

A Bioindication of Water Quality



Estuary Concept

- Watershed – an area of land that drains downhill to the lowest point which is a stream, lake or ocean.
- Estuary – a partially enclosed body of water where two different bodies of water meet and mix.
- Ecosystem – a community of living organisms that interact with each other and their physical environment.
- Macroinvertebrate – animal without a backbone that is visible to the naked eye.
- Non-point Source Pollution – wide-spread overland runoff containing pollutants that do not originate from one specific location.
- Bioindicator - an organism whose status in an ecosystem is analyzed as an indication of the ecosystem's health.

Learning Objectives

- Define an estuary and a watershed.
- Explain how land use practices affect water quality of both our estuary and Lake Erie.
- Indicate what a macroinvertebrate is and how these organisms can be used to assess water quality.
- Employ proper sampling and analyzing technique for biotic indexing of water quality.
- Discover, explore, and learn about the ecosystems that make up OWCNERR.
- Explain about the National Estuarine Research Reserve system and why there is a NERR located here in Ohio.
- Ohio State Academic Standards satisfied by this lesson plan (See page 6)

Activity Information

Grade Level

4th – 8th

Time Required

2-4 hours

Topic

Water quality

Ecosystem Interactions and Dependencies

Overview

To create an understanding of the connection between watersheds, estuaries, lakes, and water quality in students and how our actions affect each of these concepts. This understanding will include the role of Old Woman Creek National Estuarine Research Reserve in the stewardship of the watershed, estuary, and Lake Erie.

Teacher Preparation

[Learn more about macroinvertebrates](#)

Procedure or Activity Steps

Introduction: Sense of Place (20 min)

- 1.) Students arrive and disembark their bus. Greet them and welcome them to OWCNERR
 - o Welcome to Old Woman Creek National Estuarine Research Reserve. This is a special place that was created to protect the water that runs through our property on its way to Lake Erie, Ohio's Great Lake. We are going to go inside, you can use the restroom, if you need to fill up your water bottles and look around our visitor's center. While you are looking around, see if you can answer the questions to this scavenger hunt. The answers will give us some insights into what we are going to be doing for the remainder of the day. You may work in groups, and you have 20 minutes. We will call you back together when time is up.
- 2.) Handout scavenger hunt, clipboards, and pencils to small groups of students.
- 3.) Allow students to wander and explore; be there to answer questions if needed, but not the questions on the scavenger hunt.

Activity 1: Enviroscope Simulation (40 min)

- 1.) Gather students back together and briefly go over the answers to the scavenger hunt with some discussion on certain concepts.
 - o Watershed, estuary, ecosystems etc.....
- 2.) Break the students into two groups and head outside to the pre-arranged envirosapes.
- 3.) Get to know your students, play a name game with them. Ask them to tell you their name and their favorite thing to do outside, or their favorite thing to do with water, or their favorite Ohio animal. Work hard to remember their names, it is important to them, and you only have to remember it for a couple hours. It will also help you with group management if you can call out to them by name.
 - o Go over some ground rules for behavior while on the trip, respecting each other and adults, no wandering off, staying in their group, etc.



Materials Needed

- 2 Enviroscopes with supplies
- 25 hand lenses
- 20 bug viewer containers
- 25 pairs of binoculars
- 15 dichotomous keys of macroinvertebrates
- 2 or 4 seine nets
- 6 D nets
- 4 Ice cube trays for holding specimens
- 4 Large bowls/tubs for holding specimens
- 30 Plastic spoons
- 10 Identification books for birds, insects, and trees
- 25 pairs of waders or tall rubber boots
- 14 clipboards and pencils

- 4.) Gather around your enviroscape and explain that this is a model of a watershed. Go over the definition of a watershed, again.
 - o *Watershed – an area of land that drains downhill to the lowest point which is a stream, lake or ocean.*
- 5.) Ask them what watershed are we currently in.
- 6.) Ask them what watershed in which they live.
- 7.) Looking at the unused enviroscape, ask them if this looks like it would be a nice place to live, why or why not. Tell them we are you going to change the way it looks.
- 8.) Go through the enviroscape simulation, letting the students help you and discuss what the consequences of the actions were and how did it affect the water draining out of that watershed?
- 9.) Go over watershed and estuary definitions again and how they are connected. Then inform your students that we are going to go on a hike through some of our watershed and look at the estuary. Last chance to go to the bathroom or get a drink of water.
 - o *Estuary – a partially enclosed body of water where two different bodies of water meet and mix.*

Activity 2: Watershed Hike (1hr)

- 1.) One of the questions on the scavenger hunt was what types of ecosystems do they think that we have here at OWC. Let the students know that during this hike, the group will be exploring some of our ecosystems.
- 2.) Refresh on trail rules and proper behavior.
- 3.) Ask your group is anyone knows the definition of an ecosystem, or if anyone can describe it?
 - *Ecosystem – a community or living organisms that interact with each other and their physical environment.*
- 4.) As you go through the forest, prairie, and estuary, ask the students what are the special needs that organisms would have if they lived in this ecosystem.
 - o Look for clues that those organisms are there or were there.
 - o The two groups will hike the same trail, but in opposite directions. Both will visit the overlook, forest and prairie.
 - o Take binoculars and hand lenses with you to help with exploration and investigation in the field.
 - o Stop and look at interesting things, answer questions that the students have.
- 5.) You can vary your speed in different areas, but remember to budget your time for an extended stop over at the estuary.
 - o While at the overlook be sure to discuss how water that falls in the watershed drains down to the estuary. Refer back to the enviroscape. Talk about this unique environment and the plants and animals that make it up.

- *Estuary – a partially enclosed body of water where two different bodies of water meet and mix.*

6.) Both groups will meet back at the visitor center for lunch.

Activity 3: Macroinvertebrate sampling (30 min)

NOTE: this is folded into the watershed hike on the red trail.

- 1.) All equipment will be with us and in our packs to use.
- 2.) Each group should have a set of equipment.
- 3.) Groups separate and discuss macroinvertebrates, how we will collect them and why we want to know what types are living there.
- 4.) Ask students if they know what a macroinvertebrate is, break down the word together and indicate what the different parts mean.
 - *Macroinvertebrate – animal without a backbone that is visible to the naked eye.*
 - Ask them to come up with some examples.
- 5.) Talk about them as bioindicators and discuss what that means.
 - *Bioindicator - an organism whose status in an ecosystem is analyzed as an indication of the ecosystem's health.*
- 6.) Go over the equipment, what each piece is used for and how to properly use them when working in the field.
- 7.) Go over very concrete boundaries of where the students are allowed to go to sample and what behaviors are acceptable. Also discuss the consequences for not adhering to the rules.
 - This is important for safety and group management. If someone crosses a line or breaks a rule, I give one warning, then, if it happens again, that person is sitting out. If the initial action is too dangerous or reckless, and you have stated the rules and consequences, then that person can be told to sit out immediately. There are too many variables with working outside, near water, and with kids that no chances should be taken.
- 8.) After equipment, boundaries, rules, and consequences have been established, hand out equipment and set up the collection station.
 - This should be done near the water's edge but in an area where the collections are stable and safe from being knocked over.
 - Students should have a good 30 minutes to sample, collect, and switch equipment, sample, collect and repeat.
- 9.) When the time is up, call them back in, put down the equipment and take collections away from water's edge to evaluate.

Activity 4: Evaluating the Collections and Determining Stream Health (30 min)

- 1.) Hand out the dichotomous keys for macroinvertebrates.
 - o You have gone over what a macro is, so let the students do some identifying with minimal help from you.
 - o You can confirm or deny identifications to ensure they have the right information.
- 2.) Hand out the Macroinvertebrate Biotic Index sheets.
 - o You have gone over bioindicators, and this sheet goes into more detail about which macros are tolerant or intolerant of pollution.
 - o Have the students calculate the biotic index and determine the water quality rating based on the Macroinvertebrates as bioindicators.
- 3.) Facilitate a brief discussion on what are our results telling us about our watershed?
 - o Did we find tolerant or intolerant species?
 - o Are we doing a good job protecting the watershed and the estuary?

Activity 5: Free exploration of the beach (35 min)

- 1.) Bathroom break, load bus and head over to the beach to see where the estuary empties out.
- 2.) Give the students a few brief instructions to think about what we did today, and how does that affect the beach and the lake?
- 3.) Ask them to think of 2 things that they could do in their lives to help protect the shores of Lake Erie by where they live.

Closure: Share back (10 min)

- 1.) Gather into a big group and ask for volunteers to share some of their reflections from during the free exploration time.
- 2.) Talk about actions that individuals can do to help the watershed and the Lake.
 - o These first two items are stewardship/action development.
- 3.) Ask them what their favorite thing about today was.
 - o This is an informal assessment.
- 4.) Give Brady an evaluation and ask him to return it to me.
- 5.) Thank them for coming, give one last bathroom break and wish them safe travels.

Ohio Academic Content Standards to which this lesson correlates:

Life Science: content statements

- Fourth Grade
 - Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.
- Fifth Grade
 - Organisms perform a variety of roles in an ecosystem.
- Sixth Grade
 - Soil is unconsolidated material that contains nutrient matter and weathered rock.
- Seventh Grade
 - Matter is transferred continuously between one organism to another and between organisms and their physical environments.
 - In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.