a snapshot in time of what the quality of that water is at that particular time. Although assessing water samples using chemical tests can be useful, a macroinvertebrate study shows a bigger picture in that these creatures can't live in that location if the water quality is lowered.

Water pollution is anything added to a body of water that is harmful and lowers the water quality such as trash, oil, animal waste, fertilizer, or even soil. Point source pollution is pollution from which you can actually point at where the pollution came from, such as a drain that empties directly into a stream. Non-point source pollution is pollution from which a specific source can't be identified, such as runoff from fertilized lawns.

Instructions:

1. Greet the students and explain the **learning objective** of this activity. Ask how many of them have ever been in a stream before. **Explain** to the students that they will be looking for **macroinvertebrates** in the stream today.

Whirligig Beetle

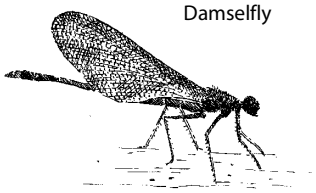


2. Ask the students if they know what a **macroinvertebrate** is.
    a. Give them the hint that **macro** is the opposite of **micro**.
    b. Tell them they are **vertebrates**, opposite of an **invertebrate.** Have the students look down and feel the back of their neck. **Explain** that they are feeling the vertebrae that make up their backbone. Animals with a backbone are called vertebrates. If needed, give them another hint that some invertebrates have a hard exoskeleton instead of a backbone.
3. Ask students to give you examples of **invertebrates**, such as insects, worms, mollusks, and crustaceans. Then ask which ones might be found in a freshwater stream.
    a. For **3rd graders**, emphasize the differences between freshwater and saltwater. Help them categorize the animals mentioned into living in one or the other, i.e. crayfish live in freshwater and lobster live in saltwater.
4. Based on the number of students and supplies, break the class up into groups of 3 or 4. Assign a chaperone to each group. If needed, assign chaperones two groups to monitor.
5. **Hand out** macroinvertebrate keys to each group of students. Remind them to share the keys so that everyone can see.
6. **Practice** identifying the organisms with students. Call out the name and ask students to point to the organism on the key.
7. Ask students if they have seen any of these animals before.
8. Ask students if they know what **pollution** is and where it can come from. **Explain** that pollution can affect what organisms will be able to live in the water.
9. Ask students for examples of pollution. **Explai**n different types of pollution with examples.
10. Prompt students to think about how animals live there all the time, so they are always affected by the quality of water. Explain that since the water is always moving, physical and chemical tests of the water examine the water just for that moment of time. Pollution will be washed downstream, changing the results of other tests. Show students a biotic index.
11. **Model** how you want students to behave in the water. Show students how to use nets to capture organisms. Show them how to turn over a rock and look under it.
12. Have students **mode**l back to you how they should behave in the water.
13. **Bring the class to the stream.**
14. Ask students to describe the habitat/ecosystem in front of them. If the group is **3rd or 4th graders**, use the term "**habitat**". If the group is **5th graders**, use the term "**ecosystem**".

Mayfly

    a. Ask **3rd grade students** to tell you how they know it is a stream (flowing freshwater confined to a channel). Ask if they know other names for this body of water (creek, brook, river). The various terms are used to indicate size with rivers generally being large and the others indicating smaller bodies of water.
15. **Model** for students how to put an organism from the water into a container. **Remind them that the organisms need to be in water to survive.** If this is a 4th grade class, use this as an opportunity to make connections to adaptations of macroinvertebrates that allow them to survive in the water (e.g. specialized gills, claws or hooks for holding onto rocks, hairy legs for capturing drifting food, etc.).

16. **Hand out** to each group a net, containers, magnifying glass or Private Eye, and macroinvertebrate key, if they don't have one already. Ice cube trays work well for students to collect organisms into, and plastic totes are good to combine collected organisms for class observation.
17. Give them 10-15 minutes to explore in the stream and collect macroinvertebrates.
18. After the time is up, bring the class out of the stream for examination. Have each group **share** with their classmates what they found. Ask them to identify the organisms they found using the key. Give groups a few minutes to take a closer look at the macroinvertebrates collected by each group.
    a. If using a biotic index with the group, this is the time to pass them out or calculate together as a group.
    b. For **4th graders**, point out some of the visible physical adaptations on what you caught.


Damselfly

19. Return all organisms carefully back to the water. Collect materials.
20. Ask students to discuss in their groups how humans can positively and negatively impact the health of the stream. Ask students if they see anything in the stream that might be affecting its health. Answers might include trash or signs of erosion for negative impacts.
21. Discuss grade level specific aspects of the activity:
    a. **Landforms for 3rd graders** - Compare streams to other bodies of freshwater and discuss differences between freshwater and saltwater.
    b. **Animal adaptations for 4th graders** – Describe various physical and behavioral adaptations of the animals that were observed.
    c. **Ecosystems for 5th graders** – Connect the organisms observed to food chains and webs, especially their role i.e. consumer or decomposer. Discuss the interconnectedness of the stream, the organisms living in it and near it, and humans.

Opportunities for Extended Learning

- If materials are available, testing the temperature, pH, turbidity, or dissolved oxygen could also be done.
- Consider incorporating a game into the 5th grade discussion of food webs. Options that could be modified for a stream ecosystem include *Web of Life*, *Pyramid of Life*, and *Rock, Paper, Ecosystems* can be found on the Schools in Parks Teacher Collaborative website at https://ie.unc.edu/nc-state-park-teacher-collaborative/.

Behavior & Materials Management Tips:

- Assign each student **a role**, so they will be on task.
- When groups are assigned, give the groups a minute **to connect**.
    - For example, have them give each team member a fist bump or have them choose a team name.
    - Give them a clear, brief time limit for this. For instance, ask students to take 45 seconds give each team member and their chaperone a high five.
- **Model the behavior** to the students exactly how you expect them to behave.
    - Students are more likely to meet expectations if have clearly been shown what they are.
    - Having the students then model the behavior for you reinforces the behavior.
    - Some of them may be uncomfortable in the water, so show them what to expect.
- Give students **defined boundaries** for how far they can go in the water.

- If students help return organisms to the stream, be sure to model how to release the animals by pouring the containers out close to the water to **keep the animals safe**.
- Remind students that they are **collecting macroinvertebrates**, animals without backbones. This means no fish, tadpoles, or snakes should be collected. If you see those, that's awesome. Just don't keep them in the container, because they are not part of today's scientific survey.

References & More Information:

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NRDC. (2018, May 14). Water Pollution: Everything You Need to Know. Retrieved from https://www.nrdc.org/stories/water-pollution-everything-you-need-know

Credits:

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