Grades 4-6, 9-12

Helping Hands

Restoring Great Lakes Habitat

Connecting students with scientific principles through local sediment and habitat projects

ALIGNED TO NGSS, NSES, AND STATE STANDARDS

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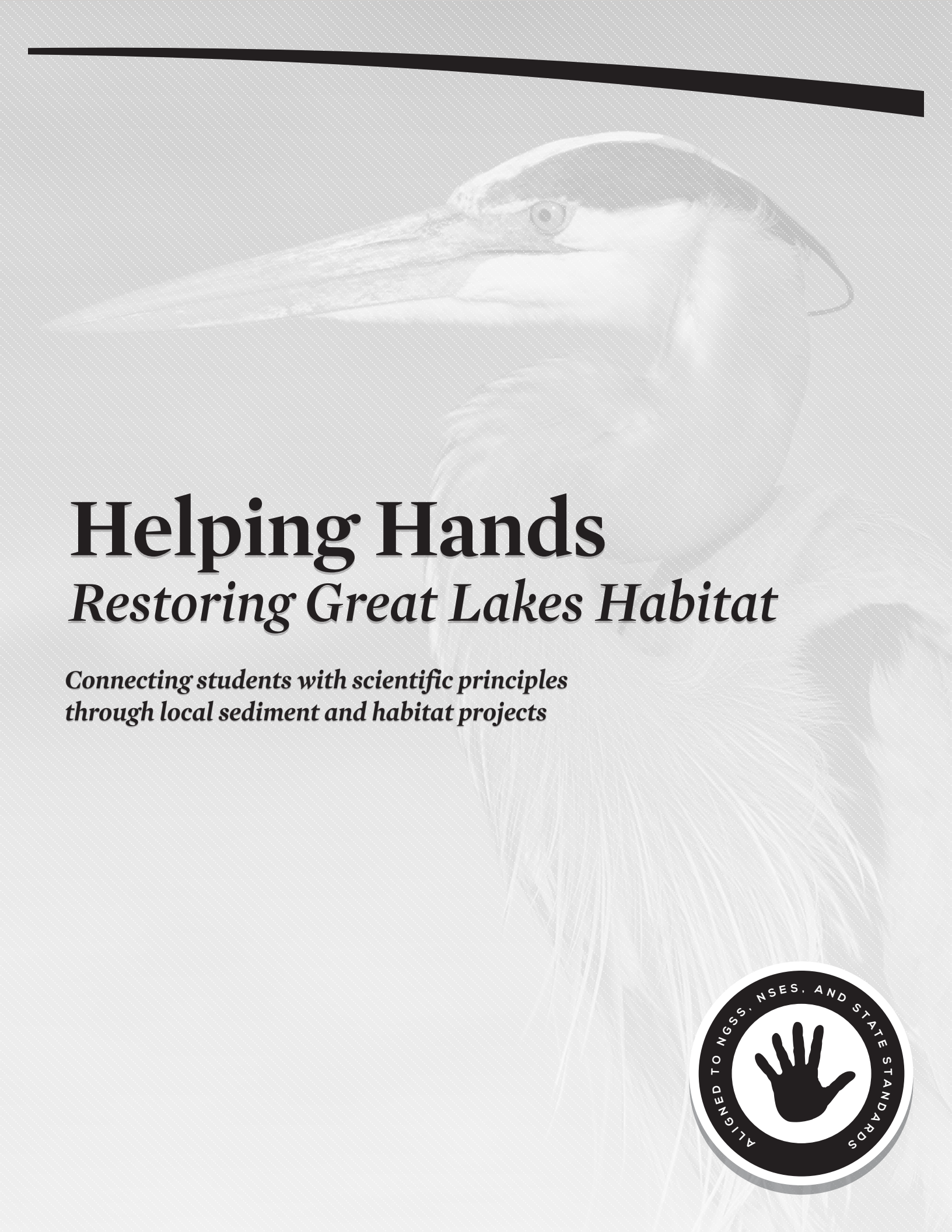

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Introduction:

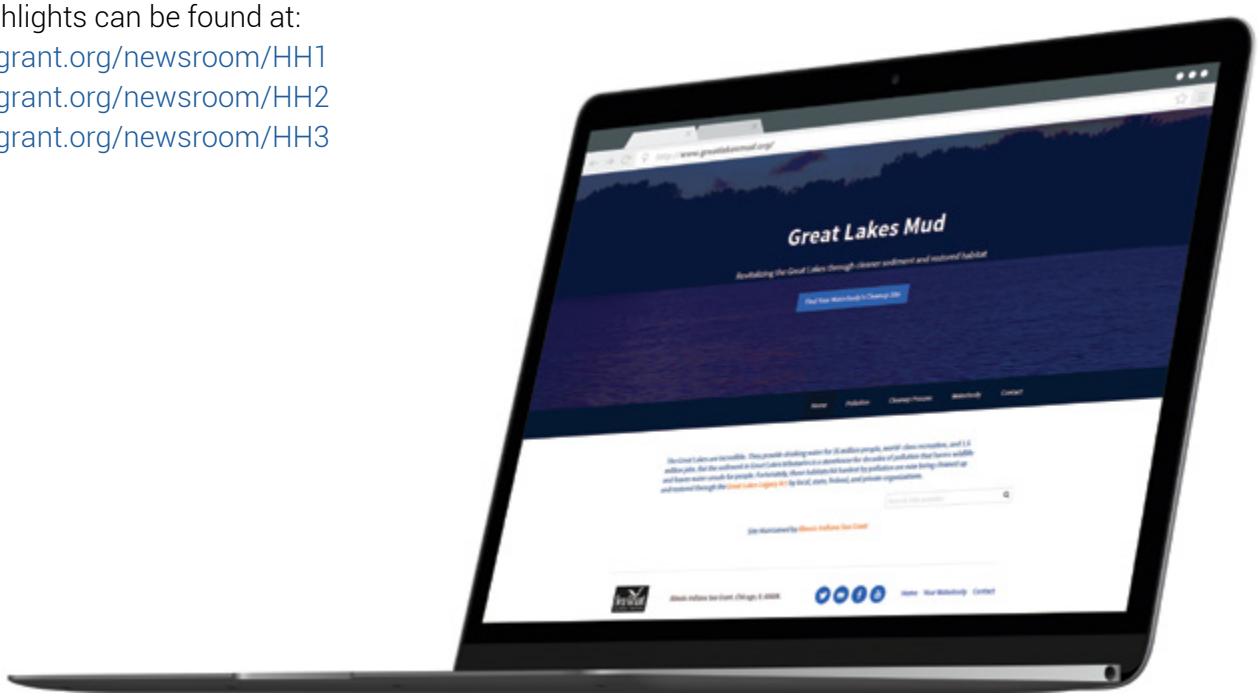
This curriculum project provides an opportunity to engage upper elementary and high school students in Great Lakes environmental stewardship. The lessons and hands-on activities apply to schools located in Great Lakes communities where large scale environmental cleanup and restoration projects are taking place. These places are called Areas of Concern due to years of degradation and pollution.

Through participation in the curriculum, students will be connected with local aquatic habitats and improve scientific and Great Lakes literacy. Students will learn ecological concepts such as water quality, pollution, and habitat restoration, while gaining an understanding about significant environmental cleanups happening near their school.

The curriculum is available online, along with additional resources to carry out lessons, such as PowerPoint files and alignment to standards. Specifically, each lesson has been aligned with National Science Education Standards, Next Generation Science Standards, and Great Lakes Literacy Principles: www.greatlakesmud.org/education.html.

Teachers interested in learning more about implementing this curriculum in their classrooms can contact Illinois-Indiana Sea Grant. This curriculum was initially implemented with schools in the Grand Calumet River Area of Concern in northwest Indiana by Caitie Nigrelli: www.iiseagrant.org/staff/nigrelli.php.

Project highlights can be found at:
www.iiseagrant.org/newsroom/HH1
www.iiseagrant.org/newsroom/HH2
www.iiseagrant.org/newsroom/HH3



Grade School Curriculum

Grades 4-6

Lesson 1:

What Makes Up My Ecosystem?
Get Down and Dirty

Grade Level: 4-6

Time: 75 Minutes

Vocabulary:
Habitat, native, invasive, shelter, migration, pollution, government, industry, U.S. Environmental Protection Agency, common names for local species.

Great Lakes Literacy Principles:

Principle 5
Concepts A, B, E, G, H

Principle 6
Concepts A, B, C

Summary:
Students learn about an environmental cleanup happening in their very own neighborhood. Students create a story and PowerPoint about their Area of Concern. They pot native seeds that they will grow in their classroom. They can then take the plants to the cleanup site to help restore the environment or plant them in a school garden.

Objectives:
- Describe the effect of historical pollution on today's environment.
- Describe the role of the U.S. Environmental Protection Agency (EPA).
- Relate EPA's role in the environmental cleanup in the students' neighborhood.

Materials:
Native seeds, flats filled with potting soil, species stickers, and spray bottles. An example PowerPoint (editable .ppt file) and seed planting instructions can be found on www.greatlakesmud.org/education.html.

Procedure:
Find a well-lit space in the classroom for the seeds to grow in flats. Contact Illinois-Indiana Sea Grant for help obtaining native seeds. Administer the Cleanup Pretest prior to the first lesson. Instruct students to complete the "Our Area of Concern" activities, including story and PowerPoint creation. Set up the materials for planting seeds in an outdoor location at the school. Deliver the story about the local ecosystem and review the plant guide PowerPoint and seed planting instructions with the students. Then take the students outside and pot the seeds. After planting, let the plants drain for an hour, then bring them inside.

Assessment:
Conduct the cleanup pretest prior to the first lesson. Have the students write reflections about their experience planting and learning about the species (*See Example Student Reflections*).

Name _____ **Date** ____/____/____

Part I: Multiple choice
Read each question carefully and circle the correct answer.

1) A(n) _____ is a group of individuals of one species that lives together in an area. It does not include other species or non-living things.
a. ecosystem
b. population
c. community
d. organism

2) Bioaccumulation is when_____.
a. pollution is stored in the body of an animal and increases over time
b. prey is able to successfully hide from its predator
c. sediment at the bottom of a river attaches to chemical pollution
d. a channel of water flows toward another body of water

3) Which of the following is NOT a component of a species' natural habitat?
a. Shelter
b. Space
c. Food
d. Invasive species

4) _____ ecosystems include rivers, wetlands, and marshes.
a. Terrestrial
b. Aquatic
c. Arid

5) In the ecosystem, which of the following food chains is in the correct order? Note: the bottom of the food chain is listed first.
a. Fish, benthos, bird of prey, bird
b. Bird of prey, bird, benthos, fish
c. Bird of prey, fish, benthos, bird
d. Benthos, fish, bird, bird of prey

6) The _____ in the water body is/are being cleaned up this year because the pollution is harming the _____ that live(s) there.
a. fish, air
b. air, fish
c. sediment, benthos
d. benthos, sediment

7) Many environmental laws in the 1970s made it illegal for industries to pollute.
a. True
b. False

8) Scientists make _____ using their senses (smell, sight, etc.) to understand and make hypotheses about the world.

a. observations
b. guesses
c. science

Part II: Fill in the Blank

Read each statement carefully and fill in the blank with the correct answer.

9) A(n) _____ species is supposed to live in the local ecosystem. It belongs there.

10) A(n) _____ species does not belong in the local ecosystem. It harms the species that belong in the ecosystem.

11) _____ is the wet, squishy mud found at the bottom of a river or lake.

Part III: Short Answer

Read each question carefully and provide an answer using a complete sentence.

12) What are two environmental problems that make the Area of Concern an unsuitable habitat for native animals?

13) Why is it important for scientists and engineers to work as a team to clean up a water body?

Name _____ **Date** ____/____/____

Part I: Multiple Choice
Read each question carefully and circle the correct answer.

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a. True
b. False

8) Scientists make _____ using their senses (smell, sight, etc.) to understand and make hypotheses about the world.

a. observations
b. guesses
c. science

Part II: Fill in the Blank

Read each statement carefully and fill in the blank with the correct answer.

9) A(n) _____native_____ species is supposed to live in the local ecosystem. It belongs there.

10) A(n) _____invasive_____ species does not belong in the local ecosystem. It harms the species that belong in the ecosystem.

11) _____sediment_____ is the wet, squishy mud found at the bottom of a river or lake.

Part III: Short Answer

Read each question carefully and provide an answer using a complete sentence.

12) What are two environmental problems that make the Area of Concern an unsuitable habitat for native animals?

Two environmental problems are invasive species and pollution.

(Will also accept degraded habitat, contaminated or polluted sediment, loss of resources like shelter and food.)

13) Why is it important for scientists and engineers to work as a team to clean up a water body?

It is important for scientists to work on a team because scientists are experts on different parts of the project. The projects are big and complex and require many different skills, which one person cannot have alone.

(We're flexible on this one. As long as they can name a reasonable, positive aspect of teamwork, we'll give it to them.)

Our Area of Concern: Our Story

Introduction:
Every place has a story. From historical developments to personal stories from people who have seen the area change, it's all an important part of the story. When students construct a story that includes facts and personal viewpoints it helps to develop a sense of place and ownership.

Teacher instructions:
For this activity we are going to combine historical facts about your Area of Concern with personal stories from those who have been in the area for a long time (if available) as well as your connection to the area and what you hope to see once the remediation project is complete.

1. Just the facts:

a. Where is the area located?
b. What is the acreage?
c. Who manages the area?
d. What history is associated with the area?
e. What pollutants have been found?
f. What are possible sources?

2. Stories from long-term residents (optional): Ask parents, grandparents, neighbors or anyone that has lived in the area for many years about how they have seen the area change. Ask questions like:

a. How long have you lived here?
b. Why did you move here?
c. What do you like about living here?
d. What do you know about problems associated with the [Area of Concern]?
e. What changes would you like to see in this area?

3. Your Story: Now tell us your story about living in the area. Here are a few starting questions, but feel free to add more information. Use complete sentences for your story.

a. How long have you lived here?
b. Were you born here or did you move here?
c. What do you like about living here?
d. What would you change about living here?
e. Do you have a favorite place to hang out?
f. What animals do you see living here?
g. Do you feel connected to where you live?
h. How long do you see yourself living here?

4. Construct a classroom story about your Area of Concern. Use the information to construct several paragraphs using items that the class has gathered and is willing to share. Keep in mind that not all of the information will be used, but together the class should be able to create a well-rounded and well represented story.

Sources for historical information:

- GreatLakesMud.org > Waterbody > Your Neighborhood Cleanup Site
- EPA Great Lakes Areas of Concern (www.epa.gov/great-lakes-aocs)
- Internet Search > [Area of Concern] history
- Look for your state's Area of Concern website
- Look for information from local municipalities and NGOs
- Local museums or libraries

Once you have completed your story, share it with others including Illinois-Indiana Sea Grant.

Our Area of Concern: Planting Renewal

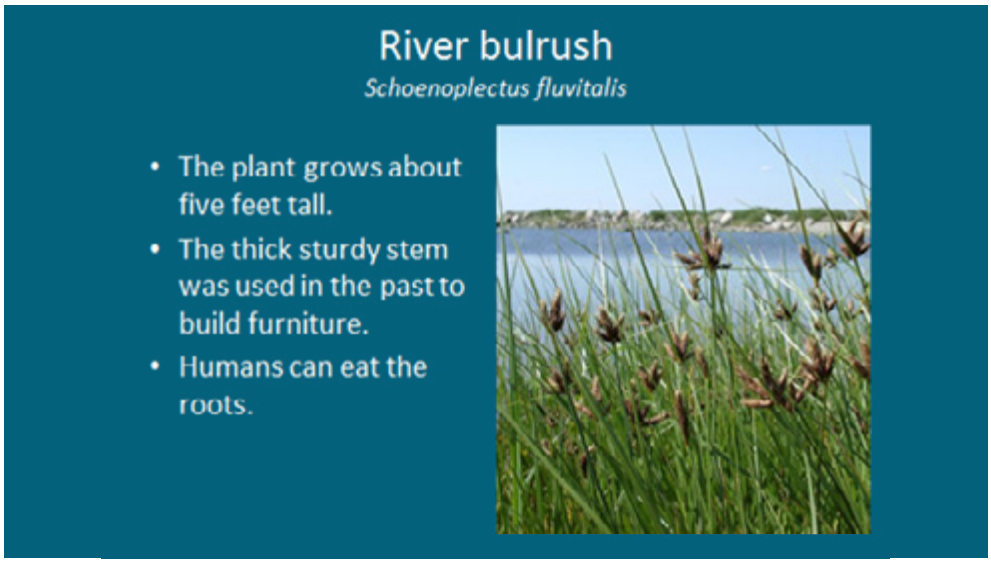
Introduction: Plants are part of what make an ecosystem viable, but some plants contribute more than others. Native plants typically provide shelter and are a food source for other native species. Invasive plant species, however, take over an area and do not support native organisms.

Teacher instructions: Students will create a PowerPoint slide about native and invasive plants in your Area of Concern. Depending on the number of species, this can be done by individual students, pairs, or small groups. Each slide will have key information about the plants:

1. The common and scientific name
2. A photo
3. 2-3 bullet point facts

When the slides are completed, compile them into one PowerPoint presentation, separating out the invasive from the native plants. Have the students present their plant to the class and encourage them to add one or two more verbal comments. The students might have a question about the plant that they couldn't find the answer to or an interesting fact about the plant. During the presentations, students should take notes on each plant. Encourage them to ask questions along the way.

Here is an **example** of a slide with speaking notes added at the bottom:



• It is threatened by nutrients like fertilizers or sewage, which increase the success of the non-native plants.
• It is native to all states except New Hampshire, where the population was introduced in a human-created wetland.

Resources for Area of Concern Research:

Since habitat restoration in your area is dependent on decisions made by local, state, and federal partners, the list of plants will vary. There are plants that are specific to the water body in your region or site. Contact Illinois-Indiana Sea Grant to learn more about native plants being considered for site restoration in your area, as well as the invasive species that pose a threat.

Sources for General Information:

Indiana:
• Aquatic Invasive Plant Species http://www.in.gov/dnr/6347.htm
• Common Native and Exotic Aquatic Plants of Indiana Waters bit.ly/22XUIVg

Minnesota:
• Invasive Aquatic Plants http://www.dnr.state.mn.us/invasives/aquaticplants/index.html
• Minnesota Aquatic Plant Guide http://dnr.state.mn.us/nr/plants/aquatic/index.html

Michigan:
• The Field Guide to Invasive Plants of Aquatic and Wetland Habitats for Michigan bit.ly/21RhRq7
• Common Aquatic Plants of Michigan Guide http://1.usa.gov/1VRy3rz

Ohio:
• List of Ohio's Aquatic Invasive Species http://ohiodnr.gov/ais
• Go Native! (Ohio Department of Natural Resources) http://ohiodnr.gov/gonative

New York:
• New York Invasive Species Information http://www.nyis.info/
• Aquatic Plants: The Good & The Bad (helpful for identifying invasive from native) bit.ly/1pHFLIf

Wisconsin:
• Common Wetland Invasive Plants in Wisconsin 1.usa.gov/1MPTKRJ
• Wetland Plants of Wisconsin http://bit.ly/1RNDvfu

Note: *As of 2016, all management actions for Areas of Concern in Illinois are complete, and all Areas of Concern in Pennsylvania have been delisted. If you are interested in the curriculum or possible projects in these states, contact Illinois-Indiana Sea Grant.*

Example Student Reflections from Different Sites

Tuesday me and my classmates helped plant seeds for the Buffalo River. My teacher taught us about the Buffalo River. She told us a story about what happened to the Buffalo River. We learned proper steps to planting seeds. There are different kinds of plants we planted.

In Buffalo River there are plants invading Buffalo River. In the 1970's the government made a lot of laws to protect our environment. Birds and other animals used to stop there and rest. Now the animals don't come because of the pollution.

Here are the steps we took to plant the seeds. First we labeled the pots with a species sticker. Then we sprinkled three seeds with a spoon because the seeds were tiny. After that we covered the seeds with soil. Last we watered the seeds. Finally we put then in the sun so they could get sunshine.

I'm helping the Buffalo River because I don't want the animals to suffer. And, because the invasive species are invading the other plants. I want the plants to grow big and wide. The reason why I want them to grow big and wide is because then the animals could have a big shelter to stay in. I can't wait to plant them in the Buffalo River!

On Tuesday a special visitor came. She came to talk to us about the Roxana Marsh. Then the lady had a paper she read to us a paper about Roxana Marsh. She told us that it is one plant that does not belong in Roxana Marsh. People were throwing trash in Roxana Marsh. Then it was the factory's fault because it was the factory that was killing the Roxana Marsh plants. No animal went to Roxana Marsh because of the pollution.

The project is that we have to plant seeds. The plants are being affected because of pollution. We are going to plant more seeds to help them. It was a plant that does not belong in Roxana Marsh. The invasive plant is called phragmites.

The first step was we had to put a name sticker on the cup. Then we filled the pot with planting soil. Next, do not push the pot down. After, tap the filled pot on the ground to help the soil. Settle in. Later, spoon sprinkle seeds into each. Sprinkle a small amount of soil over the top. Push the seeds into the soil. Finally slowly water the pot.

I am helping Roxana Marsh because I want all the animals to come back to Roxana Marsh. And because I love plants. And I love nature. I love helping people out with their problems. I hope Roxana Marsh native plants grow and animals.

Lesson 2:
Habitat Woes

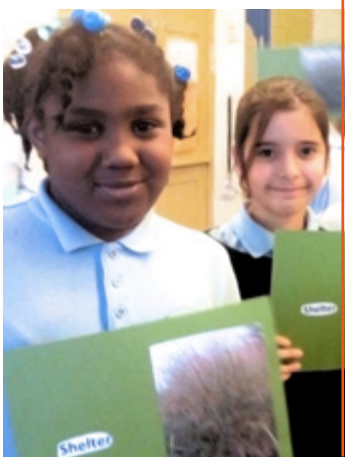
Grade Level: 4-6

Time: 75 Minutes

Vocabulary:
Habitat, wetland, river, sediment, native, invasive, organism, pollution, food web, ecosystem, community, population, aquatic, resources, shelter.

Great Lakes Literacy Principles:

Principle 6
Concepts D, E, F



Summary:
Students learn ecological terms and concepts. Students participate in a role-playing activity to understand the effects of pollution and invasive species on native species' habitat and the food web.

Objectives:
- Evaluate the importance of suitable habitat for wildlife.
- Recognize that degradation of resources from pollution and invasive species are reasons why the current habitat is unsuitable for the native species.
- Compare their own habitat to an aquatic organism's habitat.
- Describe the differences among organism, population, community, and ecosystem.

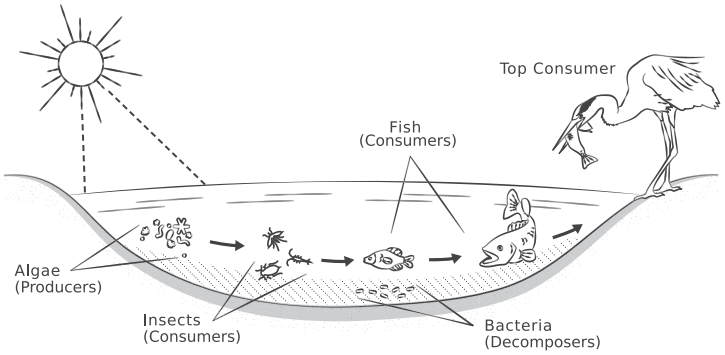
Materials:
Habitat PowerPoint, drawing paper and markers for Degraded Habitat Activity. An editable PowerPoint (.ppt) file can be found on www.greatlakesmud.org/education.html.

Procedure:
After recapping lesson one, present the Habitat PowerPoint, read the explanation of the aquatic food web, and facilitate the Degraded Habitat Activity.

Assessment:
Have students draw a food web that shows five relationships among six components of an aquatic food web as the explanation of the food web is read.

Our Area of Concern: Connecting Life

Food webs are an important way to understand how aquatic habitats function. It is also a great tool to show how each organism depends on others for survival. This basic diagram shows several biotic and abiotic factors that contribute to an aquatic food web. Make sure you use resources specific to your waterbody because not all species are found in every location.



The sun's energy, soil nutrients, and CO2 are captured by both plants (terrestrial and aquatic) and algae and converted into plant biomass that becomes the base of the food chain. Plants release O2 as a waste product (which is very important to animals). This represents the net primary productivity, which one way or another supports the rest of the ecosystem.

The next level in the food web is primary consumers. They specialize in eating both dead and living plant matter. Detritovores eat detritus (or rotting vegetation), while herbivores eat living plants.

In an aquatic habitat, an abundance of submerged vegetation and algae provides an available food source. Many types of aquatic invertebrates (benthic organisms and bugs) and small fish like minnows specialize in eating detritus and/or living plants. Plus, many types of aquatic insects (dragonfly larvae) eat other small benthic organisms, like fly or mosquito larvae. And some small fish eat only insects (i.e. bluegill species). Typically, large fish are piscivores, and they eat minnows, bluegill, and other fish. Large piscivores include largemouth bass and northern pike. Because of sediment contamination, there are limits to safe human consumption of certain fish species.

Kingfishers are an example of perching birds that eat small fish, while great blue herons are wading birds that will eat small-to-medium-sized fish. Only large raptors (eagles, osprey) and mammals (primarily humans) are capable of capturing and eating bigger fish like largemouth bass. Insectivorous songbirds such as swallows, red-winged blackbirds, and warblers are commonly found around aquatic habitats. They often feed on adult-staged, flying, benthic organisms like dragonflies, mayflies, and mosquitos.

Small mammals can also be found near the water's edge. In river areas, beavers are herbivores that feed mostly on vegetation from trees, while carnivorous mink feed on small fish, birds, frogs, and snakes. Omnivores eats vegetation, small fish, and frogs. Reptiles like water snakes (carnivorous) and turtles (omnivorous) are also found in aquatic ecosystems.

Nearshore shallow water is great habitat for mallards and coots and other dabbling ducks (tip up, with head underwater and tails in the air) and their ducklings. This is because of the abundance of plants growing there. The benthic community also thrives in shallower water because food is readily available. Environmental dredging can help remove contaminants and help the benthos flourish. Since benthos form the base of the food web, these cleanups can have a positive long-term impact on many organisms.

Degraded Habitat Activity

Summary:
Students simulate a process of historical pollution and invasive species introduction through a role-playing activity.

Materials:
Drawing paper, markers.

Procedure:
1. Review the meaning of habitat with the students and ask students to think about what makes up their own habitat. Have students make comparisons between key elements of a habitat (food, water, for native animals.)
2. Divide the students into six groups: bird, fish, water, shelter, pollution, and invasive species.
3. Using drawing paper and markers, have each student create a habitat component card for the group they are in. Each student writes their habitat component on the paper and decorates the card.
4. Establish a large area (either in the classroom with tables, chairs, and desks moved away or outside) that can be used to simulate the bird's habitat before contamination. The "pollution" stays on the sidelines at this time, simply observing the undeveloped land.
5. Ask the students representing shelter and clean water to arrange themselves in the habitat area. Then, have the fish stand next to the water and have the birds join and stand among their resources.
6. Once all the species are established in their habitats, it is time for the pollution to enter the picture. The students who are simulating pollution remove the clean water and fish and stand in their place. Clean water and fish leave the habitat area. Then, because the ecosystem is weak, the invasive species remove the shelter and stand in their place. The shelter leaves the habitat area.
7. Ask the class if the birds are happy, and why or why not. Have the birds leave the habitat area.
8. Then tell the pollution and the invasive species that the U.S. Environmental Protection Agency and its partners are coming to clean up the environment. Have the pollution and invasive species leave the bird's habitat area.
9. Tell the clean water, fish, and shelter that they can go back to their original habitat/location since the pollution and invasive species are now gone.
10. Tell the birds to go back among their resources. Ask them if they are happy, and why or why not.

Wrap-Up:
Engage all of the students in discussion of what happened in this Degraded Habitat Activity.
What actions took place? What were the consequences? Emphasize the resource needs of the bird and how these habitat requirements are being considered throughout the environmental cleanup design.

Lesson 3:
Knock Out Pollution

Grade Level: 4-6

Time: 75 Minutes

Vocabulary:
Pollution, habitat, sediment, predator, prey, food chain, benthos, bioaccumulation, biomagnification, observation.

Great Lakes Literacy Principles:

Principle 5
Concepts A, B, D, E, F, G, H, I

Principle 6
Concepts A, C, D, E, F

Summary:
Students learn ecological terms and discuss concepts. Students watch and reflect on a demonstration of bioaccumulation. Students practice scientific observation skills to identify types of pollution.

Objectives:
- Explain and diagram how pollution moves up the food chain from the sediment to the fish people eat using the terms benthos and bioaccumulate.
- Describe how pollution biomagnifies between species.
- Use observation skills to identify types of pollution.
- Describe the environmental and societal benefits of the cleanup.

Materials:
Pollution PowerPoint. See Bioaccumulation Demo and Pollution Activity for additional materials. An editable PowerPoint (.ppt) file can be found on www.greatlakesmud.org/education.html.

Procedure:
Set up the Pollution Activity. Perform a quick recap of lesson two and then present the Pollution PowerPoint. Midway through the PowerPoint, perform the bioaccumulation demo. Following the PowerPoint, facilitate the Pollution Activity.

Bioaccumulation and Biomagnification Demo

Adapted from University of Kentucky Cooperative Extension Service's Bioaccumulation Basics

Summary:
Students observe a demonstration on bioaccumulation and biomagnification that uses marbles and clear containers to illustrate the concept.

Materials:
2 ½ cups of marbles or beads, six small half cup food storage containers labeled "benthic organisms,"

two medium 1-cup storage containers labeled "fish," one large 2-cup storage container labeled "bird."

Procedure:
1. Ask for three volunteers from the class, two to stand with you and one at the board. Explain that the marbles are a type of pollution called PCBs and that the storage containers represent different parts of the food chain. Tell the volunteer the total number of marbles and have the student write it down as total units of PCB pollution.

2. Ask the other two volunteers to fill the small containers (benthic organisms) with marbles (PCB pollution). Explain that benthic organisms live in the polluted sediment and absorb the PCB pollution. Count the number of marbles in each benthic organism container and have the board volunteer write it as units of PCB pollution.

3. Say that the fish are hungry and prey on polluted benthic organisms. Ask volunteers to evenly pour the PCB pollution from the small to the medium containers, explaining that the fish now have PCB pollution from the benthic organisms in their bodies. Count the number of marbles in each fish and have the volunteer write it down on the board. Explain that as fish prey on benthic organisms, they absorb the PCB pollution. Pollution accumulates as the fish eat more benthic organisms. This is called bioaccumulation.

4. Say that the bird is hungry and that it eats the polluted fish. Ask volunteers to pour the PCB pollution from the medium containers to the large container, explaining that the bird now has all the PCB pollution from the fish and the benthic organisms in its body. Count the number of marbles in the bird and have the volunteer write it on the board. Compare the number of marbles at each step in the food chain.

5. Ask the class which animal has the most pollution. Explain that the top predators will almost always be the animals that are most harmed by pollution because they get all the pollution that was in all of the other animals. The PCB pollution increases as it moves up the food chain, and this is called biomagnifcation. Explain that not all types of pollution bioaccumulate, but PCB is one that does.

Wrap-Up:
Engage all of the students in discussion of what happened. Which animal ended up being the most polluted? Why? Did the predators know their prey was polluted?

Pollution Activity

by Amy Mucha, U.S. EPA

Summary:
Students "pollute" a habitat and use observation skills to determine the type of pollution.

Materials:
Four quart-size food storage containers filled with water and soil, 12 (three for each group) travel-size, unlabeled bottles of safe liquids or powders with different smells, colors, and textures (mouthwash, Murphy's Oil Soap, conditioner, Kool-Aid, baking soda, and dish soap).

Procedure:

1. Break students into four teams. Explain that each team will be given a "habitat" (container filled with water and soil) and supplies.

2. Give each team 5 minutes to use their supplies to pollute their experimental "habitats." (We're using safe supplies.) Students choose which of the three bottles to empty into the container. Encourage students to try different amounts of each bottle and notice the result in the container as contents are added. For example, one team may decide to use half of bottle X and all of bottles Y and Z. Another team may decide to dump the contents of all their bottles in the "habitat" container all at once.

3. Have the teams trade stations and make observations to understand what "pollutants" are in the other team's "habitat."

    a. As the students are trying to figure out what the "pollutants" are, ask them which sense they are using. What do they see? What do they smell? What does the "pollution" feel like in their hands?

Wrap-Up:
Engage all of the students in a discussion of what happened. What "pollutants" did the students use in their "habitats?" Which senses did the students use to observe the "pollution?" Explain that scientists must also make observations to understand if a habitat is polluted, where the pollution is, and what the pollution is. Scientists use their senses to learn about habitats, just like the students did in the activity. However, if the habitat is polluted, scientists may have to use protective clothes and equipment to study the environment.

Lesson 4:

Design an Ideal Habitat—Think Like Engineers and Scientists

Grade Level: 4-6

Time: 75 Minutes

Vocabulary:
Restoration, scientist, engineer, pollution, habitat, ecosystem, food chain, shelter, resources.

Great Lakes Literacy Principles:

Principle 5
Concepts A, B, D, E, F, G, H, I

Principle 6
Concepts C, D, E

Summary:
Students learn how an engineer designs a large project like habitat restoration, working with a team of environmental professionals. Students create a mural of the ecosystem using the ecological knowledge they have accumulated throughout the educational program.

Objectives:

- Describe how an engineer designs a restoration project, including the importance of working on a team.
- Describe scientific relationships of organisms within the local ecosystem.

Materials:
See Mural Activity for additional materials. The Ecosystem Components PowerPoint and project figures and maps can be found on www.greatlakesmud.org/education.html and www.greatlakesmud.org, respectively.

Procedure:
Prior to the lesson, complete step one of the Mural Activity. Provide students a quick recap of the third lesson. Engage students in a discussion about project design concepts using the Project Design Discussion Questions and project figures and maps. Present the Ecosystem Components PowerPoint. Alternative to the discussion activity, contact Illinois-Indiana Sea Grant prior to the lesson to set up a videoconference with a project scientist. Have students complete the Ecosystem Design Components worksheet. Facilitate the Mural Activity. Administer the test on a later day.

Assessment:
Post-test and answer key are provided in Lesson Plan 1 and cover concepts learned throughout the educational program.

Project Design Discussion Questions

In order to plan effective project designs for restoration, stakeholders need to discuss important components of the design. Discuss the following questions with your students and use the answers for guidance.

What kinds of plants belong in your ecosystem design?
Think native. Talk about what kinds of plants live there now compared to what kinds of plants are supposed to live there (plants they're growing in their classroom; plants discovered for the Habitat Components PowerPoint).

What kinds of animals belong in your ecosystem design?
Again, think native. Talk about the food chain. Talk about what kinds of animals live there now compared to what kinds of animals belong there. Discuss what animals students have seen in their yards and near the river.

Why are native species having a hard time living or thriving?
This is where it is important circle back to talk about the pollution in the sediment and in the food chain (bioaccumulation and biomagnification), as well as invasive species that are taking over.

How does a team of scientists and engineers decide what plants to plant?
Explain that the plants are chosen based on what native species were documented historically as well as what resources are important for the new habitat plan. Plants must have adequate light, water, and nutrients. However, they also must provide food and shelter resources for native animals. Highlight the species the students are growing in the classroom and the role of each one.

Why are certain plants planted in certain locations?
All plants need water, sun, and nutrients – but different plants need different amounts of these resources. That's why some plants can grow underwater, slightly underwater, on the shore, and up on dry ground. They provide shelter and food for different kinds of animals. Use specific examples, such as the plants they are growing in their classroom or species from the Ecosystem Components PowerPoint.

Name _____ **Date** ____/____/____

Ecosystem Design

Using the information you learned from the Ecosystem Components PowerPoint, list the plants, animals, and non-living things that belong to each component of your ecosystem design. Explain the role that each plant, animal, and non-living thing plays in supporting a healthy ecosystem. (Examples are provided below.)

Component	Name	Role / Importance
On Land or in Air (Nonliving)		
On Land or in Air (Living Plants)		
On Land or in Air (Living Animals)		
In the Water (Nonliving)		
In the Water (Living Plants)		
In the Water (Living Animals)	- Bluntnose Minnow	- Small Fish that eats plants and benthos

Mural Activity

Summary:
Students draw components of an ecosystem and put them together in a mural to demonstrate scientific relationships.

Materials:
Ecosystem Components PowerPoint and Ecosystem Component Printouts (printouts are created by printing out slides from the PowerPoint, one slide per page), 4'x3' light blue butcher paper, 4'x 2' green butcher paper, 1'x1' brown butcher paper, drawing paper, pencils, markers.

Procedure:
1. Instructions for preparing the ecosystem base with butcher paper are provided in Lesson Plan 4 procedure.

2. Break students into four teams. Explain that each team will draw one of the following ecosystem components:

    a) Above water: nonliving, living plants
    b) Above water: living animals
    c) In the water: nonliving, living plants
    d) In the water: living animals.

3. Give single-sided printouts of ecosystem components to each team, along with drawing paper, pencils, and markers. Turn on an automatic ecosystem component PowerPoint slideshow in the background.

4. Walk around as students draw ecosystem components, helping them with scale and important organism characteristics. Talk to students about species diversity and distribution and encourage them to draw a species that is different from others chosen at their table. Otherwise, the mural could end up having one songbird and five birds of prey based on species popularity with the students.

5. As students finish their ecosystem component, help them paste it on the mural. Ask the students where they think their component should go on the mural based on its needs and relationships to other species within the ecosystem.

Wrap-Up:
Engage students in a discussion about the mural. Ask them about species diversity and distribution. Relate the mural back to the second lesson, and ask them if they'd be happy organisms if they lived there. This mural can be displayed at the press event, described in Lesson Plan 5.

Lesson 5:
Press Event

Grade Level: 4-6

Time: 75 Minutes

Summary:

Contact Illinois-Indiana Sea Grant for information on press events related to the cleanup and to learn how to participate. Students who attend the press event will need to sign a photo release form, which can be obtained from Illinois-Indiana Sea Grant. Logistics and timing for the press event will be determined weeks in advance of the event. There are many options for involvement. Students may have the opportunity to listen to agency leaders speak about the cleanup, have photos taken with VIPs, display their mural, and/or plant natives near the water body. If students are planting, they will be directed to the planting area to receive directions on proper installation, and VIPs can be invited to help students install the plants.

Materials:

Dependent on participation (*e.g., trowels, murals, and/or plants from the students*).

High School Curriculum

Grades 9-12

Lesson 1:

Why Should We Keep the Great Lakes Great?

Grade Level: 9-12

Time: 55 Minutes

Vocabulary:
Native, invasive, sediment, U.S. Environmental Protection Agency, remediation, restoration.

Great Lakes Literacy Principles:

Principle 2
Concept E

Principle 5
Concept I

Principle 6
Concepts D, E, F

Principle 8
Concept F

Summary:
Students create a PowerPoint and learn about an environmental cleanup in their community, including details about scope and design.

Objectives:
- Describe the benefits of the Great Lakes.
- Discuss the effect of historical pollution on today's economy, society, and environment.
- Describe the technical aspects of an environmental cleanup.

Materials:
An example PowerPoint (editable .ppt file) can be found on www.greatlakesmud.org/education.html.

Procedure:
Administer the PowerPoint creation activity.

Assessment:
Conduct the cleanup pretest prior to the first lesson.

Name _____ **Date** ____/____/____

Part I: Multiple Choice

Read each question carefully and circle the correct answer.

1) What are two environmental problems that make the local water body unsuitable habitat for many species?

a. Species abundance, biodiversity
b. Contaminated sediment, invasive species
c. Biodiversity, contaminated sediment
d. Invasive species, species abundance

2) Scientists make _____ using their senses (smell, sight, etc.) to understand and make hypotheses about the world.

a. observations
b. data
c. science
d. sampling

3) Which of the following is NOT a step that must precede the actual cleanup in a Great Lakes Legacy Act project?

a. Project design
b. Sampling
c. Application
d. Habitat restoration

4) The Great Lakes Legacy Act targets pollution from industrial discharges _____.

a. and cannot clearly be traced to a viable entity
b. and can clearly be traced to a viable entity

Part II: Statistics

Give the mean, median, mode, and any outliers for the data in column L-1 of Table 1.

5) Mean _____

6) Median _____

7) Mode _____

8) **Outlier(s) _____**

Table 1. Levels of contaminant "X" detected in water quality samples.

Date	L-1	L-2	L-3	L-10	RSL
1-Sep	1.2	0.65	0	0	0.31
30-Aug	0	0	0	0	0.31
10-Aug	.65	0	0	0.73	0.31
5-Aug	1.2	0.79	0.89	0	0.31
2-Aug	0.68	0	0	0	0.31
25-Jul	0.71	0.72	0.63	0	0.31
20-Jul	1	0	0		0.31
14-Jul	0.63	0	0		0.31
13-Jul	3.5	0	0		0.31
7-Jul	0.66	0.66	0.75	0.5	0.31
5-Jul	0.79	0.83	0.72		0.31

9) Table 1 displays results in a format that scientists use to communicate data with one another. This format is not good for communicating science to the public. In a couple sentences, describe two alternatives for communicating these data to the public. (Note: levels of contaminant "X" above 2.0 are dangerous.)

Part III: Fill in the Blank
Read each statement carefully and fill in the blank with the correct answer.

10) A(n) _____ species is supposed to live in the local ecosystem. It belongs there.

11) A(n) _____ species does not belong in the local ecosystem. It harms the species that belong in the ecosystem.

12) _____ is the wet, squishy mud found at the bottom of a river or lake.

Part IV: Short Answer
Read each question carefully and provide an answer using a complete sentence.

13) What are three environmental, social, or economic benefits that people derive from the Great Lakes?

14) Why is it important for scientists and engineers to work as a team to clean up the environment?

Name _____ **Date** ____/____/____

Part I: Multiple Choice

Read each question carefully and circle the correct answer.

1) What are two environmental problems that make the local water body unsuitable habitat for many species?

a. Species abundance, biodiversity
b. Contaminated sediment, invasive species
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d. Invasive species, species abundance

2) Scientists make _____ using their senses (smell, sight, etc.) to understand and make hypotheses about the world.

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b. data
c. science
d. sampling

3) Which of the following is NOT a step that must precede the actual cleanup in a Great Lakes Legacy Act project?

a. Project design
b. Sampling
c. Application
d. Habitat restoration

4) The Great Lakes Legacy Act targets pollution from industrial discharges _____.

a. and cannot clearly be traced to a viable entity
b. and can clearly be traced to a viable entity

Part II: Statistics

Give the mean, median, mode, and any outliers for the data in column L-1 of Table 1.

5) Mean 1.0

6) Median 0.71

7) Mode 1.2

8) Outlier(s) 3.5

Table 1. Levels of contaminant "X" detected in water quality samples.

Date	L-1	L-2	L-3	L-10	RSL
1-Sep	1.2	0.65	0	0	0.31
30-Aug	0	0	0	0	0.31
10-Aug	.65	0	0	0.73	0.31
5-Aug	1.2	0.79	0.89	0	0.31
2-Aug	0.68	0	0	0	0.31
25-Jul	0.71	0.72	0.63	0	0.31
20-Jul	1	0	0		0.31
14-Jul	0.63	0	0		0.31
13-Jul	3.5	0	0		0.31
7-Jul	0.66	0.66	0.75	0.5	0.31
5-Jul	0.79	0.83	0.72		0.31

9) Table 1 displays results in a format that scientists use to communicate data with one another. This format is not good for communicating science to the public. In a couple sentences, describe two alternatives for communicating these data to the public. (Note: levels of contaminant "X" above 2.0 are dangerous.)

One option would be to graph the data. Another option would be to color the cells that are of concern and provide a key for the colors. Both options are visual displays, which simplify the data.

Part III: Fill in the Blank

Read each statement carefully and fill in the blank with the correct answer.

10) A(n) _____native_____ species is supposed to live in the local ecosystem. It belongs there.

11) A(n) _____invasive_____ species does not belong in the local ecosystem. It harms the species that belong in the ecosystem.

12) _____sediment_____ is the wet, squishy mud found at the bottom of a river or lake.

Part IV: Short Answer

Read each question carefully and provide an answer using a complete sentence.

13) What are three environmental, social, or economic benefits that people derive from the Great Lakes?

There are many different answers. As long as there are three distinct benefits, the student gets credit. Possibilities include fishing, swimming, beaches, boating, industrial use, transportation, drinking water, renewable energy, mining, wildlife and fish habitat, aesthetic views, etc.

14) Why is it important for scientists and engineers to work as a team to clean up the environment?

There are many different kinds of scientists and engineers, and they all have different skill sets. Cleaning up the environment is a complex process that requires those skill sets - from hydrology to animal biology to chemistry to communication. Scientists and engineers work together and share their knowledge and creative ideas to study and solve problems.

Our Area of Concern: Gettin' Cleaned Up

To learn more about your Area of Concern, you are going to do some internet research using Google and the GreatLakesMud.org site for basic information to create a class PowerPoint. Either individually or as small groups, have students "mine" for information on the site and create a slide on one or two points of information. Once each student/group has their PowerPoint slides created they should be imported into one presentation and each group will present their slides.

Slides needed for the presentation:

1. Title slide with an aerial or site picture of the Area of Concern with a catchy title.
2. A slide showing the audience what benefits we receive from the Great Lakes. (i.e. drinking water, recreation, etc.)
3. A slide with a picture of polluted sediment. Examples can be found on the GreatLakesMud.org pollution page. The students can ask the class if they know what sediment is (mud at the bottom of a lake or river). Any facts about the specific sediment pollutants of your Area of Concern would be valuable as well.
4. A slide of an aquatic food web. Examples of food webs can be found on the GreatLakesMud.org Education Introduction page for food web examples. Keep in mind that not all organisms on these food webs will necessarily be in your waterbody. Consult with Illinois-Indiana Sea Grant on organisms that are native to the area.
5. A slide that relates polluted sediment with the effects of the food chain.
6. A slide that circles back to how polluted sediment affects the benefits of the Great Lakes (slide 2).
7. Several slides for the Great Lakes Legacy Act including:
    a. Who is involved?
    b. What the partners' role?
    c. What progress has been made so far? Pounds /cubic yards of contaminated sediment removed? Make the numbers relatable (i.e. 5 million pounds = 750 adult male elephants).
        i. Volume of sediment. Again make it relatable to your audience.
        ii. Cost. Once again, how is millions of dollars relatable to your audience?
    d. What is the process start to finish for a restoration project?
        i. Helpful resources for research
            1. GreatLakesMud.org Legacy Act tab
               http://www.greatlakesmud.org/legacy-act.html
            2. U.S. Environmental Protection Agency
               http://www.epa.gov/great-lakes-legacy-act
            3. Presentation by Marc Tuchman – GLNPO
               http://tinyurl.com/jbzqwrw
8. A slide on what's going on in my Area of Concern? Use GreatLakesMud.org for information.
    a. How much is getting cleaned up?
        i. Volume (make relatable)
        ii. Acreage
        iii. Cost (relatable)
9. 7-10 slides with pictures of the site cleanup. Some will be found on GreatLakesMud.org. Check with Illinois-Indiana Sea Grant for other reliable sources for photographs.
10. Final slide for questions remaining about the project that the class can ask Illinois-Indiana Sea Grant or project managers when available.

Lesson 2:

Get the Lowdown on Your Local Water Quality

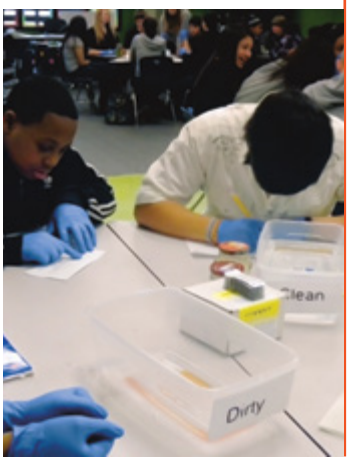
Grade Level: 9-12

Time: 180 minutes (*90 Minutes Field, 90 Minutes Lab*)

Vocabulary:
Sampling, observations, data, data collection, parameter, contaminant.

Great Lakes Literacy Principles:

Principle 6
Concepts E, F



Summary:
Students go on a field trip to a remediated or clean portion of their local water body and take water samples. They then perform a lab test with water test kits to determine water quality.

Objectives:
Students will learn how to perform water sampling and data collection, adequately representing a section of the water body.

Materials:
Lab notes, lab sheets, latex gloves, tape, Sharpies, water test kits (the AM-12 TesTab Water Investigation Kit, LaMotte, was used in the pilot), baby food jars, and two one-quart food storage containers (one empty labeled "dirty" and one full of clean water labeled "clean").

Procedure:

1. Field activity: Walk along the water and point out interesting ecological characteristics of the site. Ask students to make observations in their lab notes. While students are making notes, identify two locations where students will sample. Locations should provide easy access to the water with stable footing for the students. Separate students into teams of four each. Take half the teams to one location and half the teams to the other. Hand out gloves and a baby food jar to each team. Have students label their jar with their team name and location using tape and a Sharpie. Demonstrate how to take a water sample. Ask students to make observations about their water sample in their lab notes. Switch teams to opposite locations and repeat to obtain the second sample. Again, have students label their jar with their team name and location.

2. Classroom lab: Choose six parameters from the kit to test for. Prepare the lab with one test parameter from the water test kit at each table. Place two 1-quart food storage containers (one empty labeled "dirty" and one full of clean water labeled "clean") at each table. Ask students to divide into their field teams and sit at the

tables in teams. Go over each of the parameters with the students and explain why each is an important indicator of water quality. Remind students to take notes as this information will help them fill out their lab sheets.

Following the water test kit instructions, demonstrate how to perform a parameter test to the students. Show the students how to empty the test into the "dirty" storage container. Use water from the "clean" storage container to rinse the test tube, and dump contents into the "dirty" storage container so that the tube is clean for the next test. Tell the students they will perform one test for each sample at each table (two tests per table). Walk around and help students fill out their lab sheets as they do their tests.

Extension:

Compile the data from each group into the master dataset (template provided in the lesson) for locations one and two. On a separate day, talk to the students about data analysis. Discuss the definitions of mean, median, mode, and outlier statistics with the students. Hand out the master dataset to the students and complete statistic examples on the board. Demonstrate how to solve mean, median, and mode for the first two parameters with the students. Have students perform the data analysis activity. Send the data analysis results to Illinois-Indiana Sea Grant.

Assessment:

Lab sheets and data analysis activity with grading sheets are provided in the lesson.

Name _____ **Date** ____/____/____ **Team** _____

Field Sampling: Location One

Part I: Environment Observations
Make eight observations about the location one environment using your senses (sight, hearing, touch, and smell). Some example observations include: speed of water flow, color of the water, air and water temperature, presence of wildlife, and presence of plants in/near/far from the water.

1)

2)

3)

4)

5)

6)

7)

8)

Part II: Water Sample Observations
Make two observations about the location one water sample.

1)

2)

Name _____ **Date** ____/____/____ **Team** _____

Field Sampling: Location Two

Part I: Environment Observations
Make eight observations about the location two environment using your senses (sight, hearing, touch, and smell). Some example observations include: speed of water flow, color of the water, air and water temperature, presence of wildlife, and presence of plants in/near/far from the water.

1)

2)

3)

4)

5)

6)

7)

8)

Part II: Water Sample Observations
Make two observations about the location two water sample.

1)

2)

Name _____ **Date** ____/____/____ **Team** _____

Data Collection

List each parameter that you are testing the location one water sample for in the Test Name column. Define the parameter, perform any necessary calculations, and list your test result. Describe what this result tells you about the water and implications for the ecosystem.

LOCATION 1

Test Name/Parameter	Parameter Definition	Calculations	Test Result	What does the result tell us?

Name _____ **Date** ____/____/____ **Team** _____

Data Collection

List each parameter that you are testing the location one water sample for in the Test Name column. Define the parameter, perform any necessary calculations, and list your test result. Describe what this result tells you about the water and implications for the ecosystem.

LOCATION 2

Test Name/Parameter	Parameter Definition	Calculations	Test Result	What does the result tell us?

Name _____ **Date** ____/____/____ **Team** _____

LOCATION 1

Test Name	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8

Name _____ **Date** ____/____/____ **Team** _____

LOCATION 2

Test Name	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8

Name _____ **Date** ____/____/____

Part I: Short Answer
Read each question carefully and provide an answer using a complete sentence.

How do we solve for a mean value?

How do we solve for a median value?

How do we solve for a mode value?

What is an outlier? Give two reasons why they occur.

Name _____ **Date** ____/____/____

Part II: Data Tables

Fill in the tables below using the master dataset.

LOCATION 1

Test Name	Outliers	Mean	Median	Mode

LOCATION 2

Test Name	Outliers	Mean	Median	Mode

Name _____ **Date** ____/____/____

Part I: Short Answer
Read each question carefully and provide an answer using a complete sentence.

How do we solve for a mean value?

We solve for a mean, or average, value by calculating the sum and dividing by the number of data points.

How do we solve for a median value?

We solve for a median value by rearranging the data points in ascending order and finding the midpoint. If there is an even number of data points {a, b, c, d}, then the median is the mean of b and c.

How do we solve for a mode value?

We solve for a mode value by rearranging the data points in ascending order and finding the number that appears most often. There may be more than one mode.

What is an outlier? Give two reasons why they occur.

An outlier is a data point that is numerically distant from the other data. They occur because of chance and measurement error.

Lesson 3:

Making Environmental Decisions Through Data Analysis

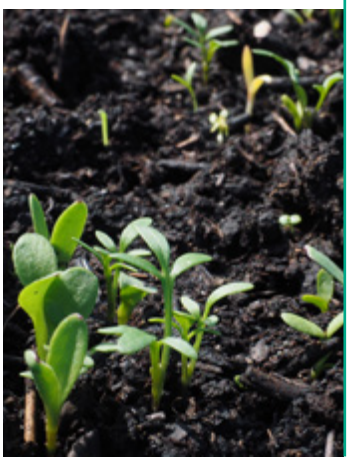
Grade Level: 9-12

Time: 55 Minutes

Vocabulary:
Data management, data analysis, data reporting, mean, median, mode.

Great Lakes Literacy Principles:

Principle 7
Concepts D, E, F



Summary:
Discuss the site water quality based on results from the data analysis activity. Students make conclusions about their data. Students learn how scientists use various communication strategies to communicate data to different groups and use data to make project-level decisions.

Objectives:

- Analyze data using simple statistics.
- Make conclusions about the environment using data.
- Describe different strategies scientists use to communicate data to the public.
- Explain how scientists use data to make project-level decisions.

Materials:
Results from data analysis, Scientific Data PowerPoint. An editable PowerPoint (.ppt) file can be found on www.greatlakesmud.org/education.html.

Procedure:
Using results from the data analysis, engage students in a discussion on making conclusions about water quality at the site. Give the presentation on data reporting and decision making. Students do data conclusions worksheet. Contact Illinois-Indiana Sea Grant if interested in having a guest speaker, such as a project scientist, visit the class. An example plan of work for the guest speaker is provided.

Assessment:
Data conclusions activity with grading sheet.

Example Plan of Work for Guest Speaker

Purpose and Background:
The objective of this guest speaker visit is to teach students about data management, data analysis, reporting data (including communicating it to the public), and using data to make project-level decisions. Use real-life examples and stories to engage the students in these topics. They will benefit from listening to "real-world scientists" speak about the process of each of these steps, which will validate each step's importance. Twenty-five minutes of time is recommended for the guest speaker, but that can be modified based on the teacher's need.

Agenda:

1. Introduce guest speakers
    a) Name, role, why you came to speak to the class

2. Guest speaker stories
    a) Use engaging stories and examples to answer each of these questions. Use as many applicable stories from the current environmental cleanup project as possible.
        i) Where did you go to school? What jobs did you have before this one?
        ii) A lot of responsibility comes with this role (problem solving, budgeting, etc.).
        iii) Is this job what you thought it was going to be?
        iv) What do you like about this job?
    b) Questions from the students

3. Deliver Scientific Data PowerPoint

4. Teacher overview of data analysis activity
    a) Mean, median, mode, outliers

5. Making Conclusions Using Data Worksheet

Timeframe: 55 Minutes

Name _____ **Date** ____/____/____

Use your data analyses and lab note observations to provide answers in complete sentences.

Part I: Synthesizing Data

What parameters were of high concern at location one?

Why do you think those parameters were of high concern?

What parameters were of high concern at location two?

Why do you think those parameters were of high concern?

Did results from location one vary from location two? How so? Why or why not?

Using what we have learned about what these tests mean, state how healthy the water body is. (Make sure you use information from both locations to make a conclusion.)

How can we as a school help to ensure that the water body continues to thrive after the remediation is done?

Part II: Reporting Data

How do scientists present data so that the public can understand the data?

Name _____ **Date** ____/____/____

Use your data analyses and lab note observations to provide answers in complete sentences.

Part I: Synthesizing Data

What parameters were of high concern at location one?

Student lists parameters.

Why do you think those parameters were of high concern?

Student uses observations about the environment and their water sample and what they know about the site to explain why parameters were of high concern in the water body.

What parameters were of high concern at location two?

Student lists parameters.

Why do you think those parameters were of high concern?

Student use observations of the environment and their water samples and what they know about the site to explain why parameters were of high concern in the water body.

Did results from location one vary from location two? How so? Why or why not?

Student describes how results are different (or not) using observations of the environment and their water sample and what they know about the site to explain why or why not.

Using what we have learned about what these tests mean, state how healthy the water body is. (Make sure you use information from both locations to make a conclusion.)

Student states the health level of the water body, using observations and data analysis results from both locations to support the statement.

How can we as a school help to ensure that the water body continues to thrive after the remediation is done?

Student describes a stewardship activity, such as spreading the word about the cleanup, data collection, getting the community involved, and performing a litter cleanup.

Part II: Reporting Data

How do scientists present data so that the public can understand the data?

Scientists can simplify the data so that only the important information is displayed. One option for data display is to graph the data and highlight areas of concern. Another option is to display the data in a table and color the cells that are of concern, providing a key for the colors. Both options are visual displays, which can help a scientist present concepts.

Lesson 4:

Dynamic Careers to Clean Up the Environment

Grade Level: 9-12

Time: 55 Minutes

Vocabulary:
Scientist, engineer.

Great Lakes Literacy Principles:

Principle 7
Concept F

Summary:
Students learn about different careers in the environment as well as the teamwork aspect of environmental cleanups. This lesson includes the option to have a project scientist or engineer visit as a guest speaker to discuss careers and their roles in the cleanup.

Objectives:

- Name important classes to take in high school and college in order to pursue an environmental career.
- Describe the variety of careers in environmental science and engineering.
- Describe the teamwork aspect of environmental cleanups.

Materials:
Career PowerPoint. An editable PowerPoint (.ppt) file can be found on www.greatlakesmud.org/education.html.

Procedure:
Prior to Lesson Plan 4, have students write one-minute speeches about the environmental cleanup. Choose five finalists to deliver their speeches to the class. Deliver the PowerPoint on environmental careers, and engage students in a Q&A session about environmental careers. Contact Illinois-Indiana Sea Grant if interested in having a guest speaker, such as a project scientist or engineer, visit the class. The guest speaker can provide personal experiences on careers in environmental science and engineering. An example plan of work for the guest speaker is provided.

Example Plan of Work for Guest Speaker

Purpose and Background:
The objective of this guest speaker visit is to teach students about careers in environmental science and engineering. They will benefit from listening to "real-world scientists" speak about their background and different career options. Twenty-five minutes of time is recommended for the guest speaker, but that can be modified based on the teacher's need.

Agenda:

1. Speeches
    a) Top five speech finalists chosen by the teacher give their speeches to the guest.
    b) The teacher works with the guest speaker to determine the best speech.
    c) The teacher may be able to have his or her student speak at a press event for the environmental clean up. Contact Illinois-Indiana Sea Grant for more information.

2. Career education PowerPoint
    a) Types of jobs in environmental science with a focus on environmental research scientists (ERS) and environmental engineers (EE).
    b) Interests of ERS/EE
    c) Where do they work? (field, lab, etc.)
    d) What classes should I take in high school?
    e) College majors
    f) Summers matter!/internships

3. Introduce guest speakers
    a) Name, role, why you came to speak to the class

4. Life of a project scientist or engineer
    a) Role of a scientist or engineer in an environmental cleanup
        i) Where did you go to school? What jobs did you have before this one?
        ii) A lot of responsibility comes with this role (problem solving, budgeting, etc.).
        iii) Is this job what you thought it was going to be?
        iv) What do you like about this job?
        v.) Describe the many ways you are a leader.
        vi.) Walk us through a typical day/week.
        vii.) How does your job differ from people you work closely with?
    b) Questions

5. Discussion about water sampling data
    a) What did you learn about the water?
    b) Did results vary between locations?
    c) Are there any parameters we should be concerned about?

Timeframe: 55 minutes

Lesson 5:

The Real Deal—Cleanup in the Field

Grade Level: 9-12

Time: 90 Minutes

Vocabulary:
Banks, erosion control, water flow, hydrology.

Great Lakes Literacy Principles:

Principle 6
Concepts D, E, F

Summary:
Students go on a tour of the site and perform a litter cleanup.

Objectives:
- Become more connected to the site by performing stewardship activities.
- Develop understanding of the engineering and science behind the cleanup by seeing it firsthand.

Materials:
Gloves, trash bags, and hand sanitizer.

Procedure:
To perform only the litter cleanup portion of this lesson, contact Alliance for the Great Lakes for information on litter cleanup opportunities in your area. To perform the entire lesson, including a site tour, contact Illinois-Indiana Sea Grant. At least two teachers are required for the completion of this lesson. Split students into two groups. One group goes on a site tour for 45 minutes with the first teacher and a project manager. The project manager highlights interesting scientific and engineering features using engineering diagrams and before and after pictures. The second teacher leads the other group in a litter cleanup. For this portion, students are split into teams of two or three each. The teacher gives gloves to each of the students and a trash bag to each team. At the end of the litter cleanup activity, students are provided hand sanitizer. The groups, including teachers and chaperones, switch and perform the remaining activity for their group. Finally, the teacher administers the test on a later day.

Assessment:
Posttest and answer key are provided in Lesson Plan 1 and cover concepts learned throughout the educational program.

Lesson 6:
Press Event

Grade Level: 9-12

Time: 60 Minutes

Vocabulary:
Remediation, restoration, scientist, engineer, contaminant, sediment, native, invasive

Great Lakes Literacy Principles:

Principle 6
Concepts D, E, F

Summary:
Contact Illinois-Indiana Sea Grant for information on press events related to the cleanup and to learn how to participate. Students who attend the press event will need to sign a photo release form, which can be obtained from Illinois-Indiana Sea Grant. Logisitics and timing for the press event will be determined weeks in advance. Students can simply attend the event to listen to speakers. There are many options for involvement. A student representative may have the opportunity to give a speech about their involvement. If grade school children are attending the event with native plants to install, they could help the younger students. Another possibility is displaying a poster and answering questions about their water sampling project. Alternatively, a student could videotape the event and write a blog post or article for the school website.

Materials:
Dependent on participation (*e.g., student's speech or poster on water sampling project).*

Helping Hands
Restoring Great Lakes Habitat

Connecting students with scientific principles through local sediment and habitat projects

> *We will conserve only what we love. We will love only what we understand, and we will understand only what we are taught.*
>
> - Baba Dioum

FIND OUT MORE

GreatLakesMud.org
Visit our webiste for additional resources

cmccoy2@illinois.edu
Please send all questions and feedback
to Environmental Social Scientist Caitie Nigrelli

Sea Grant
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