River Watchers Elementary Lesson Plan

Targeted age/grade level: 1–5th grade

Lesson Plan Overview– *Discuss what healthy temperature, oxygen and turbidity rates are in an aquatic system. Discuss what macroinvertebrates are and how they serve as indicators of water quality. Sample for each of these factors in your school's local waterways and use your scoring charts to grade the water quality and health of your aquatic system.*

Estimated Time: 1 hour total.

- 5 minute introduction
- 15 minute Chemistry sampling
- 30 minute Macroinvertebrate sampling
- 5 minute wrap up

Required materials: Macroinvertebrate sampling bin, small nets, Macroscopes, Stream Pollution Tolerance Index, thermometer, oxygen test kit, turbidity test kit

Introduction:

- Today we will be testing the health of the water in our school's backyard!
- **What do you think makes water "healthy"?**
- **What do you think makes water "unhealthy"?**
- **What is pollution and how does it affect the organisms living in our water?**
- We will be testing 2 things today that can help us learn about the health of the water. The first is water quality, a measure of the water's physical and chemical characteristics. The second is biological diversity, or how many different living things we can find in the water. We will be testing this by sampling organisms called macroinvertebrates.
- Let's get started! Walk students to the nearby creek.

Chemistry

Temperature

- Have 1 volunteer take and read temperature of water from the creek
- **Is this a good reading?**
- **Do you think organisms prefer the water to be warm or cold?**
  - Colder temperatures allow fish and other organisms to breathe better
  - This is because temperature directly impacts the amount of free oxygen available in the water for fish and other animals to breathe. Warm water has less oxygen because the molecules in warm water move faster, allowing oxygen to escape into the air. Cold water does not have as much molecule movement, so oxygen stays trapped.
- **What do you think a normal temperature for the creek is?**
  - Depends on the season, but between 45 and 70 F is ideal for fish. We usually see a range of 40–85 Fahrenheit.
- **What impacts temperature?**
  - weather/climate

Dissolved Oxygen

- Let's test our theory about oxygen! **Based on your temperature reading, do you think there will be a high or low amount of oxygen in this creek?**
- Using the Chemetricts DO test kit:
  - Have one student scoop water from the creek into the test tube. Have another break the DO test tip off inside the water. DO NOT remove from the test tube– if you do, you'll be testing the air!
  - Pass around and let students match the reading to the color chart provided. Get a consensus on the oxygen rating from 0–10
- Using the Hach DO test kit:
  - Follow the instructions laid out in the River Watchers Testing Instructions booklet
- **Is this a good reading?**
  - A normal reading is 6 to 8. When levels reach below 4, it becomes very difficult for organisms to breathe.
- **What impacts Dissolved Oxygen?**
  - Temperature
  - Water movement. Fast moving water, like riffles and rapids, result in more mixing with air, causing an increase in oxygen. In reverse, slower, stagnant water has very little mixing, so has less oxygen.
  - Depth of the water. The deeper the water, the colder the water is. However, in the deepest parts of a body of water, oxygen is lower because there is less/no photosynthesis happening to produce oxygen.
  - Turbidity

Turbidity

- Turbidity measures how much sediment (dirt) is in the water
- Have one student scoop water from the top of the creek water, so as not to stir up any extra sediment. Pass the tube and turbidity reader around for students to see and make estimates of the turbidity rating.
- **Is this a good reading?**
  - Low turbidity is more favorable.
  - If the water is clouded with lots of dirt, it clogs organisms' gills and makes it difficult for them to breathe. Imagine if the air you're breathing right now were really dusty!
  - This applies to fish, but also a lot of the macroinvertebrates we'll look at shortly
- **What impacts turbidity?**
  - Anything that would stir dirt up or wash more dirt into the water. Heavy rains, erosion, and kids like us tromping around in the creek can all increase turbidity.

Chemistry Conclusion

- **Based on your chemistry readings, does this water seem clean and healthy for the organisms living in it?**
- We will now look at some live organisms to learn if this is correct!

Macroinvertebrates

- *Present students with a photo of a dragonfly. What would you call this?*
- *Dragonflies start off their life as Aquatic Benthic Macroinvertebrates. Let's break that down*
- **Aquatic** tells us that they live in the water, **benthic** means they live mostly on the bottom, hiding under rocks and in the sediment, **macro** means they are large enough that we can see them with our eyes, and **invertebrate** means that they do not have a backbone.
- **Can you think of more examples of Aquatic Macroinvertebrates?**
  - Macroinvertebrates found in the streams of the Ohio River Valley include mussels, snails, worms, crustaceans, and insects.

- Macroinvertebrates are a very important part of an aquatic ecosystem. They serve as a food source for many other organisms including fish and birds.
- Macroinvertebrates also help to recycle nutrients in aquatic environments by breaking down dead things.

The presence of Macroinvertebrates indicates a healthy river

- Healthy stream and river conditions can support a diverse population of macroinvertebrates.
- Many macroinvertebrates are more sensitive to pollution than us or fish. Because of this, changes in their population can be the first indicator to a good or bad change in rivers.
- *Why do you think macroinvertebrates are more vulnerable to pollution?*
  - Macroinvertebrates are not able to travel long distances, so they are trapped in a small area of water. If that water becomes too polluted they may be stressed or eventually die.
  - Many macroinvertebrates go through metamorphosis. Usually, their eggs and larvae grow in the water. Organisms are more likely to be hurt by pollution during development
  - Many macroinvertebrates have a thin skin that water is absorbed through. Because of this, they are also more likely to absorb pollutants
- **Pollution Tolerant vs intolerant:**
  - Some macroinvertebrates are more **pollution tolerant** while others are **intolerant**. This means different species will be present depending on the health of the water.
  - ***Can you think of some examples of pollution that could harm macroinvertebrate populations?***
- *How would a loss of macroinvertebrates affect other living things in the river ecosystem?*
  - ***Discuss and stress their role in the food chain***

Macroinvertebrate Sampling Activity

1. Choose a portion of the stream with shallow, slower-moving water.
2. Using only your hands and magnifying glass, begin to look for macroinvertebrates present in the stream. Turn over rocks and lift them up out of the water. Look along the stream edge for anything that may be crawling. Comb through moss and check under leaf litter for any organisms that may be hiding.
3. When you find an organism, pick it up with your hands or forceps and place it in the shallow white bin provided to your group. Keep in mind that students will likely find some vertebrates, like fish and salamanders, but encourage them to leave those animals alone, observing with just their eyes.
4. Once collected, identify macroinvertebrates using the macro scope and identification key.
5. Tally up your organisms and multiply by the rate at the bottom of each row. The first row contains pollution tolerant organisms, the second row contains mildly sensitive organisms and the 3rd row is very sensitive. The multiplication step accounts for these different values.
6. Once all organisms are identified and recorded, empty the tray, returning organisms to the stream
7. Interpretation of PTI
   - High # of Pollution tolerant species, Low # of Pollution Intolerant means water may be polluted
   - Great variety of macroinvertebrates with few of each kind: clean water
   - Only one or two kinds of macroinvertebrates, with great abundance: Possible pollution
   - Few or no macroinvertebrates: Likely pollution. If its late fall to early spring, could just be too cold. Alternatively, you may have had a bad luck day, which is why scientists do this many times over years to properly determine water health.

Conclusion

- **Did your chemistry and macroinvertebrate tests match up?**

- **If not, what could be causing this difference?**
- **What are some things you can do to prevent pollution in your streams and rivers so that our waters stay clean and healthy?**
  - Don't litter, or join a trash cleanup!
  - Plant trees and gardens! Plants hold dirt in place and prevent it from eroding into our waterways
  - Don't use pesticides or fertilizers on your plants

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