Helping Hands: Restoration for Healthy Habitats

A curriculum guide to revitalize Great Lakes Areas of Concern

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ILLINOIS - INDIANA

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Introduction

This curriculum provides a four-month 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 communities where large scale environmental cleanup and restoration projects are currently taking place. These communities have been labeled Areas of Concern due to years of industrial pollution. Through participation in these activities, 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.

Working closely with teachers, Illinois-Indiana Sea Grant's (IISG) environmental social scientist, Caitie McCoy, will lead the curriculum project in the classroom, providing engaging classroom presentations and conducting activities in varied instructional modes. This curriculum can be adapted to complement existing school-based education needs. Each lesson has been aligned with relevant Great Lakes Literacy Principles—see www.greatlakesliteracy.net for a complete listing of all eight principles. As the Next Generation Science Standards are finalized, alignment to each lesson will be provided on IISG's webpage at www.iiseagrant.org/education/steward_educ.html.

Teachers interested in participating with IISG to teach this curriculum should contact Caitie McCoy, www.iiseagrant.org/staff/mccoy.html.

This curriculum was initially implemented in Hammond and East Chicago, Indiana, and in Sheboygan, Wisconsin. Project highlights are provided below.

http://lakesideviews.blogspot.com/2012/03/nw-indiana-students-engage-in-hands-on.html
http://lakesideviews.blogspot.com/2012/06/grand-calumet-and-roxana-marsh-cleanup.html
http://lakesideviews.blogspot.com/2012/12/wisconsin-students-learn-about-great.html

Grade School Curriculum

Sample Plan of Work for Grade School Lessons

Classroom Collaboration with Illinois-Indiana Sea Grant Program

The students at East Chicago Lighthouse Charter School (ECLCS) growing their classroom seeds of species that will be planted as part of the Great Lakes Legacy Act (GLLA) habitat plan.

- ECLCS has five window sills, which are 3-1/2 feet long by 8 inches wide where they could place the flats
- Contractors are getting the seeds, flats, and soil.

Sea Grant visits the classrooms multiple times and does hands-on activities regarding the GLLA project.

- Guest speakers: USFWS, USEPA and contractor
  - ✓ Guests for two separate classes
- Doodle poll for dates
  - ✓ Need to commit to dates sooner than later
  - ✓ End of month is better
  - ✓ Classes on M/T/Th/F 11-12:30 and 1:30 – 3:00
- Two separate classes
- January: Send seeds/soil/flats to ECLCS (may be early February)
  - ✓ School visit for introduction to the project
- February: School visit on habitat
  - ✓ Feb 20 Holiday, Feb 24 unavailable
  - ✓ PowerPoint
  - ✓ Habitat activity
- March: ECLC visit on pollution and fish
  - ✓ March 5 – 9 Testing (Check on school's state testing exams)
  - ✓ Guest speaker – USFWS /USEPA
  - ✓ Bioaccumulation activity
- April: Revisit discussion on cleanup and restoration
  - ✓ Guest speaker
- May: Students plant their seedlings onsite at Roxana Marsh. This is in conjunction with a press event.
- Leave a safe, easily accessible section located near press event site for students to plant (subject to the class's availability)
- Number of children permitted on the site.
  - ✓ About 25 at one time
  - ✓ 2 Field trips; one in press event attendance
- Check with school on best dates for the restoration activity
- Staging at Knights of Columbus – picnic area
- Safety concerns – Determined by landowner
  - ✓ May involve the parents/teachers signing access safety agreements and having the students take a safety briefing onsite
  - ✓ Contingency plan for bad weather for student involvement date
  - ✓ Contractors plan to end their restoration work

Lesson 1

What Makes Up My Ecosystem? Get Down and Dirty

Grade Level: 4 – 6

Time: 75 minutes

Summary: Students learn about an environmental cleanup happening in their very own town. Students pot native seeds that they will grow in their classroom and take to the cleanup site to help restore the environment. (IISG will work with U.S. Environmental Protection Agency (EPA) to obtain seeds that are native to the restoration site.)

Objectives

- Describe the effect of historical pollution on today's environment.
- Describe the role of EPA.
- Relate EPA's role in the environmental cleanup in the students' town.

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

Materials: Provided by IISG: Story about local ecosystem, plant guide PowerPoint, seed planting instructions, native seeds, flats filled with potting soil, and spray bottles

Activity Preparation: Teachers will need space in the classroom or school to grow seeds in their flats. Flat size may vary depending on the project, and IISG specialist will work with the teacher to determine space requirements.

Procedure: Prior to the Sea Grant specialist's arrival in the classroom, the teacher will administer the Cleanup Pretest. The IISG specialist will bring materials for planting native seeds and set them up in an outdoor location at the school. After making introductions to the students, the specialist will deliver a story about the local ecosystem, review a plant guide PowerPoint and seed planting instructions with the students, and then take the students outside and pot native seeds with help from the teacher. The seed planting instructions are as follows:

1. Sprinkle THREE seeds into the middle of each pot.
2. Do NOT push the seeds into the soil.
3. Instead, sprinkle a small amount of soil over the top, just enough to cover seeds.
4. Gently and slowly water the pots.

Assessment: Conduct the Cleanup Pretest on vocabulary and ecosystem concepts prior to the Sea Grant specialist's visit to the classroom.

Great Lakes Literacy Principles

Great Lakes Literacy Principle 5
The Great Lakes Support a Broad Diversity of Life and Ecosystems.
Concepts A, B, E, G, H (www.greatlakesliteracy.net/principles/5)

Great Lakes Literacy Principle 6
The Great Lakes and Humans in their Watersheds are Inextricably Interconnected.
Concepts A, B, C (www.greatlakesliteracy.net/principles/6)

Name _____ Date _____

Lesson 1 Environmental Cleanup Pretest (Grades 4-6)

Part I: Vocabulary

Read each question carefully and print the letter of the correct answer next to the question.

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: Short Answer

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

1) A(n) _____ species is supposed to live in the local ecosystem; it belongs there.

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

3) _____ is the wet, squishy dirt found at the bottom of the river.

Part III: Complete Sentence

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

1) What are two environmental problems that make the water body unsuitable habitat for native animals?

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

Name _____ Date _____

Lesson 1 Environmental Cleanup PreTest Key (Grades 4-6)

Part I: Vocabulary (5 points each)

Read each question carefully and print the letter of the correct answer next to the question.

1) B 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) A 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) D Which of the following is NOT a component of a species' natural habitat?
   a. shelter
   b. space
   c. food
   d. invasive species

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

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

8) A Scientists make _____ using their senses (smell, sight, etc.) to understand and make hypotheses about the world.
   a. observations
   b. guesses
   c. science

Part II: Short Answer (10 points each)

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

1) A(n) _____native_____ species is supposed to live in the local ecosystem; it belongs there.

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

3) Sediment_____ is the wet, squishy dirt found at the bottom of the river.

Part III: Complete Sentence (15 points each)

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

1) What are two environmental problems that make the water body unsuitable habitat for native animals?

   Two environmental problems are invasive species and pollution. (Will also accept degraded habitat and contaminated or polluted sediment.)

2) Why is it important for scientists and engineers to work on 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.)

Sample Introductory Case Study

The Story of Roxana Marsh (East Chicago, IN)

By Caitie McCoy

A long time ago, before you were born or even I was born, there was a very special place - very close to your school - where **migrating** birds would stop to rest their wings from their long journeys. This place was full of yummy bugs and fish for the birds to eat. It had big, full plants where the birds could find **shelter** from bad weather and **predators**. This place was called Roxana **Marsh**.

In the 1800s and 1900s, factories moved into NW Indiana. These factories made lots of good things that humans use, but they also put a lot of **pollution** into the environment. This pollution hurt the environment of Roxana Marsh and made it a difficult place for fish and plants to live and grow. Birds would stop to rest their wings at Roxana Marsh, but they could not find food; they could not find shelter.

In the 1970s, our **government** made lots of laws to protect the **environment**, which made it illegal for these industries to pollute. The **industries** stopped polluting, but there was still a lot of pollution left in Roxna Marsh.

As if the pollution wasn't bad enough, Roxana had another problem. About a decade ago, a plant called **Phragmites** came to Roxana Marsh. Its roots spread very far and grew very fast. This plant did not belong in the marsh; it was **invasive**. It took over the marsh, and all the native plants still left struggling to live there died. Phragmites is not a helpful plant for birds or fish. It does not bring the right kind of bugs; it does not provide the right kind of shelter. Because of pollution and Phragmites, birds do not come to Roxana Marsh anymore.

This is a pretty sad story so far, but I have some very good news! The **U.S. Environmental Protection Agency**, with the help of other **government agencies**, is cleaning up Roxana Marsh! They are cleaning up the pollution in the marsh and replacing Phragmites with native plants. And they want your help! They have sent me here with native seeds, soil, and containers. They want you to raise these seeds into native plants that will help the birds and help the fish. Once the plants get big enough toward the end of the school year, you'll get to take them to Roxana Marsh and plant them in the ground!

After a few years go by, the native species that you have planted at Roxana Marsh will get big enough that they will provide a good **habitat** for the fish and birds.

Sample Student Reflections

Tuesday me and my classmates helped plant seeds for Roxana Marsh. Ms. McCoy, a scientist from EPA taught us about Roxana Marsh. Ms. McCoy told us a story about what happened to Roxana Marsh. We learned proper steps to planting seeds. There are different kinds of plants we planted.

In Roxana Marsh there are plants called phragmites invading Roxana Marsh. 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 Ms. McCoy 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 Roxana Marsh because I don't want the animals to suffer. And, because the phragmites 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 Roxana Marsh!

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.

Roxana Marsh Plants

Grown by

Ms. Bock's Fourth Grade Classes

ILLINOIS-INDIANA SEA GRANT

Aster laevis

smooth blue aster

- Popular source of food for butterflies and white-tailed deer
- Provides shelter for butterflies

Monarda fistulosa

wild bergamot

- Bees, butterflies, and hummingbirds eat the nectar from this flower
- Native Americans flavored meat with it and made it into tea for treating colds

Penstemon calycosus

longsepal beardtongue

- Bees like to drink nectar from this flower
- This flower has no floral (or flowerlike) scent

Rudbeckia hirta

blackeyed Susan

- Provides food and shelter for songbirds and game birds (turkeys, pheasants)
- Used by Native Americans to treat colds, swelling, snake bites, and earaches

Schizachyrium scoparium

little bluestem

- Seed is eaten by songbirds and the plant provides shelter for birds and small mammals

Silphium perfoliatum

cup plant

- The leaves form a cup shape. Birds drink water that gets caught in this cup after it rains.

Seed Planting Instructions

1. Label individual pot with the species sticker.
2. Fill individual pot with planting soil mix to about ½ inch of the top of the pot.
3. Do NOT push the soil mix into the pot.
4. Instead, lightly tap the filled pot on the ground to help the soil settle in.
5. Using a plastic spoon, sprinkle THREE seeds into the middle of each pot.
6. Do NOT push the seeds into the soil.
7. Instead, sprinkle a small amount of soil over the top, just enough to cover seeds.
   - Rule of thumb: a seed gets planted to a depth of 1-2 times its size. Since these seeds are very small, they don't need to go deep.
8. Gently and slowly water the pots.

Lesson 2
Habitat Woes

Grade Level: 4 – 6

Time: 75 minutes

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.

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 animal's habitat.
- Describe the differences among population, community, and ecosystem.

Vocabulary: habitat, wetland, river, sediment, native, invasive, pollution, ecosystem, community, population, aquatic, resources, shelter

Materials: *Habitat* PowerPoint, See *Degraded Habitat Activity* for additional materials

Procedure: The IISG specialist makes introductions to students, including any guest speakers. After recapping lesson one, present the *Habitat* PowerPoint and facilitate the *Degraded Habitat Activity*.

Extension: Students complete "Who Lives in My Community" from Alliance for the Great Lakes curriculum, *Great Lakes in My World*, Unit 4.

Assessment: Rubric for "Who Lives in My Community" is provided on p. 309 of *Great Lakes in My World*.

Great Lakes Literacy Principles
Great Lakes Literacy Principle 6
The Great Lakes and Humans in their Watersheds are Inextricably Interconnected.
Concepts D, E, F (www.greatlakesliteracy.net/principles/6)

Degraded Habitat Activity

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

Materials: 8 ½ x11 habitat component cards [one for each student; sample cards for 27 students would include three aquatic birds, three fish (food), three clean water (water), six vegetation (shelter and space), six pollution, and six invasive species]

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 of key elements of habitat (food, water, shelter and space) to native animals.
2. Divide the students into six groups: bird, fish, water, vegetation, pollution, and invasive species.
3. 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.
4. Ask the students representing vegetation and clean water to arrange themselves in the habitat area. Have the fish sit next to the water. Then have the birds go in and stand among their resources.
5. Once all the animals 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. Then, because the ecosystem is weak, the invasive species remove the vegetation and stand in their place.
6. Ask the birds if they are happy, and why or why not. Have them take a couple steps back.
7. Then tell the pollution and the invasive species that EPA and its partners are coming to clean up the environment. Have the pollution and invasive species sit down.
8. Tell the clean water, fish, and vegetation that they can go back to their original habitat/location since the pollution and invasive species are now gone.
9. Have the birds 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 throughout this Degraded Habitat activity. What actions took place? What were the consequences? Emphasize the needs of the bird and how these habitat requirements are being considered throughout the project design.

Unit 4

Human Communities

*Humans (*Homo sapiens*) have been dependent on the Great Lakes for thousands of years. Humans have the potential to both create and solve problems for the Great Lakes.*

essential questions

- **In what ways do humans depend on the Great Lakes?**
- **How do human communities and the Great Lakes affect each other?**
- **How can a community be healthy and live in balance with the Great Lakes?**

unit overview

Students reflect on and examine how human relationships with the environment affect Great Lakes' communities. They study how human and wildlife needs are met within the Great Lakes region. In exploring how urban ecosystems are dependent on water resources, students learn about the interplay and balance essential in maintaining a healthy relationship with the Great Lakes. Students investigate issues that face the Great Lakes and the human role in creating, perpetuating and helping to solve these problems. By looking at communities and how they work, students evaluate their communities, with an eye toward improvements to the system. As a final project, students design a community that takes into account what they learn in this unit.

concepts

- The Great Lakes serve the region in many ways. To fully appreciate this ecosystem, it is important to understand the ways in which plants, animals, people and their communities depend on the lakes.

- Humans can both create and solve problems for the Great Lakes. In order to conserve, preserve and have a healthy relationship with our Great Lakes, we need to understand the impact our actions have on them.

CONNECT **1 | What's the Environment?**

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DISCUSSIONS: Student participates in class discussions both before and after drawing his/her interpretation of the word "environment." Student uses active listening skills (eye-contact, confirming or referencing others' comments, affirmative gestures or comments).	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
DRAWING: Student draws his/her interpretation of the environment both before and after class discussion. Changes in thought are reflected in the second drawing. Student's drawing reflects attention to detail and shows personal investment.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components

CONNECT **2 | Sound Picture**

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
SOUND PICTURE: Student listens quietly to sounds of a Great Lakes beach. S/he uses words and/or images to reflect what is heard. Student includes words to describe the images, as necessary.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
DISCUSSION: Student shares his/her drawing with a partner or small group. S/he participates in the discussion about the class sound pictures. Student discusses the interaction between humans and the Great Lakes and his/her personal connection to the lake.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components

EXPLORE **3 | Take a Good Look**

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
OBSERVATION: Student observes and makes note of various living and non-living objects at the beach, and then draws and labels a living and non-living item.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
SHORT ANSWER: Student answers questions about the items, discusses the relationship between living and non-living items to the ecosystem, and participates in the class discussion, connecting human impact with the Great Lakes. Student includes evidence of personal response to the lake.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components

EXPLORE **4 | Who Lives In My Community?**

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DISCUSSION: Student brainstorms the basic needs of organisms and compares them to human needs. Student gives examples of how human needs are met, and distinguishes between needs and wants.	Addresses all of the components	Missing one component	Missing two components	Missing three components
GROUP WORK: Student works with others to determine which plants and animals live in the community. Student helps select and present one organism to the class and explain how the organism's needs are met (or not met) within the context of the community.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
JOURNAL QUESTIONS: Student responds to journal questions completely. Student uses sentences and pictures in journal answers. Student demonstrates an understanding of the basic needs organisms share.	Addresses all of the components	Missing one component	Missing two components	Missing three components

EXPLORE

4 | Who Lives In My Community?

GRADE LEVEL

K-4

45 minutes

Developmental Modifications: Kindergartners can complete the first journal page only.

summary

Students discuss the basic needs of living things by identifying what humans, plants and animals require for survival. Students identify the resources the Great Lakes provide for local organisms.

objectives

- List the basic needs of living things.
- Explain what a habitat is.
- Identify several of the common plants and animals of the area.
- Describe why we depend on the Great Lakes.
- Explain why it is important to keep the Great Lakes and the surrounding community clean and healthy.

prerequisite

None

vocabulary

Habitat: place where an organism lives that includes its food, water, shelter and space
Organism: a living creature, either plant or animal

subjects

Life Science, Social Studies, Language Arts

standards

Science: 12.A.1b, 12.B.1a, 12.B.1b, 12.B.2a
Language Arts: 4.B.1a, 4.B.1b, 4.B.2a

Science: K.4.2, 1.4.3, 1.4.4, 2.4.1, 2.4.2, 2.4.3, 3.4.1, 3.4.2, 3.4.6, 4.4.3
Social Studies: 5.5.1
Language Arts: 1.7.10, 2.7.6

Science: SCI.III.2.E.4, SCI.III.5.E.1, SCI.III.5.E.2
Social Studies: SOC.II.2.EE.1, SOC.II.2.LE.1, SOC.II.4.LE.5

Science: F.4.1, F.4.4
Language Arts: C.4.1, C.4.2, C.8.1

setting

materials

- Creature Cards
- Journals
- Pencils

background

Plants and animals have their own communities that enable them to survive, without needing to rely on human communities. Humans have built communities that they share with plants and animals. These communities often overlap in the spaces they occupy and in the ways they support life. For example, some birds nest at the beach, while humans also use the space as recreation. All living organisms have similar needs that they must meet in order to survive. This activity focuses on the importance of keeping the Great Lakes and our communities clean and healthy in order to support all the life that depends on them. Prior to this activity, separate the Creature Cards according to step #6.

procedure

1. As a class answer the following question and write responses on the board:
   What do all animals need to survive?
   Food, water, shelter, space, air and livable temperatures are the components of a habitat and are the essential things that all animals need to survive. Other student responses may include things like specific types of food, air, nests, etc, which all fit under the basic headings of food, water, shelter, and space. Animals also need each other for reproduction.
2. Write food, water, shelter, and space as categories and show how other answers fit into these categories. Explain that these are the things all animals need to survive and items that can always be found in an animal's habitat. Define a habitat.
   For example, a squirrel's habitat is a forest (or, in some cases, a city). Its food is acorns, its shelter is a tree, its space is the area it has to move around, and it has a water source within this area.
3. Repeat this process for plants. *Plants need sunlight, water, nutrients, air and a substrate (place), such as soil. Some plants also need each other or animals for seed dispersal or reproduction.*
4. Discuss how humans and animals have similar needs. Compare human and plant needs.
5. What is a human's space? *Neighborhood, town, city.* What are our communities? *Response will vary.* For this activity, we will consider the Great Lakes as part of the community. How does a human get what it needs to live in that space? *Discuss where we get food, water and shelter.* Who lives in our communities? *Other humans, animals and plants that depend on the resources of the Great Lakes region.*
6. Break students into small groups and give each group several Creature Cards. For an additional card set, print them from the compact disc. It is fine if some of the cards are repeated in more than one group. At least one card should be a species that can be found in or near a human community. *Depending on where the students live, some organisms that live in human communities include: Canada goose, mosquito, herring gull, mallard duck, and black ant. It is possible that students decide that all of the species can live in their community.*
7. Have students separate the cards into species that can be found in their Great Lakes community and those that cannot. They use the information on the backs of the Creature Cards to help decide why an animal may or may not be able to live in their community. *For example, a goose may be able to live in their community if it has water, grass and insects. A fish would not be able to live in their community if there is not a river, pond or lake.*
8. Students should answer journal questions.
9. Have each group choose one species and present to the class why this plant or animal can or cannot live in their communities, keeping in mind the components of a habitat and what is available to the plants/animals in their community.
10. Discuss: Have you seen any of these organisms in or around your community before? Where? How are humans similar to plants and animals? *They are all living beings that live where they can meet their needs.* How do the Great Lakes meet the needs of living species? *They provide water, food, shelter and space*. Do these species live only in human communities or do they overlap into other habitats as well? If so, which ones and why? *Other habitats may include beach, dune, forest.*

wrap-up

1. Imagine the region without the Great Lakes. How would life be different for humans, animals and plants? What do humans get from the Great Lakes to meet their needs? *Drinking water, goods are shipped (food, clothing, housing materials), some fish are eaten.*
2. Why is it important that we keep the Great Lakes and the areas around them clean and healthy? *Humans and animals depend on the Great Lakes for food, water, goods via the shipping industry and recreation.*

extension

Take a walk in the school neighborhood to look for some of these organisms. Make a list of all organisms you find on your walk.

assessment

Rubric on page 309

4 | Who Lives In My Community?

GRADE LEVEL
K-4

journal pages

FIRST NAME																				
LAST NAME																				

[1] Which plant or animal will your group present to the class?

[2] Draw it:

[3] Does it live in your community? Why or why not?

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journal pages

4 | Who Lives In My Community?

GRADE LEVEL
K-4

FIRST NAME																			
LAST NAME																			

[4] What does it need to live?

[5] Where does it live?

[6] What do humans have in common with it?

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Great Lakes in My World

Creature Cards

Over 60 illustrated information cards featuring Great Lakes plants and animals

Why

Great Lakes Creature Cards familiarize students with sixty of the plants and animals that inhabit the region, an essential part of learning about the Great Lakes. They have illustrations on one side and information on the other and can be used in various ways.

How To Use

Use the cards with the Great Lakes In My World curriculum activities listed below. You can also use them as flashcards, or have students sort them into various groups (by kingdom, class, habitat, position in food chain, etc.). With two sets, students can play a variety of card games such as Memory, Go-Fish, Old Maid or Rummy.

Use Great Lakes Creature Cards with:

Lake Unit:
Satisfy Your Curiosity
A Closer Look
Fish Observation
Web of Life
Tangled Web
What's New?
It Adds Up and Up

Dune Unit:
Satisfy Your Curiosity
Adaptations and Observations
Adaptation Stories
Succession
Living Dune
Dune Project
Indoor Dunes

Human Communities Unit:
Who Lives in My Community?

History Unit:
Something's Fishy

Name: Species' common and scientific names are provided.
*: Indicates that this card can be used in the activities Tangled Web and Web of Life.

who? *description*	**where?** *environment*	**what?** *characteristics*
A description of the species that includes type, physical characteristics and species status (endangered, invasive, etc.)	An explanation of the species' general environment and specific habitat	Facts about the species role in the food web, reproduction and other distinguishing habits

Scale: A scale conveys the relative size of the species. A darkened column indicates the species place in the size range. The sizes for each column are as follows:

#1: less than .6 cm / .25 in
#2: .6 cm / .25 in – 6.3 cm / 2.5 in
#3: 6.6 cm / 2.6 in - 30 cm / 12 in
#4: 31 cm /1 2.1 in - 61 cm / 24 in
#5: 63.5 cm / 25 in - 122 cm / 48 in
#6: 123 cm / 48.5 in - 183 cm / 72 in
#7: more than 183 cm / 72 in

Size:

Interesting Fact ★

Characteristics that make this plant or animal unique

Creature Card Definitions

Carnivore: a flesh-eating animal

Colony: a population of plants or animals in a particular place that belong to one species

Consumer: a plant or animal that preys on other living things or eating particles of organic matter

Crustacean: any of a large class of mostly water-dwelling arthropods (as shrimps, wood lice, water fleas, and barnacles) having an exoskeleton of chitin

Decomposer: an organism that lives on and breaks down dead organisms

Detritus: particles of decaying organic material

Diurnal: active in the daytime

Endangered species: a species in immediate danger of extinction

Flock: a group of birds or mammals assembled together

Forage fish: fish that primarily eat phytoplankton and zooplankton (especially diporeia); they are prey for larger predators such as lake trout and whitefish; they include smaller fish such as herring, alewives, chubs, and smelt.

Herbivore: animal that eats only plants

Invasive species: plant or animal that enters an ecosystem to which it is not native and competes with one or more species for food, shelter, and/or reproductive opportunities.

Larva: a young wingless, often wormlike, form (grub or caterpillar) that hatches from the egg of many insects

Migrate: to pass from one region or climate to another usually on a regular schedule for feeding or breeding

Creature Card Definitions

Mollusk: any of the category (phylum: mollusca) of invertebrate animals (as snails, clams, and mussels) with a soft body lacking segments and usually enclosed in a shell

Nocturnal: active in the night

Omnivore: feeds on both animal and plant matter

Phytoplankton: very small, freely floating plant that drifts with water currents

Plankton: small water organisms that exist in a drifting, floating state; is the base of freshwater ecosystems, provides food for larger animals and indirectly for humans, whose fisheries depend on phytoplankton and zooplankton

Predator: an animal that lives by killing and eating other animals

Prey: an animal hunted or killed by another animal for food

School: group of fish that swim together; generally of the same species for protection, feeding and other reasons

Solitary: growing or living alone; not forming part of a group or cluster

Spawn: to produce or deposit eggs

Species of concern: a plant or animal that may become threatened

Threatened species: a plant or animal needing special action to protect it from becoming endangered

Toxin: a substance produced by a living organism that is very poisonous

Zooplankton: Very small floating or swimming animals that drift with water currents

Canada Goose*

Scientific Name: *Branta canadensis*

who? *description*

Type: bird

Length: 63.5-114 cm / 25-45 in

Weight: 1-8 kg / 2-17 lbs

Coloring: black head and neck, white cheek patches, mottled grey-brown body

Body Features: brown webbed feet

Size:

where? *environment*

Habitat: interdunal pond, freshwater lakes, wetlands, ponds; builds a nest on the ground, near water

Interesting Fact ★

Canada geese fly in a "V" formation during migration. They use their large, strong wings as weapons when protecting their young.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** coyotes eat geese; eggs are eaten by fox, raccoons and coyotes

What do I eat? Plants and insects

Role: consumer, omnivore

Reproduction: lays 5-7 eggs

Grouping: pairs and flocks

Activity: diurnal, migrate south in the winter

Daphnia*

Scientific Name: *Daphnia pulex*

who? *description*

Type: zooplankton, crustacean

Length: less than 3 mm / .1 in

Coloring: clear body tissue shows organs inside

Body Features: 5 pairs of legs used to capture food, large antennae are pushed downward for swimming

Size:

where? *environment*

Habitat: near the surface of lakes, ponds, and quiet streams

Interesting Fact ★

Dozens of daphnia can fit on a single fingernail.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** fish

What do I eat? phytoplankton

Role: consumer, herbivore

Reproduction: lays eggs in lake bottom sand, young hatch in spring

Dragonfly (blue darner)*

Scientific Name: *Aeschna constricta*

who? *description*

Type: insect

Length: 5-8 cm / 2-3 in wingspan

Coloring: primarily blue and green

Body Features: four wings operate independently

Size:

where? *environment*

Habitat: interdunal pond, in and around wetlands; underwater for first stage of life

Interesting Fact ★

Dragonflies are a living fossil; they have not changed for over 300 million years. They can hover, fly backwards, loop, and speed up to 56 km / 35 mi per hour.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** fish

What do I eat? mosquitoes, midges and other small, flying insects

Role: consumer, carnivore

Reproduction: lay eggs in water; first stage of life underwater; adult stage on land and in flight

Grouping: solitary

Activity: diurnal

Eurasian Milfoil*

Scientific Name: *Myriophyllum spicatum*

who? *description*

Type: plant

Height: up to 91 cm / 3 ft

Leaves: 1.5-4 cm / .6-1.5 in long, have a feather-like outline, in groups of 4; stem is leafless towards the base, but branches out, the top often turns red

Flowers: lower ones are female, upper ones are male

Invasive Species

Size:

where? *environment*

Sunlight: moderate

Habitat: lives in water from 1-3 m / 3-9 ft deep

Interesting Fact ★

Eurasian milfoil is an invasive species brought to North America from Europe in the 1940's. It competes with native plants and can impair water quality.

what? *habits*

Feeding:

Who eats me?
water birds

What do I use to make food?
sunlight

Role: producer

Reproduction: stems release fragments that develop roots, new stems and leaves, then sink and grow from the bottom; can also be pollinated

Fingernail Clam*

Scientific Name: *Sphaeriidae*

who? *description*

Type: mollusk

Length: 1.3 cm / .5 in

Coloring: cream, orange, white

Body Features: fine rows of concentric, raised lines

Size:

where? *environment*

Habitat: sandy bottom of freshwater lakes and streams

Interesting Fact ★

Fingernail clams do not have eyes, a nose, or antennae, but they do have a foot they push out of the shell to help them to move.

what? *characteristics*

Feeding:

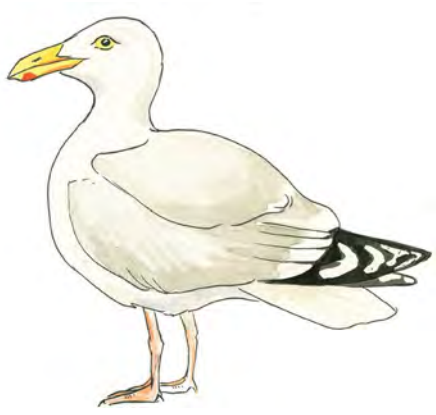
Who eats me?
bottom feeding fish

What do I eat?
plankton, bacteria

Role: consumer, omnivore

Reproduction: young emerge from parents in adult form

Activity: year-round



Herring Gull*

Scientific Name: *Larus argentatus*

who? *description*

Type: bird

Length: up to 61 cm / 24 in

Weight: 1.1 kg / 2.5 lb average

Coloring: white, grey wing backs, yellow bill with red spot

Body Features: pink legs

Note: The ring-billed gull is also commonly found in the Great Lakes region. It has a black line around its beak and has similar characteristics to the herring gull.

Size:

where? *environment*

Habitat: beach, lakeshore and seacoast, grass nests on flat ground

Interesting Fact ★

Herring gulls will travel up to 40 miles from home for food.

what? *characteristics*

Feeding:

Who eats me?
other gulls, eagles eat young

What do I eat?
clams, small fish, small mammals, garbage, birds, dead animals

Role: consumer, omnivore, scavenger

Reproduction: 3 eggs in spring

Grouping: colonies

Activity: diurnal

Human*

Scientific Name: *Homo sapien*

who? *description*

Type: mammal

Length: adults average 152-182 cm / 5-6 ft

Weight: adults average 50-91 kg / 110-200 lbs

Coloring: skin shades range including, white, pink, beige, tan, light-dark brown

Body Features: 2 arms, 2 legs, 10 digits on hands and feet

Note: rely on sense organs (eyes, ears, mouth, nose) and opposable thumb

Size:

where? *environment*

Habitat: homes in a variety of ecosystems, rural-urban; homes vary in shape, size, and material depending on culture and location

Interesting Fact ★

Humans do not have natural predators and are able to live in many different types of environments.

what? *characteristics*

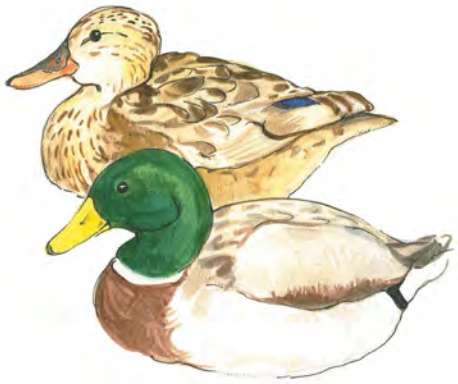
Feeding:

➲ ***Who eats me?*** not a primary food source for animals, but may be eaten by large carnivores

▯ ***What do I eat?*** depends on culture - various vegetables, fruits, nuts, fish (including lake trout and yellow perch), cows, pigs, chickens

Role: consumer, omnivore

Reproduction: live young which is generally raised by both parents



Mallard Duck*

Scientific Name: *Anas platyrhynchos*

who? *description*

Type: bird

Length: 50-60 cm / 19-23 in

Weight: 1.24 kg / 3 lbs

Coloring: male-green head, white neck ring, brown breast, yellow bill; female-all brown/ white mottled, greenish bill, white patch around wing

Body Features: orange webbed feet

Size:

where? *environment*

Habitat: interdunal pond, freshwater lakes, ponds, swamps, grass nest on the ground

Interesting Fact ★

The mallard is the most commonly recognized wild duck in the world.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** muskellunge, humans, coyotes, snapping turtle

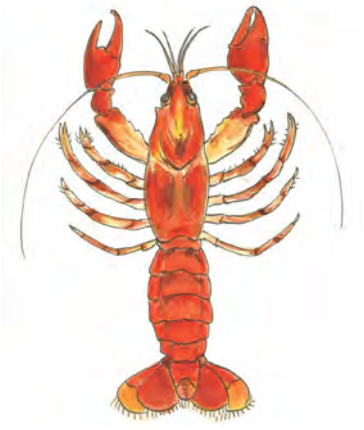
▯ ***What do I eat?*** emergent weeds, small invertebrates, larval insects, grains

Role: consumer, omnivore

Reproduction: 8-12 eggs in spring

Grouping: pairs or flocks

Activity: diurnal



Rusty Crayfish*

Scientific Name: *Orconectes rusticus*

who? *description*

Type: crustacean

Height: 8-10 cm / 3-4 in

Coloring: red / brown color

Body Features: large claws and rusty colored spots on each side of the main body section

⊠ ***Invasive Species***

Size:

where? *environment*

Habitat: lakes, ponds, and streams in areas where there is debris on the bottom

Interesting Fact ★

Rusty crayfish are an invasive species that have been spread when used for bait by fishermen. They have also been spread by science classes who have released them after being classroom pets.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** predator fish, birds, raccoons

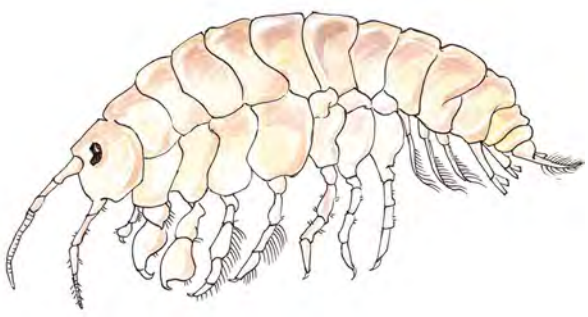
▯ ***What do I eat?*** aquatic plants and insects, fish eggs and small fish

Role: consumer, omnivore and scavenger

Reproduction: eggs are usually laid in the spring by the female

Grouping: young crayfish stay with their mother for several weeks. After, they tend to live independently

Activity: nocturnal



Scud*

Scientific Name: *Gammarus*

who? *description*

Type: crustacean

Length: 2.54 cm / 1 in

Coloring: most are gray and tan; some are shades of green, blue, orange, and purple

Body Features: shrimp-like with an arched, flat body; two pair of antennae and nineteen paired legs

Size:

where? *environment*

Habitat: shallow water in lakes, ponds, and slow moving rivers with abundant vegetation and debris on the bottom

Interesting Fact ★

Scud populations may be declining because of competition with the zebra mussel for phytoplankton.

what? *characteristics*

Feeding:

➲ ***Who eats me?***
insects, amphibians, shore birds and fish like sculpin, smelt and chub

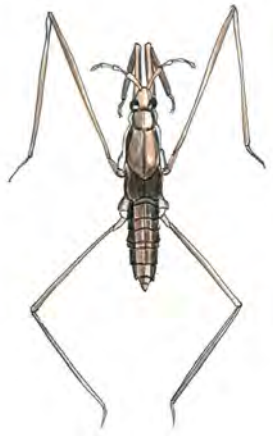
What do I eat?
algae, dead plants and animals

Role: consumer, omnivore

Reproduction: reproduces after 5-8 years

Grouping: colonies

Activity: mainly nocturnal



Water Strider*

Scientific Name: *Gerris remigis*

who? *description*

Type: insect

Length: 1.2 cm / .5 in

Coloring: dark brown to black

Body Features: long legs, two legs can fold under front of body

Size:

where? *environment*

Habitat: interdunal pond, freshwater lakes and wetlands, live under leaves, spend time on surface of water

Interesting Fact ★

Water striders communicate with each other through ripples on the surface of the water.

what? *characteristics*

Feeding:

➲ ***Who eats me?***
birds, fish, dragonflies

What do I eat?
Insects from water and land, plants

Role: consumer, omnivore

Reproduction: lay eggs at water's edge

Zebra Mussel*

Scientific Name: *Dreissena polymorpha*

who? *description*

Type: mollusk

Length: up to 5 cm / .75 in

Coloring: tan and blackish stripes (like a zebra)

Body Features: two connected shells hold a small mussel between them, they attach to hard surfaces with byssal threads

Invasive Species

Size:

where? *environment*

Habitat: freshwater, native to the Caspian and Black Sea, but now in all Great Lakes and some inland lakes; depths of 2-7 m / 6-23 ft

Interesting Fact ★

Zebra mussels are commonly found around the Great Lakes. They compete with native fish for plankton, which causes problems for the fish. Because they are filter feeders, zebra mussels can increase water clarity.

what? *characteristics*

Feeding:

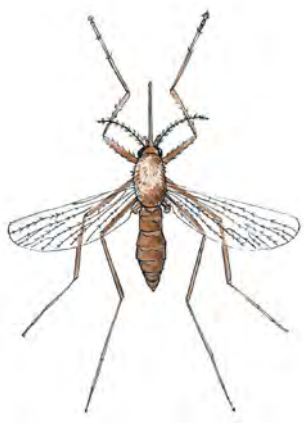
➲ ***Who eats me?***
round goby

What do I eat?
algae

Role: consumer, omnivore

Reproduction: eggs expelled by females and fertilized outside of the body by males in spring / summer

Grouping: colonies



Mosquito

Scientific Name: *Aedes stimulans*

who? *description*

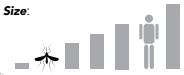
Type: insect

Length: 6.4-12.7 mm / .125-.5 in

Coloring: brown

Body Features: 6 long legs

Size:



where? *environment*

Habitat: interdunal pond, lake or pond, anywhere with standing water

Interesting Fact ★

Mosquitoes can travel up to one mile from their breeding spot to find a meal. The adult female (only!) seeks a blood meal so she can produce a new patch of eggs.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** fish, birds, frogs, other insects

▯ ***What do I eat?*** organic matter in water, human and animal blood

Role: consumer, omnivore, parasite

Reproduction: females lay 50-500 eggs

Grouping: singly or in swarms

Activity: most active at dawn and dusk

Monarch Butterfly

Scientific Name: *Danaus plexippus*

who? *description*

Type: insect

Length: wingspan is 8.6 - 12.4 cm / 3.5- 4.9 in; caterpillars are 5 cm / 2 in long

Coloring: orange wings with black veins and black margin with small white spots on each wing

Body Features: 6 legs and 4 wings

Note: Females have larger veins and males have a dark spot on the hindwing.

Size:

where? *environment*

Habitat: foredune, fields where common milkweed grows

Interesting Fact ★

A monarch butterfly is a poisonous snack. The toxins from the monarch's milkweed diet make the caterpillar and butterfly stages poisonous to predators.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** eggs eaten by insects, spiders, birds, mice; some insects eat adults

▯ ***What do I eat?*** caterpillars eat common milkweed, adults eat nectar of milkweed and other plants

Role: consumer, herbivore

Reproduction: life cycle is: caterpillar, cocoon, butterfly; lay eggs on the bottom of milkweed leaves.

Grouping: migrate in groups

Activity: migrate to Mexico each year

Great Blue Heron

Scientific Name: *Ardea herodias*

who? *description*

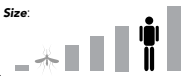
Type: bird

Length: 1.2 m / 4 ft tall, wingspan is 2.4 m / 7 ft

Coloring: head white with black stripe, back grey-blue, breast white

Body Features: long, yellow bill

Size:



where? *environment*

Habitat: interdunal pond, wetlands and lakes, nests in treetops made of dry branches, nests are 30 cm / 1 ft deep and 91 cm / 3 ft wide

Interesting Fact ★

The great blue heron is the largest heron, and the second largest bird (by height) in the Great Lakes. The largest bird by height is the sandhill crane.

what? *characteristics*

Feeding:

➲ ***Who eats me?*** eggs eaten by crows, ravens, gulls, raccoons

▯ ***What do I eat?*** small fish, shell fish, frogs, rodents, reptiles, small birds

Role: consumer, carnivore

Reproduction: 3-5 eggs; nest in woodlands in spring

Grouping: colonies

Activity: female is diurnal, male is nocturnal; migrate south for winter

Fowler's Toad

Scientific Name: *Bufo fowleri*

who? *description*

Type: amphibian

Length: 4-7 cm / 2-3 in

Coloring: cream colored front; green-grey back with dark brown spots; males have dark vocal pouches during breeding season

Body Features: each dark spot contains 3-4 warts

Size:

where? *environment*

Habitat: foredune, lives in sand dunes and lakeshore; uses shallow water for breeding, burrows in sand, debris, or leaf litter

Interesting Fact ★

This toad secretes a toxin from the glands on the sides of the neck to protect itself from predators.

what? *characteristics*

Feeding:

➲***Who eats me ?***
eastern hognose snake, raccoons, skunks.

What do I eat?
insects

Role: consumer, carnivore

Reproduction: female lays 7000 eggs in shallow water; tadpole-frog life cycle takes 1-2 months

Grouping: gathers in April-June for breeding, otherwise solitary

Activity: juveniles are diurnal; adults are nocturnal

Song Sparrow

Scientific Name: *Melospiza melodia*

who? *description*

Type: bird

Length: 12-18 cm / 5-7 in

Coloring: brown streaked, under parts are whitish with dark streaks, spot in the center of the breast

Body Features: long tail that is pumped up and down to help with flying

Size:

where? *environment*

Habitat: forested backdune, thickets, pastures, undergrowth in gardens, city parks, make nests on the ground, a later nest is made in a tree or shrub, nests are used more than once

Interesting Fact ★

Song sparrows sing throughout the year, although much less in winter. Each male sings between 6 and 24 different songs. Some song sparrows do not migrate during the winter.

what? *characteristics*

Feeding:

➲***Who eats me?***
hawks, owls, snakes, cats, some turtles

What do I eat?
beetles, flies, caterpillars, seeds, grains, berries

Role: consumer, omnivore

Reproduction: Nests in a cup of grass, 3 broods per season

Grouping: pairs remain mates through years, both parents feed young

Activity: most migrate in winter

ALLIANCE FOR THE GREAT LAKES

ENSURING A LIVING RESOURCE FOR ALL GENERATIONS

Dear Educator,

This lesson plan is from the Alliance for the Great Lakes' *Great Lakes in My World K-8* curriculum, an elementary and middle school curriculum that teaches science, language arts and social studies using the Great Lakes. The curriculum is aligned with Common Core and state learning standards in all eight Great Lakes states. Thank you for your interest in Great Lakes education.

Great Lakes in My World K-8 contains:

- A 480-page book with 80 indoor and outdoor lesson plans
- Assessment rubrics for each lesson plan
- Student journal pages
- Creature Cards with information about 66 Great Lakes plants and animals
- A CD with additional resources to supplement the lesson plans

The complete curriculum costs $50 and includes permission to make unlimited copies for non-commercial educational purposes. Discounts are available for bulk purchases.

For more information about *Great Lakes in My World*, visit www.greatlakes.org/GLiMW.

To order the curriculum online, visit www.greatlakes.org/OrderGLiMW. If you have questions about the curriculum or Great Lakes education opportunities, please email education@greatlakes.org.

To see how this activity aligns with state learning standards, visit www.greatlakes.org/GLiMWstandards.

We hope you enjoy your new lesson plan!

Sincerely,

Katharine Larson
Education Coordinator
Alliance for the Great Lakes
klarson@greatlakes.org

Sample food web provided by USFWS for Grand Calumet River AOC

The sun's energy, soil nutrients and CO^2 are captured by plants (both terrestrial and aquatic) and algae, and converted into plant biomass that becomes the base of the food chain. Plants release O^2 as a waste product (which is very important to us animals). This represents the net primary productivity, which in 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 the Grand Calumet River (GCR), there is an abundance of submerged aquatic vegetation and algae available to be eaten. There are many types of aquatic invertebrates (i.e. bugs) and small fish that specialize in eating detritus and/or living plants (i.e. bluntnose minnow and goldfish, respectively). Then there are many types of aquatic insects (dragonfly larvae) that eat other small aquatic insects (i.e. Dipterians [fly larvae], or mosquito larvae). And some small fish eat only insects of all types (i.e. bluegill).

Typically, large fish are piscivores (i.e. they eat fish only) and they eat minnows, goldfish and bluegill. Large piscivores include such things as largemouth bass and Chinook salmon, although in polluted waterways such as the Grand Calumet River, the common carp (a detritovore/herbivore) is the king of the fishery.

Green Herons are wading birds that eat these small fish, while Great Blue Herons will eat small to medium size fish. There are only four things that can capture and eat large living fish such as salmon or carp. They are Eagles (both Bald and Golden eagles have been seen in the GCR area), Osprey, River Otters and humans with nets, spears or fishing poles. Eagles, osprey and otters do not live in this area, but an occasional eagle or osprey will be seen over the river while migrating through in the spring or fall. The GCR is too contaminated to support healthy river otters and is not supposed to be fished by humans for the same reason.

There is one more very important component of this food web, which is insectivorous songbirds such as barn swallows (that nest under all the bridges along the river) red-winged black birds and marsh wrens (that nest in the cattails). Most species of aquatic invertebrates (bugs) have an adult stage that fly like dragonflies, mayflies, and mosquitoes. These air borne insects are eaten by barn swallows, wrens, and red-wings.

There should be many more aquatic invertebrates in the shallow water marsh than in the river, primarily because fish cannot get to this food source. This is what makes shallow water wetlands such good habitat to dabbling (tip up, with head under water and tails in the air) ducks and their ducklings, such as mallards and coots.

One last component of the food web in this area is a top predator of songbirds and ducks, which is the peregrine falcon (aka duck hawk). Peregrines are known to nest in the Grand Calumet River/IHC, but the closest ones nest under the Cline Ave (Hwy 912) near Dickey Road ramps. They feed on pigeons from the city and mill area, gulls from the lakefront, as well as songbirds and an occasional duck.

This description of the Grand Calumet River and Roxana Marsh food web would not be complete without two very important points. Many of the different aquatic invertebrates (bugs) make their life in and on the river bottom sediments (mud). However, the mud in both Roxana Marsh and the Grand Calumet River is toxic (poisonous) to these bugs. So, only a few species (rather than hundreds of species) can survive to reproduce and be eaten by fish, ducks or songbirds. Fish that depend on only insects (like bluegill) are also few and far between because of this.

Many fish lay their eggs on the river bottom mud, and those species of fish are missing from this fish community. An occasional adult fish that lays its eggs on the sediment (largemouth bass, bluegill or white sucker for

example) will be found in the river, but any attempt to have young fish will fail.

In summary, in order to bring the bugs back (which make up the foundation of this food web), and to bring back a multi-species fish community (rather than the 5 to 7 species that make up 99 percent of this fish community), we need to remove the contaminated mud or cover it up with a cap of clean sediment that bugs and fish can live and reproduce in. That, in essence, is what we are doing here.

HABITAT

Miss Yunus and Miss McCoy

Vocabulary

- Habitat
- Prairie
- Wetland
- **Sediment**
- **Pollution**
- **Ecosystem**
- **Community**
- **Population**
- Native
- Invasive

Habitat

What is a habitat?

- The place where a plant or animal normally lives

What do you need to live?

- Food
- Water
- Shelter

- **What makes a habitat healthy?**

Examples of habitat

Aquatic - water

- Lake
  - Lake Michigan
- River
- Pond
- Wetland

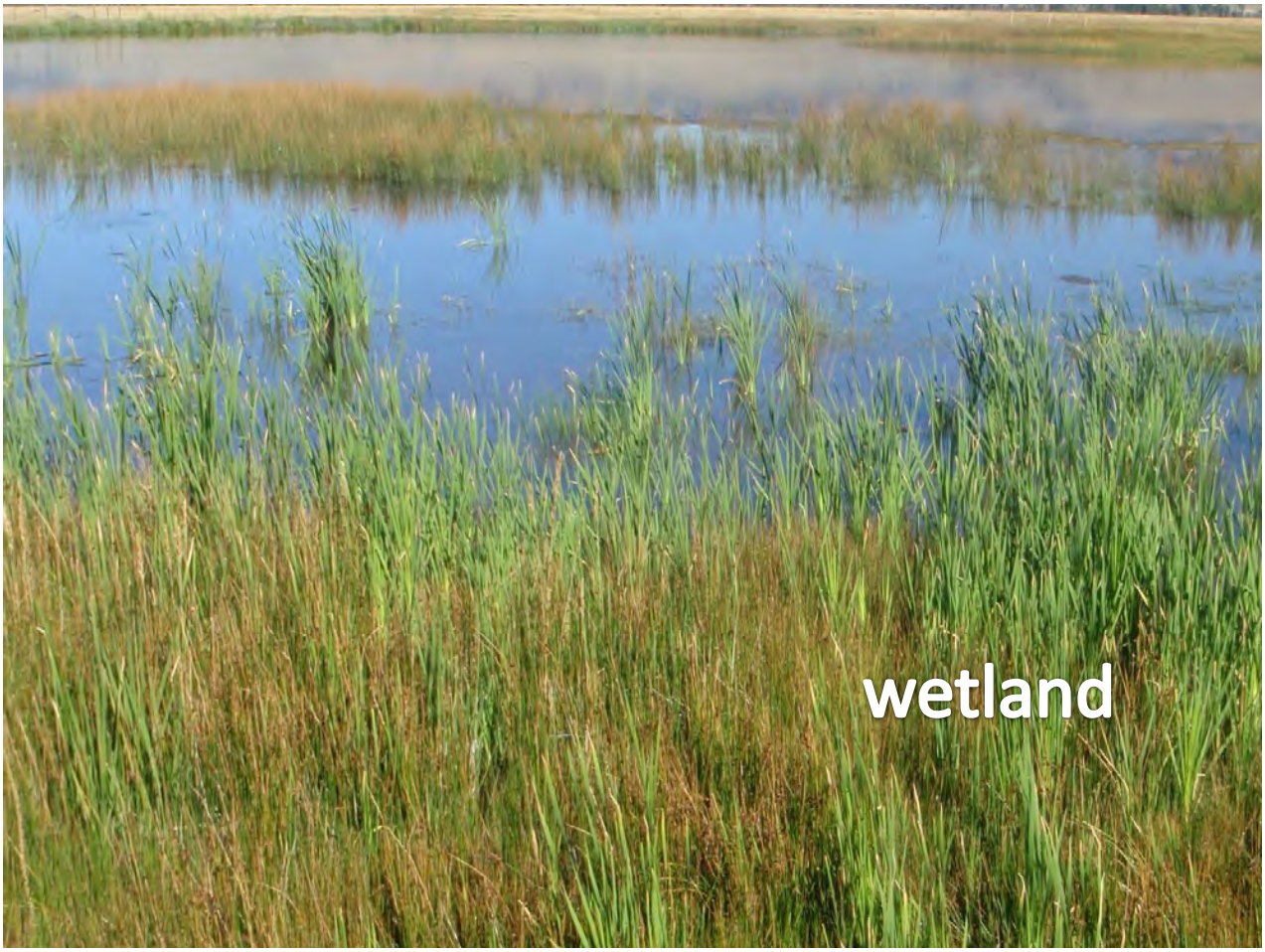
Terrestrial - land

- Forest
  - Tree
- Prairie
- Desert
- Wetland
- City

What is your habitat?

What is a prairie?

- Open spaces made up of mostly grasses, sedges (grasslike plants), and other flowering plants called forbs (e.g. coneflowers, milk weed).
- Some prairies also have a few trees.



What is a wetland?

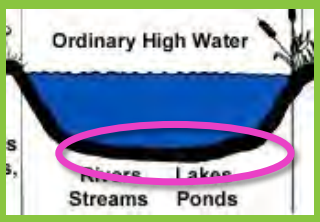
low land + water + lots of plants and animals = wetland!

Key Ingredients:

- Shallow water or very soggy soil at least part of the time.
- The plants love having wet "feet" (roots).

What is sediment?

- The loose sand, clay, silt and other stuff that settle at the bottom of a body of water.
- It's similar to **soil**. Made up of living and non-living things.
- It's the **foundation** of the habitat.

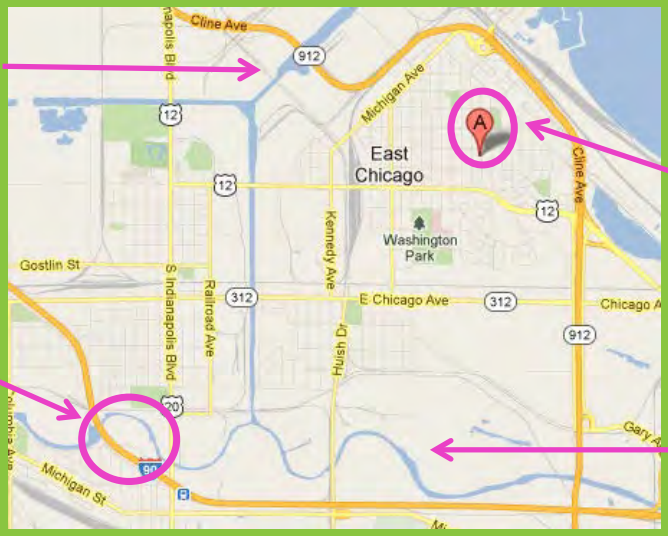


What does sediment tell us?

- Not just current pollution but pollution from the past
  - Pollution that flows down a river settles into the sediment
- We study them to decide how much to cleanup
- Home for aquatic animals and fish

Roxana Marsh: Where is it?

Indiana Harbor Canal



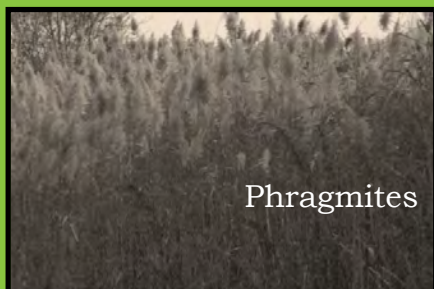
East Chicago Lighthouse Charter School

Roxana Marsh

Grand Calumet River

Roxana Marsh is a wetland and a habitat

- Why are we working in the marsh?
  - Polluted sediment (dirty mud)
- What are we doing?
  - Removing the pollution
  - Removing invasive plants
  - Adding native plants


Phragmites


Showy Goldenrod

Important Ecological Terms


Peregrine Falcon

- **Population:** a group of individuals of one species in an area


Blue Heron

- **Community:** many populations of different kinds of organisms living in the same place


Bluegill

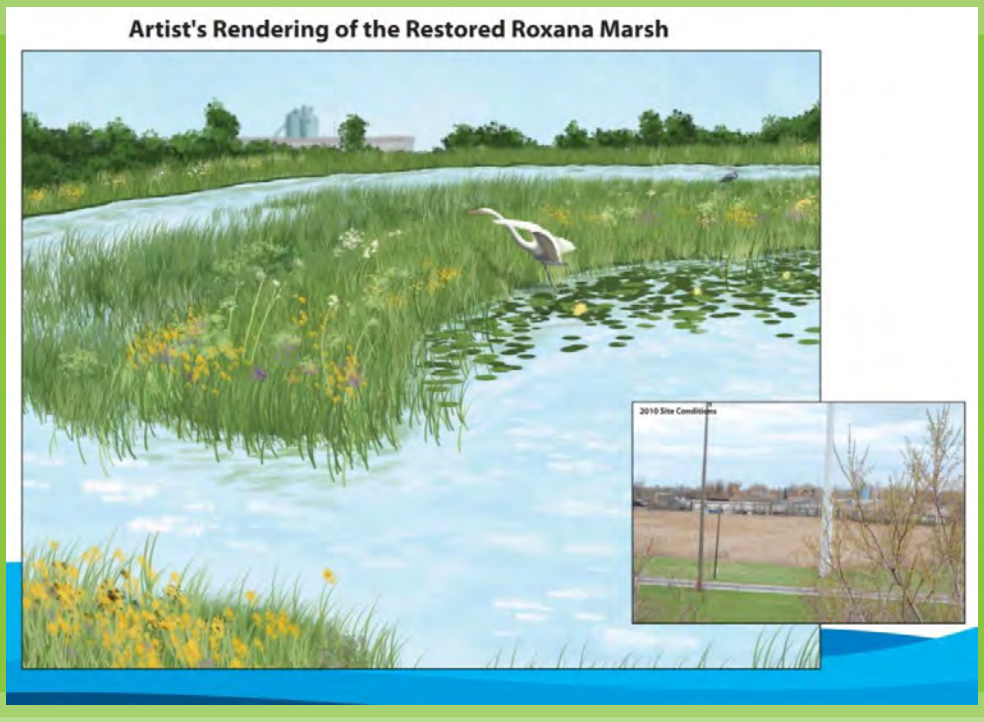

Dragonfly

- **Ecosystem:** groups of organisms along with the non-living parts of their surroundings


Black-eyed Susan

Roxana Marsh before:

After: Designing a Habitat



Before and after

References

- United States Environmental Protection Agency
- Illinois-Indiana Sea Grant
- United States Fish and Wildlife Service
- Indiana Department of Natural Resources
- Indiana Department of Environmental Management

The Blue Heron

- What do we know about the Blue Heron?
- What does it eat?
- What kind of habitat does it need?

The Blue Heron

Food

Frogs

Fish

Wetland insects

Insects

Meadow voles

Shelter

40-60' in tall trees

Dead branches and twigs to make platform nests

Water

Lakes and ponds

Marshes

Streams and rivers

Space

Lakes and ponds

Marshes

Streams and rivers

Logs and woody debris in the water

Meadows

Forests with tall trees not too far from water

Lesson 3
Knock out Pollution

Grade Level: 4–6

Time: 75 minutes

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 fish people eat, using the terms benthos, bioaccumulate, and biomagnify.
- Use observation skills to identify types of pollution.
- Describe environmental and societal benefits of the cleanup.

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

Materials provided by IISG: Pollution PowerPoint; See *Bioaccumulation Demo and Pollution Activity* for additional materials

Procedure: IISG specialist sets up *Pollution Activity* in the back of the room. After making introductions to students, including any guest visitors, the IISG specialist performs a quick recap of lesson two and then presents the Pollution PowerPoint. Midway through the PowerPoint, the IISG specialist performs the *Bioaccumulation Demo*. Following the PowerPoint, IISG facilitates the *Pollution Activity*.

Extension: Students engage in an adaptation of question 4 under procedure, p.64 from "Moving Mercury" from Alliance for the Great Lakes curriculum, Great Lakes in My World, Unit 1. The IISG specialist will provide the teacher with this adaptation (i.e., the pollutant will change to reflect the contaminant of concern at the local Great Lakes Legacy Act project site).

Assessment: The "Concept Map" rubric for "Moving Mercury" question 4 is provided from Great Lakes in My World.

Great Lakes Literacy Principles
Great Lakes Literacy Principle 5
The Great Lakes Support a Broad Diversity of Life and Ecosystems.
Concepts A, B, D, E, F, G, H, I (www.greatlakesliteracy.net/principles/5)

Great Lakes Literacy Principle 6
The Great Lakes and Humans in their Watersheds are Inextricably Interconnected.
Concepts A, C, D, E, F (www.greatlakesliteracy.net/principles/6)

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 provided by IISG: 2 ½ cups of Marbles or beads, six small ½ cup food storage containers labeled benthos, 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 pollution, and the storage containers represent different animals in the food chain. Tell the volunteer the total number of marbles, and have the board volunteer write it down as total units of pollution.

2. Ask the other two volunteers to fill the small containers (benthos) with marbles (pollution). Explain that the benthos live in the polluted sediment, and they absorb the pollution. Count the number of marbles in each benthos and have the volunteer write it down on the board as units of pollution.

3. Say that the fish are hungry, and they eat polluted benthos. Ask volunteers to pour the pollution from the small to the medium containers, explaining that the fish now have pollution from all the benthos in their bodies. Count the number of marbles in each fish and have the volunteer write it down on the board. Explain that as the fish eats each benthos, it also is taking in the pollution. The pollution is accumulating as the fish eat more benthos, and this is called bioaccumulation.

4. Say that the bird is hungry, and they eat the polluted fish. Ask volunteers to pour the pollution from the medium to the large container, explaining that the bird now has all the pollution from the fish and the benthos in their bodies. Count the number of marbles in the bird and have a volunteer write it down 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 that bioaccumulates because they get all the pollution that was in all of the animals. The pollution grows as it goes up the food chain, and this is called biomagnification.

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 provided by IISG: 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 (such as 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. Each team will have 5 minutes to use their supplies and make their experimental habitats polluted (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 container "habitat" all at once.

3. The teams will 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?

Great Lakes Literacy Principles

Wrap Up: Engage all of the students in discussion of what happened. 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.

INVESTIGATE 13 | Invasive Issues

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
PARTICIPATION: Student actively participates in creating the class table. Student uses appropriate cooperative learning skills (participation in group discussion, affirmation of teammates' ideas, equal distribution of tasks). Student works with his/her group to create a new food web depicting the invasive species' impact on native species.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
SOLUTIONS: Student brainstorms eight possible solutions to minimize non-native organism's impact on the lake food web. Student selects one solution to articulate in the essay. All sources are credited correctly.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
ESSAY: Student identifies a specific non-native organism and at least three ways it impacts the lake food web. Student presented one possible solution to minimizing the non-native organism's impact. The essay is well developed and thorough. All ideas presented are supported with evidence from research. Spelling and grammar are accurate.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components

INVESTIGATE 14 | Moving Mercury

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DIAGRAM 1: Student creates a diagram that shows how mercury enters the Great Lakes. It includes the appropriate components and is labeled.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
DIAGRAM 2: Student creates a diagram that shows mercury being passed through the Great Lakes food web. It includes the appropriate components and is labeled.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
DEMONSTRATION: Student defines bioaccumulation and plan to illustrate the concept, using the materials provided.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
CONCEPT MAP: Student uses the vocabulary provided to make a concept map that shows an understanding of bioaccumulation and biomagnification of mercury in the Great Lakes. Map is labeled and has arrows and additional words that explain and portray an accurate understanding. There are minimal spelling and grammatical errors.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components
SOLUTIONS: Student brainstorms five possible solutions for minimizing mercury pollution.	Addresses all of the components	Missing one component	Missing two components	Missing three or more components

Vocabulary

- Pollution
- Habitat
- Ecosystem
- Wetland
- Sediment
- Food chain
- Benthos
- Bioaccumulation

Pollution

What is pollution?

What does pollution look like? Smell like? Taste like?

What are examples of pollution near your school?

What does pollution do to an animal's habitat?

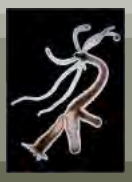
Where does pollution come from?

Is this ecosystem polluted?

Is this ecosystem polluted?

Is this ecosystem polluted?

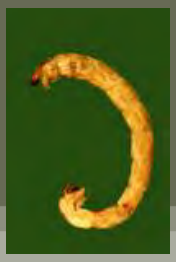
Benthos



- Small critters and bugs that live in the sediment

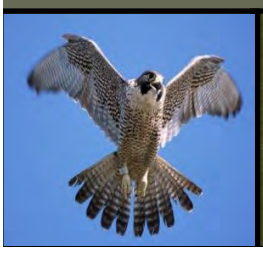
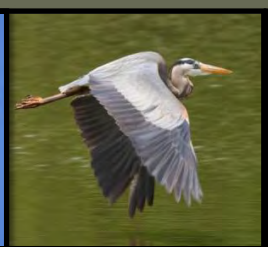


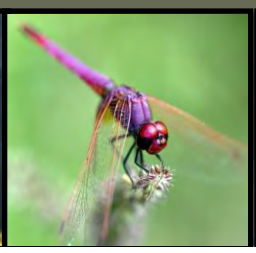
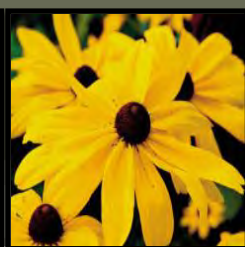




What is sediment?

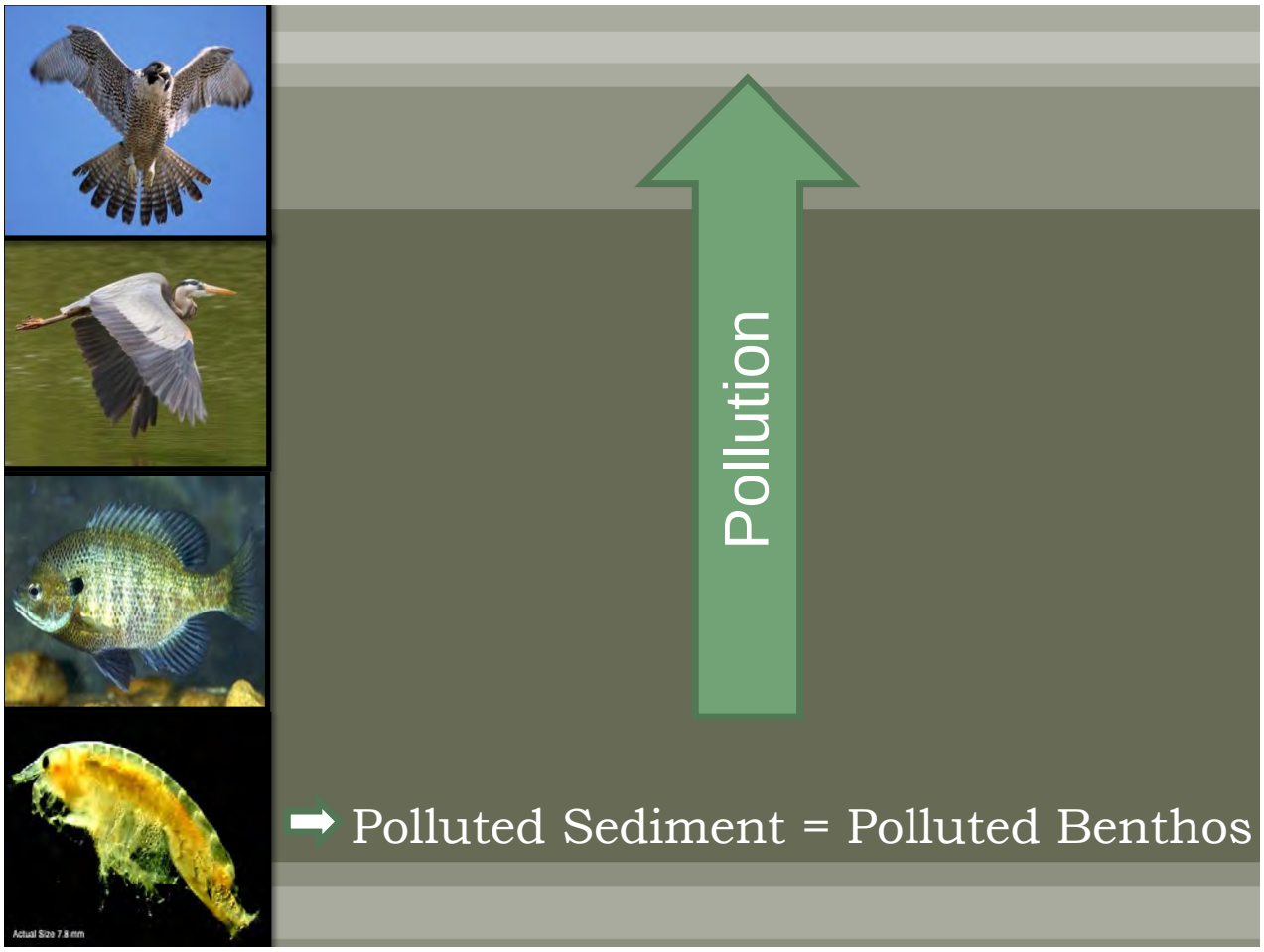
- The mud at the bottom of a body of water
- The **base** of the ecosystem
- Home for small critters (benthos)


polluted sediment


clean sediment


Pollution
Polluted Sediment = Polluted Benthos

Bioaccumulation

- When an animal like a fish eats a polluted animal like benthos, that pollution stays inside the fish. If the fish eats more polluted benthos, the pollution inside the fish gets bigger. This is bioaccumulation.

Pollution

➡ Polluted Sediment = Polluted Benthos

The Cleanup

- How much is getting cleaned up?
  - Weight: 2.2 million pounds of pollution
    - 300 adult male elephants
  - Volume
    - 73,000 dump trucks

- How much does it cost?
  - $85 million
    - A big plane (Airbus 320)
    - Peyton Manning's 5-year contract with Colts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References

- United States Environmental Protection Agency
- Illinois-Indiana Sea Grant
- United States Fish and Wildlife Service
- Indiana Department of Natural Resources
- Indiana Department of Environmental Management

How Do You Know What's Polluted and Where It Is?

- You've talked about how to tell if something is polluted.
- Today we'll do an experiment to help understand how scientists study pollution.

Is this ecosystem polluted?

Is this ecosystem polluted?

How Does Pollution Affect the Ecosystem and the Habitat?

- Another thing scientists think about is how does pollution affect the ecosystem.
- And sometimes it affects different parts of the food chain in different ways.

- If we cleaned up Roxana Marsh for the plants – how much would we have to clean up? How about for the falcon? How about if we put a park there?

Experiment

- We will break into teams.
- Each team will get an 'ecosystem' to experiment with and will be given supplies.
- Each team will use their supplies to make their experimental ecosystems polluted (nothing really bad is in there).
- Then the teams will trade ecosystems and then the teams will have to try and determine what the other team's ecosystem is polluted with.

Lesson 4

Design an Ideal Habitat—Think like Engineers and Scientists

Grade Level: 4–6

Time: 75 minutes

Summary: Students learn how an engineer designs a big project, like habitat restoration, working with a team of environmental professionals. Students will then create a mural of the local cleanup site 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.
- Name multiple components of the project.
- Describe relationships within the local ecosystem.

Vocabulary: restoration, scientist, engineer, pollution, habitat, ecosystem, food-chain, shelter, resources

Materials provided by IISG: Project design figures and maps

Materials provided by teacher: Writing board, writing tool, See *Mural Activity* for additional materials

Procedure: Prior to the lesson, the teacher prepares for the *Mural Activity* by hanging up blue butcher paper on an open wall space in the classroom where students can easily reach it. The IISG specialist arrives and makes introductions to students, including any guest visitors. The IISG specialist provides a quick recap of lesson three. The IISG specialist (or an agency project manager, if available) will engage students in a discussion about project design concepts, using the writing board, writing tool, and supplementary materials like Sample Engineering Diagram. See Sample Project Design Discussion Questions for example discussion questions. The IISG specialist will then facilitate the *Mural Activity*. The teacher administers the test on a later day.

Assessment: Test and answer key provided by IISG on concepts learned throughout the educational program.

Great Lakes Literacy Principles

Great Lakes Literacy Principle 5
The Great Lakes Support a Broad Diversity of Life and Ecosystems.
Concepts A, B, C, D, E, F, G, H, I (www.greatlakesliteracy.net/principles/5)

Great Lakes Literacy Principle 6
The Great Lakes and Humans in their Watersheds are Inextricably Interconnected. Concepts C, D, E (www.greatlakesliteracy.net/principles/6)

Mural Activity

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

Materials provided by IISG: Habitat Components PowerPoint and Habitat Component Printouts

Materials provided by teacher: 4′ x 3′ blue butcher paper, 4′x 2′ brown butcher paper, drawing paper, pencils, markers

Procedure:

1. Have prepared blue butcher paper, according to 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 and above water: living—plants
    b) Above water: living—animals
    c) In the water: nonliving and in the water: living—plants
    d) In the water: living animals.
3. Give single-sided printouts of habitat components to each team, along with drawing paper, pencils, and markers. Turn on automatic slideshow of PPT of habitat components for the background.
4. Walk around as students draw ecosystem components, helping them with scale and important organism characteristics. Tell students about species diversity and distribution and encourage them to include all the organisms in their mural. Otherwise, the mural will end up having one songbird and five birds of prey.
5. Also, as students draw ecosystem components, cut and arrange the brown butcher paper to create the basis for an aquatic ecosystem.
6. As students are wrapping up their pictures, help them paste their component on the mural. Ask the student where they think their ecosystem component should go, based on its needs and relationships to other components within the ecosystem.

Wrap Up:

Engage students in discussion of the mural. Ask them about species diversity and distribution. Relate the mural back to lesson two, and ask them if they'd be happy organisms if they lived there. Display the mural at the press event.

Name _____ Date _____

Lesson 1 Environmental Cleanup Posttest (Grades 4-6)

Part I: Vocabulary

Read each question carefully and print the letter of the correct answer next to the question.

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: Short Answer

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

1) A(n) _____ species is supposed to live in the local ecosystem; it belongs there.

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

3) _____ is the wet, squishy dirt found at the bottom of the river.

Part III: Complete Sentence

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

1) What are two environmental problems that make the water body unsuitable habitat for native animals?

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

Name _____ Date _____

Lesson 4 Environmental Cleanup Posttest Key (Grades 4-6)

Part I: Vocabulary (5 points each)

Read each question carefully and print the letter of the correct answer next to the question.

1) B 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) A 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) D Which of the following is NOT a component of a species' natural habitat?
   a. shelter
   b. space
   c. food
   d. invasive species

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

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

8) A Scientists make _____ using their senses (smell, sight, etc.) to understand and make hypotheses about the world.
   a. observations
   b. guesses
   c. science

Part II: Short Answer (10 points each)

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

1) A(n) _____native_____ species is supposed to live in the local ecosystem; it belongs there.

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

3) Sediment_____ is the wet, squishy dirt found at the bottom of the river.

Part III: Complete Sentence (15 points each)

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

1) What are two environmental problems that make the water body unsuitable habitat for native animals?

   Two environmental problems are invasive species and pollution. (Will also accept degraded habitat and contaminated or polluted sediment.)

2) Why is it important for scientists and engineers to work on 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.)

Sample Project Design Discussion Questions

What kinds of plants belong in Roxana Marsh?

Native. What kinds of plants live there now (they know all about Phragmites) vs what kinds of plants are supposed to live there (the plants they're growing in their classroom)

What kinds of animals belong in Roxana Marsh?

Native. Food chain. What kinds of animals live there now vs what kinds of animals are supposed to live there?

Why are native animals having such a hard time living at Roxana Marsh?

Pollution in the sediment, benthos-food chain, invasive plant species take over (they know all about Phragmites)

How did you decide which plants to plant in Roxana Marsh?

Shelter, native plants, food resources for the native animals, absolutely mention the species they are growing in their classroom and the role of each one (see Roxana Marsh plant guide PowerPoint)

Why are certain plants planted in certain locations?

Zones for different plants (this will be a new concept). All plants need water, sun, and nutrients—but different plants need different amounts. 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. Specific examples, especially incorporating plants they're growing in their classroom, would be great.

Sample Habitat Design Components from Roxana Marsh

Above water: Nonliving

Sun (energy)
Carbon dioxide
Oxygen

Above water: Living—Plants

Smooth blue aster (*Aster laevis*, 3-5 ft, food source and shelter for butterflies)
Wild bergamot (*Monarda fistulosa*, 2-4 ft, bees eat its nectar)
Longsepal beardtongue (*Penstemon calycosus*, 1-3 ft, bees eat its nectar)
Blackeyed Susan (*Rudbeckia hirta*, 1-3 ft, provides food and shelter for songbirds)
Little bluestem (*Schizachyrium scoparium*, 1-3 ft, provides food for songbirds and shelter for birds and small mammals)
Cup plant (*Silphium perfoliatum*, 3-8 ft, Shelter for birds and bugs)

Above water: Living—Animals

Bugs such as bees, butterflies, and dragonflies
Songbirds such as red-winged blackbirds and marsh wrens (Small bird that builds nest in cattails and eat bugs)
Mallard ducks (medium bird that swims and eats insects)
Green heron (medium bird that wades and eats small fish)
Great blue heron (big bird that wades and eats small and medium fish)
Peregrine falcon (medium bird that eats small birds)
People

In the water: Nonliving

Sediment
Carbon dioxide
Oxygen

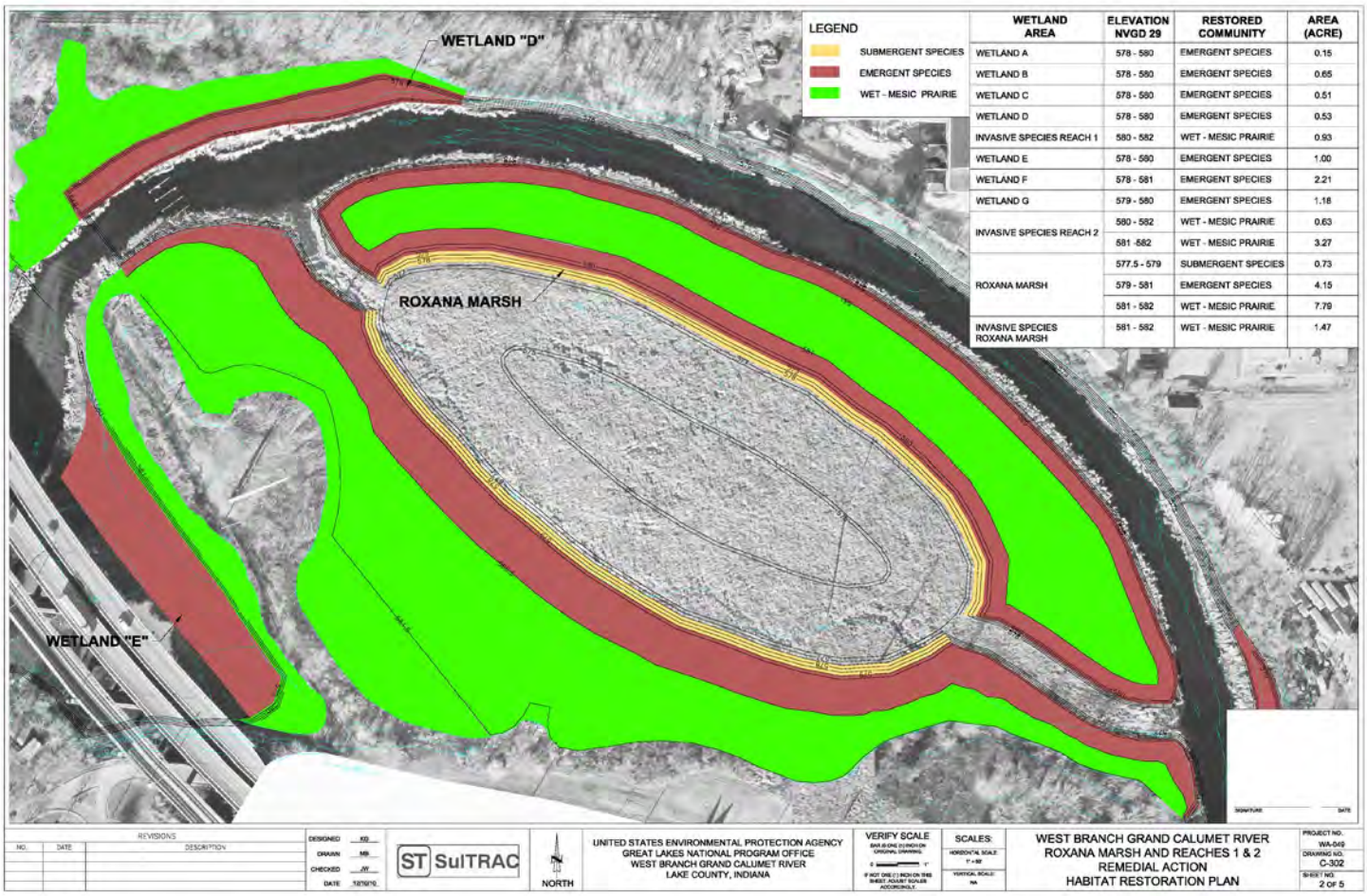
In the water: Living—Plants

Common arrowhead (3 ½ ft, bees, butterflies eat nectar, ducks eat plant)
Swamp milkweed (3 to 5 ft, bees and butterflies eat nectar)
River bulrush (Shelter for fish, spawning habitat for bluegill and bass, eaten by ducks and birds)

In the water: Living—Animals

Benthos (small bugs)
Minnows (small fish that eats plants and benthos)
Bluegill (medium fish that eats insects)
Largemouth bass (lay eggs in the sediment, big fish that eats small fish)
Chinook salmon (big fish that eats small fish)

Sample Engineering Diagram



Roxana Marsh Habitat Mural Components

Ms. Bock's Fourth Grade Classes

Caitie McCoy, Illinois-Indiana Sea Grant

Nishaat Yunus, ORISE Intern for GLNPO

ILLINOIS-INDIANA SEA GRANT

Above water – Nonliving

- Sun (energy)
- Soil
- Carbon dioxide
- Oxygen

CO_2

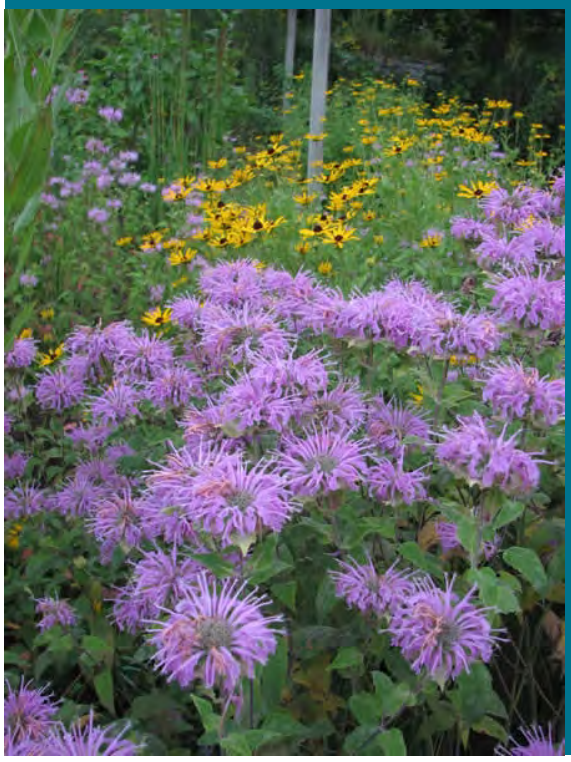
O_2

Above water – Living - Plants

Aster laevis or smooth blue aster

- 3-5 ft high
- Shelter for bugs and birds
- Food for butterflies

Above water – Living - Plants



Monarda fistulosa or wild bergamot

- 2-4 ft high
- Shelter for bugs
- Bees eat the nectar

Above water – Living - Plants

Penstemon calycosus or longsepal beardtongue

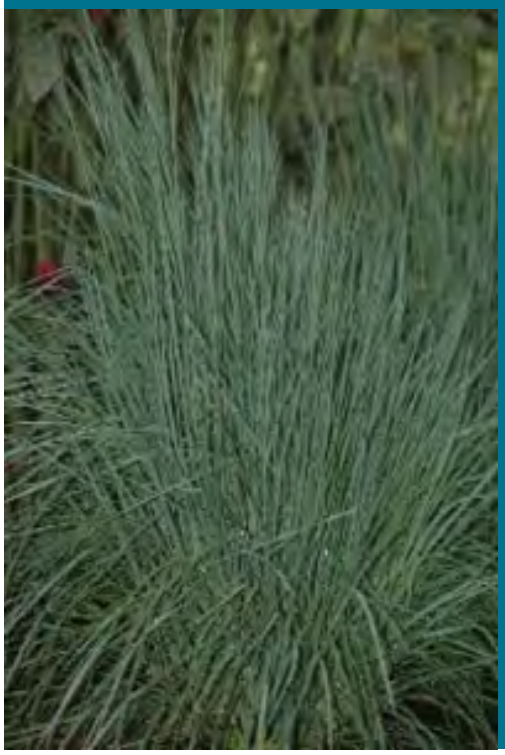
- 1-3 ft high
- Shelter for bugs
- Bees eat the nectar

Above water – Living - Plants

Rudbeckia hirta or black-eyed Susan

- 1-3 ft high
- Food and shelter for songbirds

Above water – Living - Plants



Schizachyrium scoparium or little bluestem

- 1-3 ft high
- Shelter for birds
- Food for songbirds

Above water – Living - Plants

Silphium perfoliatum or cup plant

- 3-8 ft
- Shelter for birds and bugs

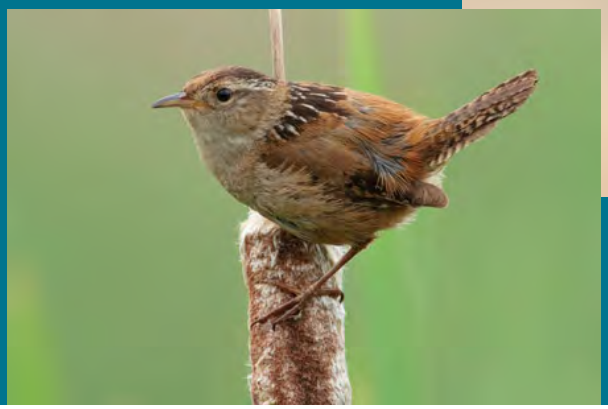
Above water – Living - Animals

Bugs like bees, butterflies, and dragonflies

Above water – Living - Animals

Songbirds like red-winged blackbirds or marsh wrens

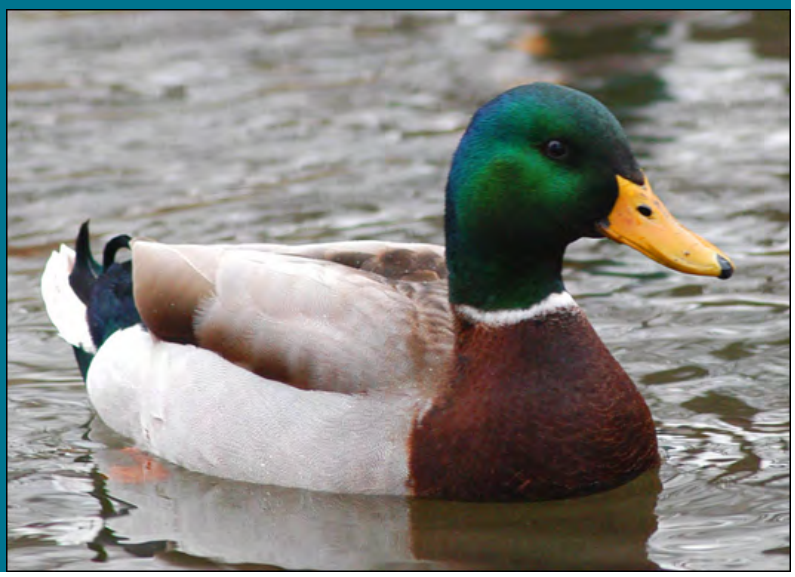
- Build nests in tall grass
- Eat bugs



Above water – Living - Animals

Ducks like mallard

- Medium bird that swims
- Eats bugs



Above water – Living - Animals

Green heron

- Medium bird that wades
- Eats small fish

Above water – Living - Animals

Great blue heron

- Large bird that wades
- Eats small and medium fish

Above water – Living - Animals

Peregrine falcon

- Medium bird that attacks prey from the sky
- Eats small birds

Above water – Living - Animals

People!

In the water – Nonliving

- Sediment
- Carbon dioxide
- Oxygen

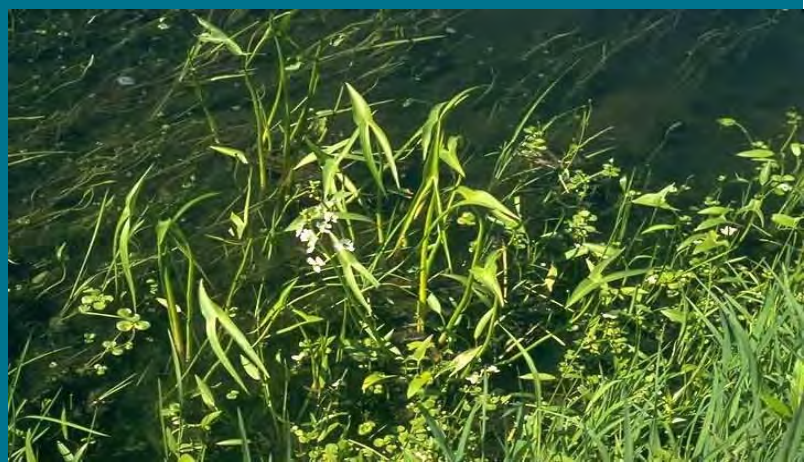
CO_2

O_2

In the water – Living - Plants

Common arrowhead

- 3 ½ ft high
- Shelter for fish
- Eaten by ducks
- Butterflies and bees eat nectar



In the water – Living - Plants

Swamp milkweed

- 3 to 5 ft high
- Butterflies and bees eat nectar

In the water – Living - Plants

River bulrush

- Shelter for fish
- Spawning habitat for bluegill and bass
- Eaten by ducks and birds

In the water – Living - Animals

Benthos

- Small bugs that live in the sediment

In the water – Living - Animals

Minnows

- Small fish
- Eats plants and benthos

In the water – Living - Animals

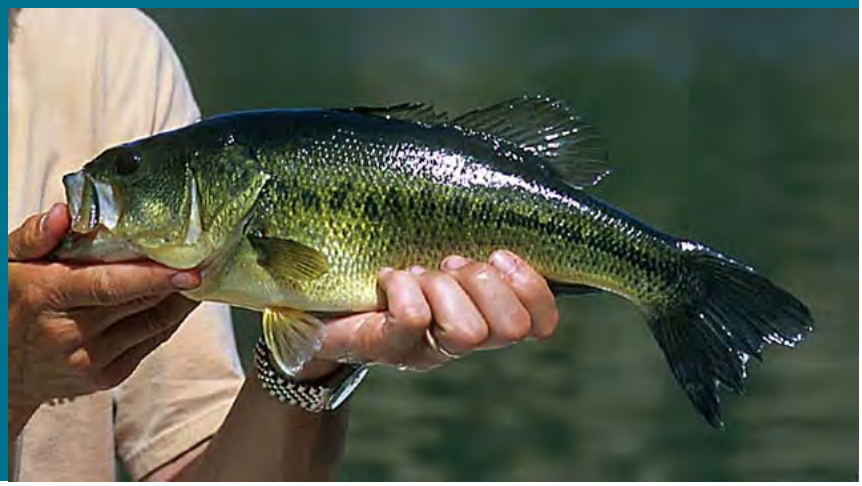
Bluegill

- Medium fish
- Eats benthos and big insects

In the water – Living - Animals

Largemouth bass

- Large fish
- Eats small fish
- Lays eggs in sediment



In the water – Living - Animals

Chinook salmon

- Large fish
- Eats small fish

Lesson 5
Press Event

Grade Level: 4 – 6

Time: 75 minutes

Summary: Students attend a press event to listen to agency leaders speak about the cleanup, have photos taken with VIPs, and plant natives near the water body.

Materials provided by IISG: Extra plants and trowels

Materials provided by teacher: Murals, plants from the students, transportation*

Procedure: Students arrive at the press event and are seated for speeches. The teacher delivers the murals to the IISG specialist, who then posts them up at the press event. During the press event, it is announced that students will be planting their natives at the end of the event. When speeches end, students and VIPs will have the opportunity to stand with the mural for a photo opportunity. The IISG specialist will then direct students to the planting area and give directions on proper installation. VIPs will be invited to help students install the plants, providing an additional photo opportunity.

*Under the current grant, Illinois-Indiana Sea Grant is not allowed to fund bus transportation for schools. The school will need to provide its own funding for bus transportation. If this is not possible, the school may speak with Illinois-Indiana Sea Grant to explore alternative options.

[Insert name of school]

Illinois-Indiana Sea Grant

Photo Release Form

Permission to Use Student's Photograph

During a portion of this academic year, [insert teacher's name] class has participated in an educational program with Illinois-Indiana Sea Grant (IISG). The purpose of this program is to teach students about the Great Lakes Legacy Act cleanup of [insert name of cleanup site].

On [insert date], the program will conclude with student attendance at a press event hosted by the United States Environmental Protection Agency (U.S. EPA) to celebrate the cleanup of the waterway. The students have been growing native plants in the classroom and will plant them that day. Photos or video may be taken of the students who attend the press event by U.S. EPA, IISG, or the press for publications, presentations, or press releases. Parents and guardians of the students are invited to attend this event.

I hereby allow U.S. EPA and IISG to use photos/video of my son/daughter in any publication affiliated with the U.S. EPA's Great Lakes Legacy Act or with any news service used for publicity.

_____ Yes, you may use my child's photo.

_____ No, you may not use my child's photo.

_____ _____

Name of Student | Name of Parent or Guardian

_____ _____

Signature of Parent or Guardian | Date

High School Curriculum

Sample Plan of Work for High School Lessons

Classroom Collaboration with Illinois-Indiana Sea Grant Program

Nishaat and I visit the classrooms multiple times and do hands-on activities regarding the GLLA project.

- Guest speakers: USFWS, USEPA, IDEM

- Visits
  - ✓ 1) Early February – start off with visit on an explanation of how the project got started, with detail on the planning. Planning – Lab – Cleanup Steps
    - Difference between water sampling and sediment sampling
  - ✓ 2) Late February –Field trip to River (collecting and recording data/observations)
    - 3-4 hr trip in morning; eat lunch; and then do test strips in class
    - 4 teachers + parents/extra staff
    - Why we test for certain parameters: water vs sediment
  - ✓ 3) March - Data analysis (mean, median, mode)
  - ✓ 4) April - Making management decisions based on data
  - ✓ 5) April - Field trip to Roxana Marsh

- Send doodle poll to Amanda for February events

- Field trips to river for sampling
  - ✓ Hydrolab with Anne Remek from IDEM
  - ✓ Locations:
    - Sohl Ave – riprap – railroad owned – 1 ½ miles (walkable) – pursuing this one; Caitie looking into access issues
    - Columbia Park
    - Hohman Ave – would sink to knees – plywood?
  - ✓ Safety: E. Coli after high rain events
  - ✓ Baby food jar collection at school

- Sediment sample (with water) from contaminated river sections for school testing
  - ✓ Statement from school for liability of risk from contamination
  - ✓ If not possible, we can provide data

- Parameters for water quality monitoring
  - ✓ USEPA water tests for turbidity; sediment tests for oil and grease, PAHs, metals, PCBs
  - ✓ Students did mock testing for phosphates and nitrates
  - ✓ Teacher has AM-12 TesTab Water Investigation Kit, LaMotte
    - Alkalinity, Dissolved Oxygen, Ammonia, Hardness, Chloride, Iron, Chlorine, Nitrate, Chromium, pH, Copper, Phosphate

- What to do with collected data?
  - ✓ Hoosier River Watch – IDEM uses it to describe fishability, swimmability
    - Amanda will look this up as a potential outlet for data use
  - ✓ Students – Interpretation/Analysis

Field trip to Roxana Marsh. Press event involvement with select students.

- Number of children site can accommodate for press event
  - ✓ About 25
  - ✓ Amanda has about 72 students

- Press Event – participation

- ✓ Students journal through experience and write 1-2 speech about meaning of the cleanup
  - English teacher help turn journaling into a speech
- ✓ One representative (speech winner) from each class attends press event
- ✓ EPA chooses the best speech and that student speaks about what the cleanup/experience means to her/him

- Field Trip to see the site
  - ✓ Multiple trips on one day?
  - ✓ Staging at Knights of Columbus – picnic area
  - ✓ Can we do two groups of 36? Students will not be planting; rather they will explore. This will minimize bussing cost.

- Bussing is about $10-12/student – Sea Grant can do cost-match

- Date:
  - ✓ HAST's best days: April 16-19 (flexible but not Friday)
  - ✓ Aim for this so that students can see the remaining equipment

- Safety concerns
  - ✓ May involve the parents/teachers signing access safety agreements and having the students take a safety briefing onsite
  - ✓ Depend on the date (contractors are going to demobilize around mid-May, safer after this)
  - ✓ Contingency for weather – concern for field trip but not press event

Lesson 1

Why Should We Keep the Great Lakes Great?

Grade Level: 9 – 12

Time: 55 minutes

Summary: Students learn about an environmental cleanup in their town, 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/environment.
- Describe technical aspects of a cleanup.

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

Materials provided by IISG: Great Lakes Legacy Act PowerPoint, jars of sediment (sediment from the river, sediment treated with polymer, weep water from geotubes, carbon, and sand)

Procedure: The IISG specialist makes introductions to the students and delivers PowerPoint.

Assessment: Pretest on vocabulary and concepts of remediation and restoration

Great Lakes Literacy Principles

Great Lakes Literacy Principle 2
Natural forces formed the Great Lakes; the lakes continue to shape the features of their watershed.
Concepts E (www.greatlakesliteracy.net/principles/2)

Great Lakes Literacy Principle 5
The Great Lakes support a broad diversity of life and ecosystems.
Concepts I (www.greatlakesliteracy.net/principles/5)

Great Lakes Literacy Principle 6
The Great Lakes and humans in their watersheds are inextricably interconnected.
Concepts D, E, F (www.greatlakesliteracy.net/principles/6)

Great Lakes Literacy Principle 8
The Great Lakes are socially, economically, and environmentally significant to the region, the nation, and the planet.
Concepts F (www.greatlakesliteracy.net/principles/8)

Name _____ Date _____

Lesson 1 Cleanup Pretest (9-12)

Part I: Vocabulary

Read each question carefully and print the letter of the best answer next to the question.

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 that came from industrial discharges _____.
   a. and cannot clearly be traced to a viable entity
   b. and can clearly be traced to a viable entity
   c. after modern-day environmental regulations like the Clean Water Act were passed

Part II: Data Analysis and Reporting

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 air 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	0.31
5-Aug	1.2	0.79	0.89	0.73	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	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: Short Answer

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 sand, silt, and clay found at the bottom of the river.

Part III: Complete Sentence

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 _____

Lesson 1 Cleanup Pretest Answer Key (9-12)

Part I: Vocabulary (5 points each)

Read each question carefully and print the letter of the best answer next to the question.

1) B _____ 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) A 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) D _____ 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) A _____ The Great Lakes Legacy Act targets pollution that came from industrial discharges _____.
   a. and cannot clearly be traced to a viable entity
   b. and can clearly be traced to a viable entity
   c. after modern-day environmental regulations like the Clean Water Act were passed

Part II: Data Analysis and Reporting

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

5) 1.00 **Mean**

6) 0.71 **Median**

7) 1.2 **Mode**

8) 3.5 **Outlier(s)**

Table 1. Levels of contaminant "x" detected in air 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	0.31
5-Aug	1.2	0.79	0.89	0.73	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	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: Short Answer

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

10) A native species is supposed to live in the local ecosystem; it belongs there.

11) An invasive species does not belong in the local ecosystem. It harms the species that belong in the ecosystem.

12) Sediment is the sand, silt, and clay found at the bottom of the river.

Part III: Complete Sentence

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.

Grand Calumet River
Roxana Marsh
Great Lakes Legacy Act

Caitie McCoy
Illinois-Indiana Sea Grant
Nishaat Yunus
ORISE

Sea Grant
ILLINOIS - INDIANA

Great Lakes National Program Office
EPA

REBUS PUZZLES

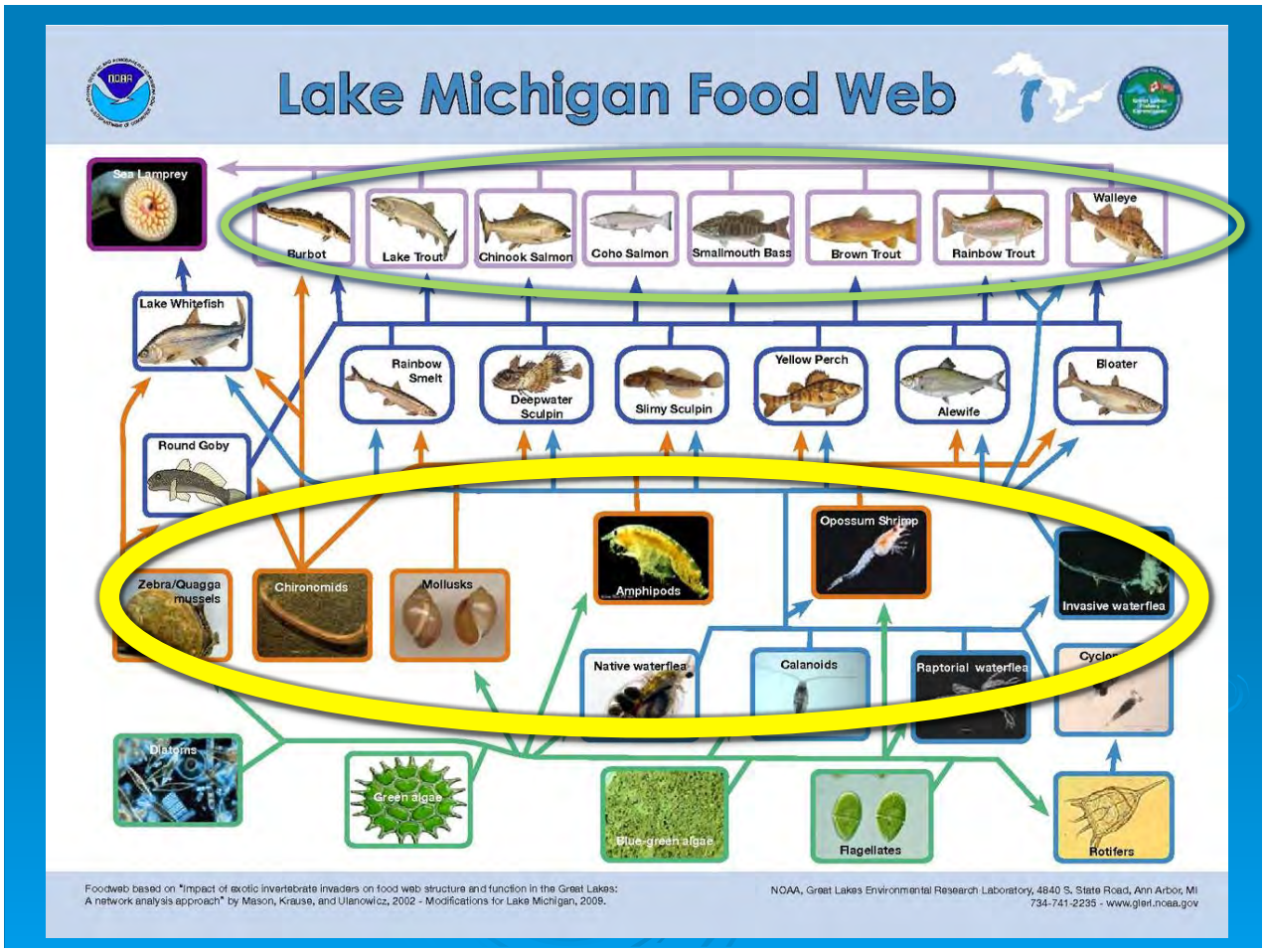
ECONOMY

GROWING ECONOMY

REBUS PUZZLES

HEAD
HEELS

HEAD OVER HEELS


Lake Michigan Food Web
Sea Lamprey
Burbot
Lake Trout
Chinook Salmon
Coho Salmon
Smallmouth Bass
Brown Trout
Rainbow Trout
Walleye
Lake Whitefish
Rainbow Smelt
Deepwater Sculpin
Slimy Sculpin
Yellow Perch
Alewife
Bloater
Round Goby
Zebra/Quagga mussels
Chironomids
Mollusks
Amphipods
Opossum Shrimp
Invasive waterflea
Native waterflea
Calanoids
Raptorial waterflea
Cyclo
Diatoms
Green algae
Blue-green algae
Flagellates
Rotifers
Foodweb based on "Impact of exotic invertebrate invaders on food web structure and function in the Great Lakes: A network analysis approach" by Mason, Krause, and Ulanowicz, 2002 - Modifications for Lake Michigan, 2008.
NOAA, Great Lakes Environmental Research Laboratory, 4840 S. State Road, Ann Arbor, MI
734-741-2235 - www.glerl.noaa.gov

REBUS PUZZLES

CHIMADENA

MADE IN CHINA

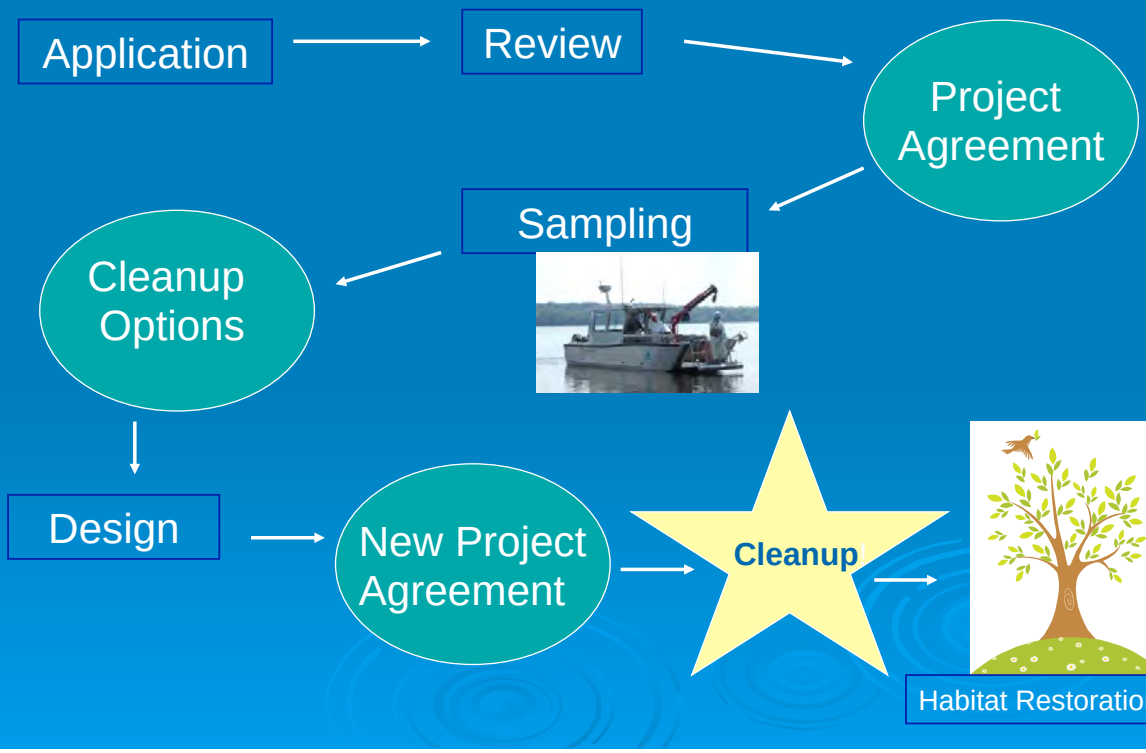
Great Lakes Legacy Act

- U.S. Environmental Protection Agency
- Partners: Industries, states, local government, nongovernmental organizations (NGOs), businesses
- Partners share the cost of the cleanup

GLLA Progress

- Pounds/Cubic Yards
  - Weight: 5 million pounds of contamination
    - About 750 adult male elephants
  - Volume: 1.5 million cubic yards
    - 150,000 dump trucks
- Cost
  - $212 million
    - Hope Diamond
    - A Pro-basketball team
    - Toy Story 3

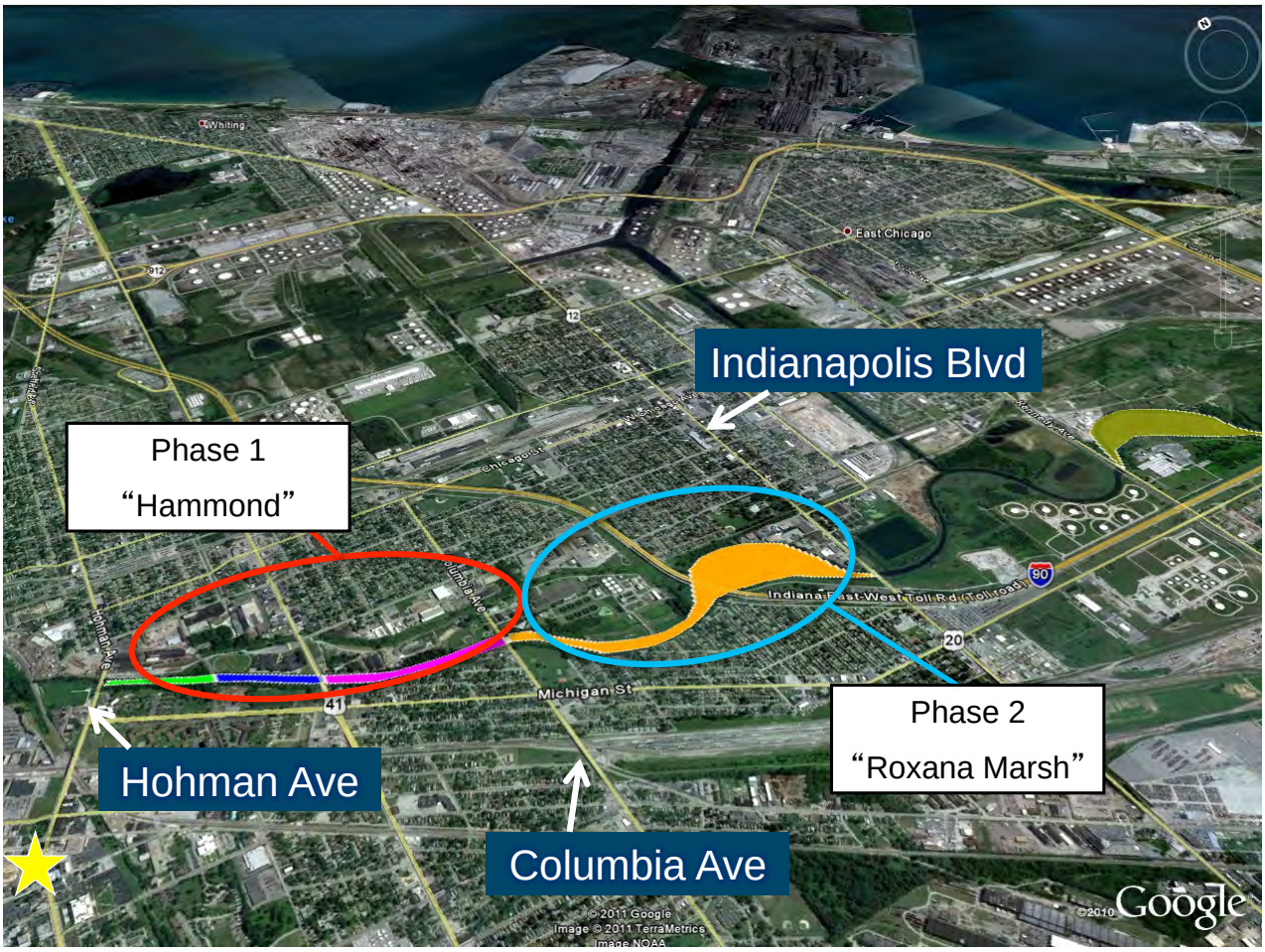
The GLLA process



REBUS PUZZLES

NINE
CUMULUS

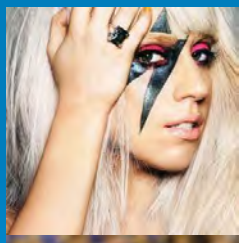
ON CLOUD NINE



Grand Calumet River

- Pounds/Cubic Yards
  - Weight: 2.2 million pounds of contamination
    - 300 adult male elephants
  - Volume: 730,000 cubic yards
    - 73,000 dump trucks

- Cost
  - $85 million
    - Lady Gaga's salary for 2011
    - Peyton Manning's 5-year contract with Colts



BRAIN TEASERS

KNEE
UR FULL OF

YOU'RE FULL OF BOLOGNA (BELOW KNEE)


06 27.2011 13:37

JOKE TIME

What do you do with a dead element?

BARIUM


I ❤ MY JOB!

REBUS PUZZLES

TAILR
RIALT
AIRTL
TLRIA

TRAIL MIX


10.06.2011 11:21


11.16.2011 15:11

REBUS PUZZLES

GIVE GET

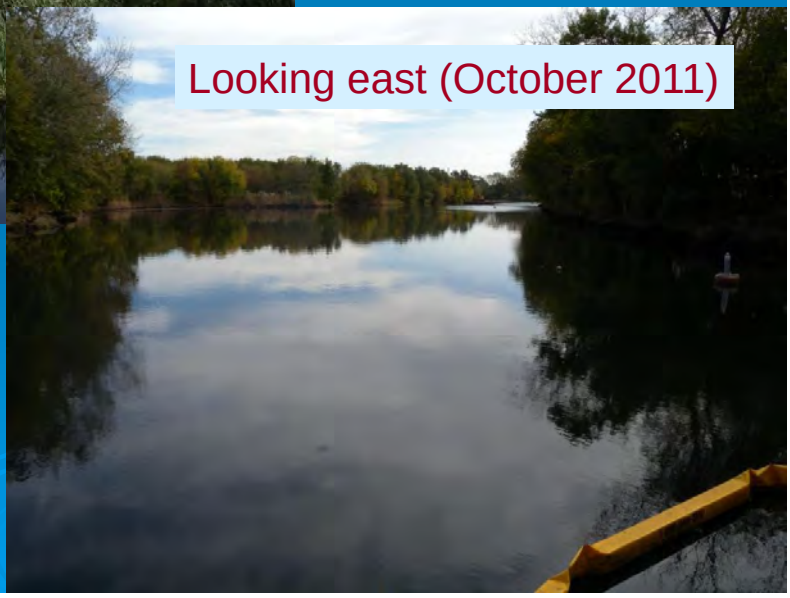
GIVE GET

GIVE GET

GIVE GET

FORGIVE AND FORGET


Looking east (July 2011)


Looking east (October 2011)

Questions?


MEDICINE
© A.BACALL
"Will this prescription interact with the meds already in my drinking water?

We need your help!

Lesson 2

Get the Lowdown on Your Local Water Quality

Grade Level: 9-12

Time: 90 minutes for sampling + 90 minutes for lab

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 with water test kits to determine water quality.

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

Vocabulary: sampling, observations, data, data collection, parameter, toxic

Materials provided by IISG: Lab sheets, latex gloves, and water test kits

Materials provided by teacher: Baby food jars, two 1-qt food storage containers (one empty labeled "dirty" and one full of clean water labeled "clean"), transportation*

Procedure

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

2. Classroom Lab: Prepare the lab with one test parameter from the water test kit at each table. Also, place two 1-quart food storage containers (one empty labeled "dirty" and one full of clean water labeled "clean") at each table. Once students arrive, ask them 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 for locations one and two. On a separate day, conduct a lesson on 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. Students perform the data analysis activity. Send the data analysis results to IISG.

Assessment: Lab sheets and data analysis activity with grading sheets

Great Lakes Literacy Principles
Great Lakes Literacy Principle 6
The Great Lakes and humans in their watersheds are inextricably interconnected.
Concepts E, F (www.greatlakesliteracy.net/principles/6)

*Under the current grant, Illinois-Indiana Sea Grant is not allowed to fund bus transportation for schools. The school will need to provide its own funding for bus transportation. If this is not possible, the school may speak with Illinois-Indiana Sea Grant to explore alternative options.

Name _____ Date _____ Team_____

Location One: Field Sampling

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.

Make two observations about the **location one** water sample.

1.

2.

Name _____ Date _____ Team _____

Location Two: Field Sampling

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.

Make two observations about the **location two** water sample.

1.

2.

Name _____ Date _____ Team _____

Location One: Data Collection (15 points per table)

Test Name	What does this test tell us?	Calculations	Test Result	What does the result tell us?

Name _____ Date _____ Team_____

Location Two: Data Collection (15 points per table)

Test Name	What does this test tell us?	Calculations	Test Result	What does the result tell us?

Lab Sheet for Lesson 2

Name _____ Date _____ Team_____

Location One: Field Sampling Key

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. Student makes eight unique observations about the environment. **(1 point each)**

2.

3.

4.

5.

6.

7.

8.

Make two observations about the **location one** water sample.

1. Student makes two unique observations about the water sample. **(1 point each)**

2.

Lab Sheet for Lesson 2

Name _____ Date _____ Team_____

Location Two: Field Sampling Key

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. Student makes eight unique observations about the environment. **(1 point each)**

2.

3.

4.

5.

6.

7.

8.

Make two observations about the **location two** water sample.

1. Student makes two unique observations about the water sample. **(1 point each)**

2.

Name _____ Date _____ Team_____

Location One: Data Collection Key (15 points per table)

Test Name	How does this parameter affect the ecosystem?	Calculations	Test Result	What does the result tell us?
Student lists parameter (completion)	Student describes at least one effect of the parameter on the ecosystem.	Perform any necessary calculations (completion)	List test result (completion)	Student states whether the result is in normal range. Student states whether it will affect the ecosystem.

Name _____ Date _____ Team_____

Location Two: Data Collection Key (15 points per table)

Test Name	How does this parameter affect the ecosystem?	Calculations	Test Result	What does the result tell us?
Student lists parameter (completion)	Student describes at least one effect of the parameter on the ecosystem.	Perform any necessary calculations (completion)	List test result (completion)	Student states whether the result is in normal range. Student states whether it will affect the ecosystem.

Name _____ Date _____

Water Body Sampling Analysis

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.

For each parameter, list the data and calculate the mean, median, and mode.

Location One

Test Name	List Data Points	Mean	Median	Mode

For each parameter, list the data and calculate the mean, median, and mode.

Location Two

Test Name	List Data Points	Mean	Median	Mode

List any outliers below.

Name _____ Date _____

Water Body Sampling Analysis (3 points each) Answer Key

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.

For each parameter, list the data and calculate the mean, median, and mode. (15 points)

Location One

Test Name	List Data Points	Mean	Median	Mode
Student lists test name	Student lists data points from master dataset	Student calculates mean	Student calculates median	Student calculates mode

For each parameter, list the data and calculate the mean, median, and mode. (15 points)

Location Two

Test Name	List Data Points	Mean	Median	Mode

List any outliers below. **(3 points)**

Master Dataset Location One

Test Name	Group One	Group Two	Group Three	Group Four	Group Five	Group Six	Group Seven	Group Eight

Master Dataset Location Two

Test Name	Group One	Group Two	Group Three	Group Four	Group Five	Group Six	Group Seven	Group Eight

Lesson 3

Making Environmental Decisions through Data Analysis

Grade Level: 9 – 12

Time: 55 minutes

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.

Background: Data analysis activity

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

Materials provided by IISG: Data PowerPoint and data conclusions activity

Procedure: Using results from the data analysis, the IISG specialist engages students in a discussion about making conclusions about water quality at the site. The IISG specialist gives a presentation on data reporting and decision-making. Students begin data conclusions worksheet.

Assessment: Data conclusions activity with grading sheet

Great Lakes Literacy Principles
Great Lakes Literacy Principle 7
Much remains to be learned about the Great Lakes.
Concepts D, E, F (www.greatlakesliteracy.net/principles/7)

Name _____ Date _____

Making Conclusions Using Data

Use your data analyses and lab notes observations to answer the following questions.

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 address both locations.

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

Reporting Data

How do scientists use data that they collect to make informed decisions? How do scientists present data so that the public can trust their data?

Name _____ Date _____

Making Conclusions Using Data Key

Use your data analyses and lab notes observations to answer the following questions.

What parameters were of high concern at location one? **(2 points)**

Student lists parameters.

Why do you think those parameters were of high concern? **(3 points)**

Students use observations of 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? **(2 points)**

Student lists parameters.

Why do you think those parameters were of high concern? **(3 points)**

Students use observations of the environment and their water sample along with 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? **(3 points)**

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 address both locations. **(5 points)**

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

How can we as a school help to ensure that the water body continues to thrive after the remediation is done? **(5 points)**

Students describe stewardship activities, such as spreading the word about the cleanup, getting the community involved, and performing a litter cleanup.

Reporting Data (5 points)

How do scientists use data that they collect to make informed decisions? How do scientists present data so that the public can trust their data?

Sample Plan of Work and Guidance for Guest Speaker

Purpose and Background

The purpose of the Great Lakes Legacy Act (GLLA) educational program at HAST is to connect local youth to the river, while building scientific literacy. On our first visit, we gave the students an overview of the GLLA project, using pictures to illustrate the various stages of remediation and restoration at the Grand Cal. On the second visit, students obtained water samples from remediated sections of the river and created data sets from their lab on water kit testing.

The objective of our upcoming March visit is to teach the students about data management, data analysis, reporting data (including communicating it to the public), and using data to make project-level decisions. We ask that you use real-life examples and stories to engage the students in these topics. They'll learn better that way. The students will benefit from your contribution by listening to "real-world scientists" speak about the process of each of these steps and validate each step's importance.

How much time would you each like to talk? We anticipated 25-30 minutes total for the guest speakers. Each class is 55 minutes long, but the teacher is willing to let you spend the whole time sharing your stories if you need it. The week is flexible, and she can do the writing prompts the next day.

Suggested 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. Please use as many applicable stories from the Grand Cal project as possible.
      i) What does a scientist do with data once they've collected them? Who needs to look at the data before reporting them?
      ii) Why should you manage/process/cleanup datasets?
      iii) Can the average person read a data table? Can data be presented in different ways? How might you present data to scientist colleagues vs. local concerned citizens vs. political decision makers?
      iv) How do data help scientists and engineers make project-level decisions/design projects? How can we motivate decision makers to make scientifically-informed decisions using data?
   b) Questions from the students

3) Teacher Overview of Data Analysis Activity
   a) Mean, median, mode, outliers

4) Student Activity

5) Writing Prompts

Timeframe: Approximately 45 minutes- 1 hour per classroom

Grand Calumet River
Roxana Marsh
Great Lakes Legacy Act

Scientists collect data on…

- Fish

- Birds and eggs

Scientists collect data on…

- Water

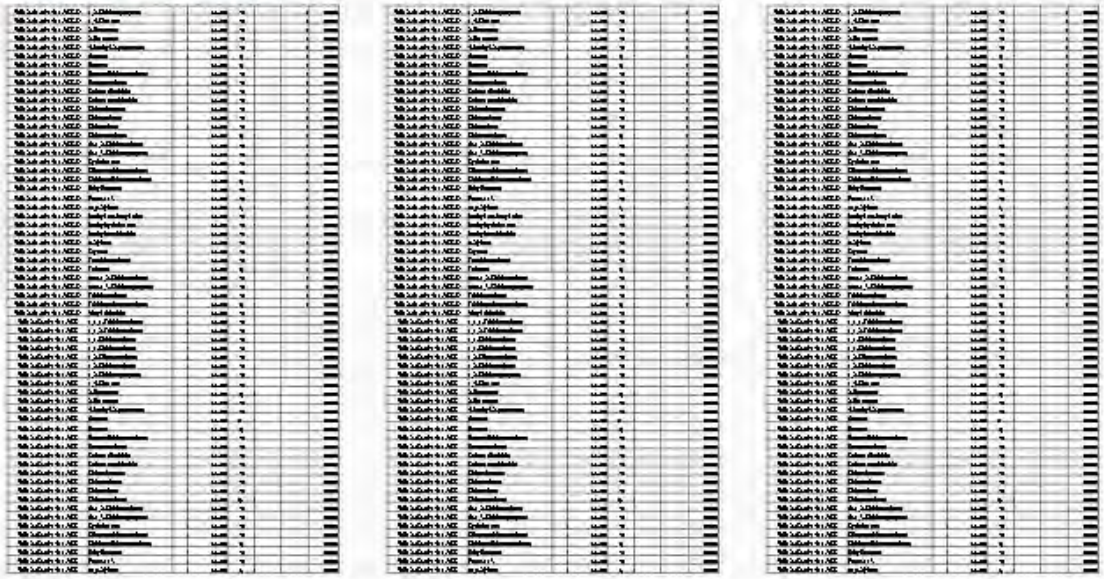
- Sediment

Using data collection instruments

What scientists are looking for

- Fish tissue
- Deformities
- Egg shell thinning
- Reproductive success
- Metals in sediment and water
- Semi volatile and volatile organics
- PCBs
- Oil and grease
- Pesticides
- Emerging contaminants

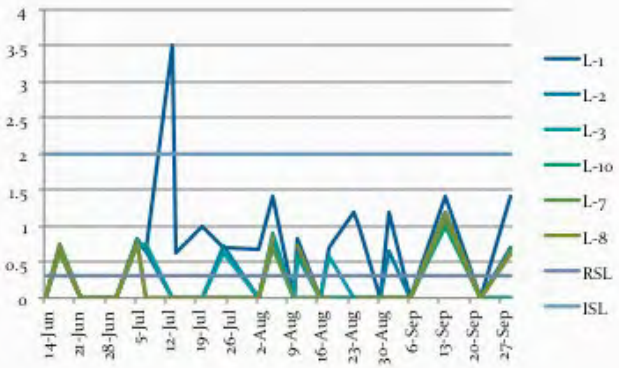
Raw Data



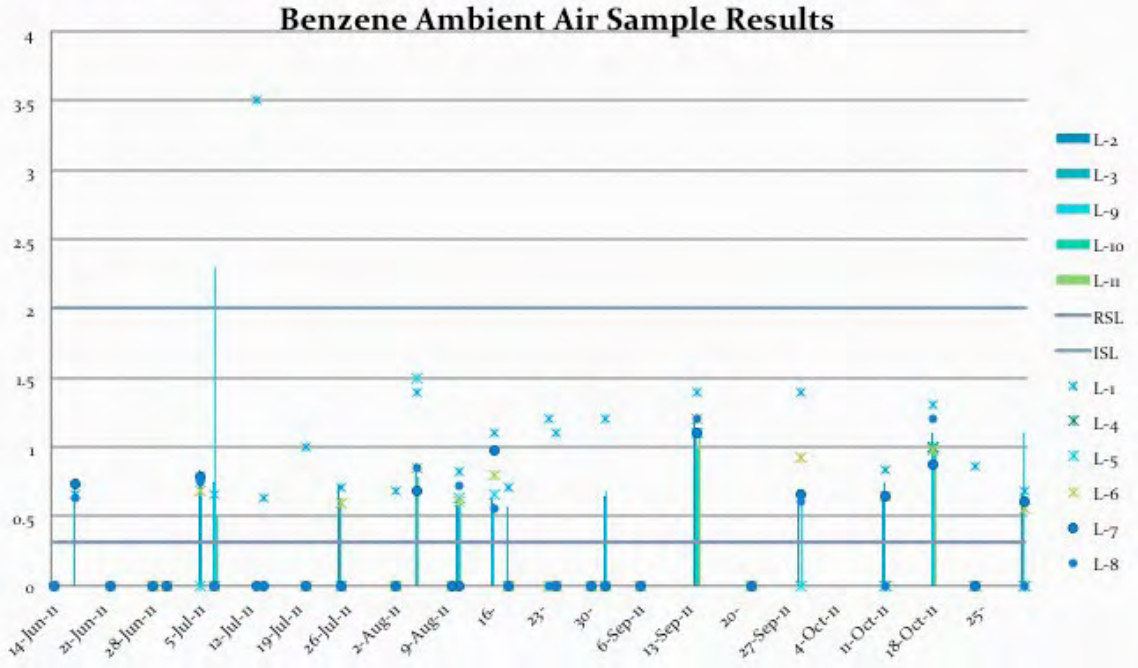
Raw Benzene Data with Graph

Biologist or Project Manager

Date	L-1	L-2	L-3	L-10	L-7	L-8	RSL	ISL
11-Oct	0.84	0.69	0.75					
29-Sep	1.4	0.7	0	0	0.66	0.61	0.31	2
22-Sep	0	0	0	0	0	0	0.31	2
14-Sep	1.4	1.2	1.1	0.99	1.1	1.2	0.31	2
6-Sep	0	0	0	0	0	0	0.31	2
1-Sep	1.2	0.65	0	0	0	0	0.31	2
30-Aug	0	0	0	0	0	0	0.31	2
25-Aug	1	0	0	0	0	0	0.31	2
24-Aug	1.2	0	0	0			0.31	2
18-Aug	0.71	0	0.57	0	0	0	0.31	2
16-Aug	0	0	0	0	0	0	0.31	2
11-Aug	0.82	0.62	0.58	0	0	0.72	0.31	2
10-Aug	0	0	0	0	0		0.31	2
5-Aug	1.4	0.79	0.89	0.73	0.69	0.85	0.31	2
2-Aug	0.68	0	0	0	0	0	0.31	2
25-Jul	0.71	0.72	0.63	0	0	0	0.31	2
20-Jul	1	0	0	0	0	0	0.31	2
14-Jul	0.63	0	0		0	0	0.31	2
13-Jul	3.5	0	0		0	0	0.31	2
7-Jul	0.66	0.66	0.75	0.5	0	0	0.31	2
5-Jul	0.79	0.83	0.72		0.79	0.75	0.31	2
30-Jun	0	0	0		0	0	0.31	2
28-Jun	0	0	0		0	0	0.31	2
22-Jun	0	0	0		0	0	0.31	2
17-Jun	0.66	0.65	0.73		0.74	0.63	0.31	2
14-Jun	0	0	0		0	0	0.31	2



Biologist/Project Manager Data



Decision Maker/General Public

Parameters		Location 1	Location 3	Location 5	Location 6
		RA Location		RA Location	RA Location
		Industrial			
PCBs					
Pesticides					
PAHs					
Metal				N/A	N/A
Mercury				N/A	N/A
VOCs*				N/A	N/A

For Industrial Locations:

Higher than industrial screening level

Higher than background and lower than industrial screening level

Equal to or below background level

Using a model to design the Cap

Model Inputs and Outputs for Cap Thickness

carbon layer and sand layer

Contaminant Properties

Contaminant	
Organic carbon partition coefficient, log K_{oc}	5.13log L/kg
Colloidal organic carbon partition coefficient, log K_{DOC}	4.76log L/kg
Water diffusivity, D_w	5.0E-06cm²/s
Cap decay rate (porewater basis), λ_1	0.00yr⁻¹
Bioturbation layer decay rate (porewater basis), λ_2	0.00yr⁻¹

Sediment/Bioturbation Layer Properties

Contaminant pore water concentration, C_0	646.7ug/L
Biological active zone fraction organic carbon, $(f_{oc})_{bio}$	0.038
Colloidal organic carbon concentration, ρ_{DOC}	87.03mg/L
Darcy velocity, V	309.2cm/yr
Depositional velocity, V_{dep}	0cm/yr
Bioturbation layer thickness, h_{bio}	10cm
Pore water biodiffusion coefficient, D_{bio}^{pw}	100cm²/yr
Particle biodiffusion coefficient, D_{bio}^{p}	1cm²/yr
Boundary layer mass transfer coefficient, k_{bl}	0.16cm/hr
Effective retardation factor in sediment	856

Output-Steady State Model

Pore water concentration at depth, $C(z)$	384.509ug/L
Solid concentration at depth of interest, $W(z)$	1971014.6ug/kg
Average bioturbation layer loading, $(W_{bio})_{avg}$	136484Cug/kg
Flux to overlying water column, J	1999585.ug/m²/yr
Cap-bioturbation interface concentration, C_{int}/C_0, C_{int}	59.46% 384.5088
Cap-water interface concentration, C_w/C_0, C_w	18.07% 116.8801
Average bioturbation concentration, $(C_{bio})_{avg}/C_0$, $(C_{bio})_{avg}$	41.17% 266.2553
Time to contaminant breakthrough, t_{cont}	4.21E+02yr

Dimensionless Parameters

Chemical isolation layer Peclet no., Pe_1	50.11
Chemical isolation layer Damkohler no., Da_1	0.00
$\beta = SQRT(Pe_1^2/4+Da_1)$	25.06
Bioturbation layer Peclet no., Pe_2	0.70
Bioturbation layer Damkohler no., Da_2	0.00
$\gamma = SQRT(Pe_2^2/4+Da_2)$	0.352
Sherwood number at interface, Sh	3.2
Equivalent ratio of active layer thickness to sand layer	27.6

Other Parameters

Chemical isolation layer depth, h_{cap}	36cm
Chemical isolation Layer Retardation Factor, R_1	18.3
Bioturbation layer retardation factor, R_2	876
Effective advective velocity (>=0), U	309cm/yr
Dispersivity, α	0.51cm
Chemical isolation layer diffusion/dispersion coeff., D_1	220cm²/yr
Bioturbation layer diffusion/dispersion coeff., D_2	4.39cm²/yr
Characteristic advection time-cap layer, t_{adv}	7.22E+02yr
Characteristic diffusion time-cap layer, t_{diff}	1009.6yr
Characteristic reaction time-cap layer, t_{rxn}	infinite yr

Math Equations for Model

Biologist / Scientist

$$C_1 = \frac{C_{bio}e^{-\frac{Pe_1}{2}} - C_0 e^{-\beta}}{2\sinh\beta}\exp\left[\left(\frac{Pe_1}{2}+\beta\right)\frac{h_{cap}-z}{h_{eff}}\right] + \frac{C_0 e^{\beta} - C_{bio}e^{-\frac{Pe_1}{2}}}{2\sinh\beta}\exp\left[\left(\frac{Pe_1}{2}-\beta\right)\frac{h_{cap}-z}{h_{eff}}\right]$$

$$Pe_1 = \frac{Uh_{eff}}{D_1} \qquad Da_1 = \frac{\varepsilon\lambda_1 h_{eff}^2}{D_1} \qquad \beta = \sqrt{\frac{Pe_1^2}{4}+Da_1}$$

$$C_2 = \frac{C_0 e^{-\frac{Pe_2}{2}} - C_{bio}e^{-\gamma}}{2\sinh\gamma}\exp\left[\left(\frac{Pe_2}{2}+\gamma\right)\frac{h_{bio}-z}{h_{bio}}\right] + \frac{C_{bio}e^{\gamma} - C_0 e^{-\frac{Pe_2}{2}}}{2\sinh\gamma}\exp\left[\left(\frac{Pe_2}{2}-\gamma\right)\frac{h_{bio}-z}{h_{bio}}\right]$$

$$Pe_2 = \frac{Uh_{bio}}{D_2} \qquad Da_2 = \frac{\varepsilon\lambda_2 h_{bio}^2}{D_2} \qquad \gamma = \sqrt{\frac{Pe_2^2}{4}+Da_2}$$

$$C_{bio} = \frac{C_0\frac{Pe_2}{Pe_1}e^{\frac{Pe_1}{2}}\beta\sinh\gamma}{\frac{Pe_2}{Pe_1}\beta\cosh\beta\sinh\gamma + \gamma\sinh\beta\cosh\gamma - \left(Sh+\frac{Pe_2}{2}\right)\sinh\gamma + \gamma\cosh\gamma}$$

$$C_0 = \frac{C_e e^{\frac{Pe_1+Pe_2}{2}}}{\left(\frac{Pe_1}{2}+\frac{Pe_1 Sh}{Pe_2}\right)\frac{\sinh\beta\cosh\gamma}{\beta} + \left(\frac{Pe_1}{2}+Sh\right)\frac{\cosh\beta\sinh\gamma}{\gamma} + \frac{Pe_1\gamma\sinh\gamma\sinh\beta}{Pe_2\beta} + \cosh\beta\cosh\gamma}$$

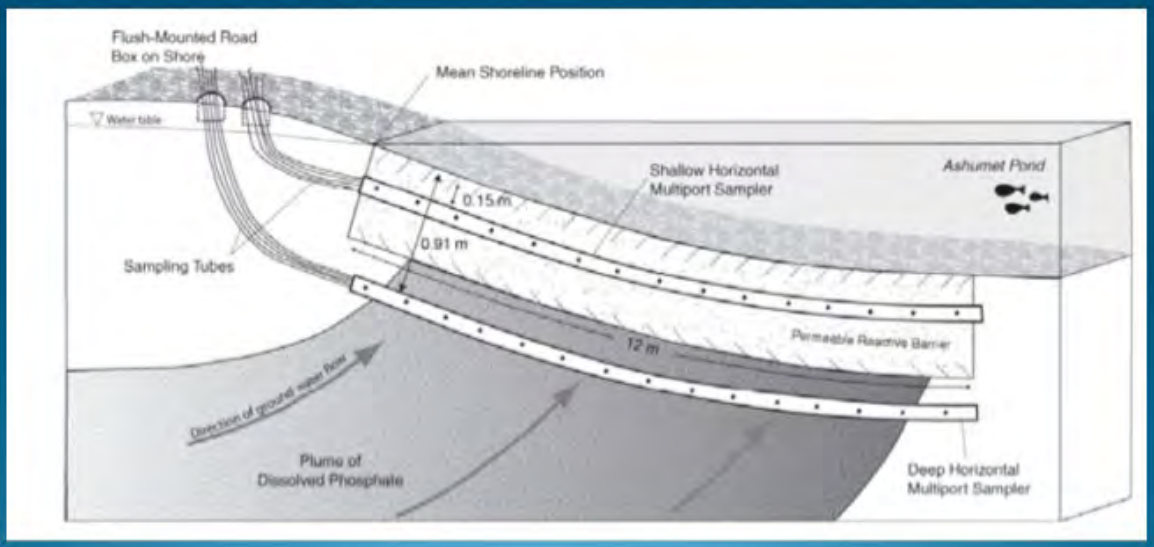
= 24 inches of Sand

Table 1: Cap Model Results Summary
PW conc – Porewater Concentration (ug/L)
NA – Average concentration in the bioturbation zone is less than 27 mg/kg at steady-state (infinity) conditions in the

Model Results

Area	Cap Configuration Sand Cap Thickness	"Breakthrough time" (yrs) tadv/diff	Steady State Wbio (mg/kg)	Time to Wbio > 27 mg/kg (yrs)	Conditions PW conc	 Darcy Velocity
Pipeline Area	0.5 ft	0.5	13.5	NA	16.16	96.33
	0.5 ft	0.3	34.6	0.8-1.1	16.16	309.2
	0.5 ft	0.07	72.4	0.2	16.16	1592
	1.0 ft	3.9	13.5	NA	16.16	96.33
	1.0 ft	1.5	34.4	~2	16.16	309.2
	1.0 ft	0.3	71.8	0.5	16.16	1592
	1.5 ft	7.8	13.4	NA	16.16	96.33
	1.5 ft	2.8	34.1	3-4	16.16	309.2
	1.5 ft	0.6	71.1	0.6-1.1	16.16	1592
	0.5 ft sand with 0.5 ft 10 % organoclay/ sand mix	471	34.3	625	16.16	309.2

The Model



Lesson 4

Dynamic Careers to Clean Up the Environment

Grade Level: 9-12

Time: 55 minutes

Summary: Students learn about different careers in the environment as well as the teamwork aspect of environmental cleanups. Visiting scientists/project managers conduct Q&A with the students, discussing their careers, their roles in the cleanup, and the students' water sampling data.

Objectives

- Name important classes to take in high school and college in order to pursue an environmental career.
- Name different jobs in the environment.
- Describe the teamwork aspect of environmental cleanups.

Vocabulary: scientist, engineer

Materials provided by IISG: Career PowerPoint

Procedure: The IISG specialist makes introductions to students, including any guest speakers. The IISG specialist delivers PowerPoint on environmental careers, and guests engage students in a Q&A session about environmental careers and personal experiences.

Great Lakes Literacy Principles
Great Lakes Literacy Principle 7
Much remains to be learned about the Great Lakes.
Concept F (www.greatlakesliteracy.net/principles/7)

Sample Plan of Work for Visiting Scientists and Engineers

Nishaat Yunus, Caitie McCoy, Scott Ireland, Diana Mally & Daniel Goldfarb

Class 1: 10:00-10:55am
Lunch
Class 2: 11:30-12:25pm

1. Data (20 min)—6 groups of students will each present 2 test's worth of data to us.

2. Speeches (2-3 min)—video of highlights from speeches the students have recorded and edited

3. Career/education (10 min)—PowerPoint (will be sent out week of 23rd by Nishaat)
   a. Types of jobs in environmental science with focus on environmental research scientist (ERS) AND environmental engineer (EE)
   b. Interests that align with 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
   g. Day in the life of an environmental scientist (Scott and Diana)

4. Scott/Diana share: Life of a Project Manager
   a. Role of an EPA scientist in a clean-up
   b. Is a project manager just a boss?
      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 do your jobs differ? (Scott/Diana)
   c. Questions

5. Ask students about their water sampling data (20 min).
   a. What did you learn about the water?
   b. Did results vary between locations?
   c. Are there any parameters EPA should be concerned about?

Careers in Environmental Science

Nishaat Yunus – ORISE
Caitie McCoy – IL-IN Sea Grant
Diana Mally – U.S. EPA
Scott Ireland – U.S. EPA

What kinds of jobs?

Freshwater scientist
Forester
Environmental Engineer
Environmental Resource Manager
Environmental Scientist
Hydrologist
Urban Planner
Ecologist
Agricultural Engineer
Restoration Technician
Atmospheric Scientist
Conservation Scientist
Chemical Oceanographer
Renewable Energy Engineer
GIS Analyst
Park Ranger
Fisheries Conservationist
Environmental Constultant
Social Scientist

Where do they work?

Everywhere!

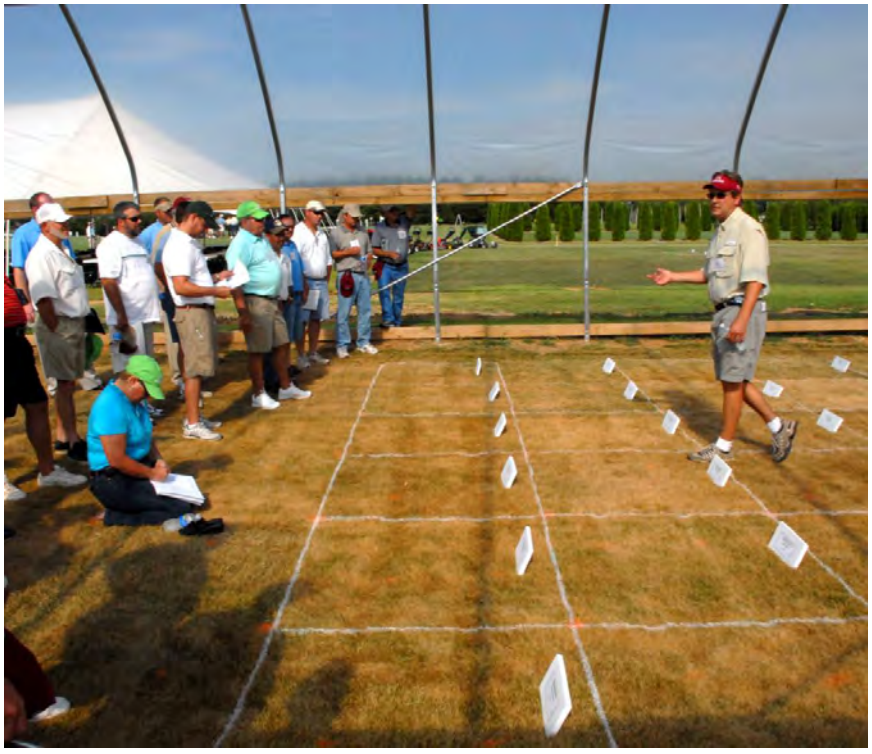
In laboratories

At a desk

On ships!

In the field!

On farms



Underwater

On the water

What interests environmental scientists and engineers?

- Animals
- Plants
- Climate change
- Pollution
- Creative problem solving
- Policy
- Research
- Human health
- Human impacts on the environment
- Maps
- Computers
- Improving the environment
- People
- Complex math
- Communication

What classes should I take in high school?

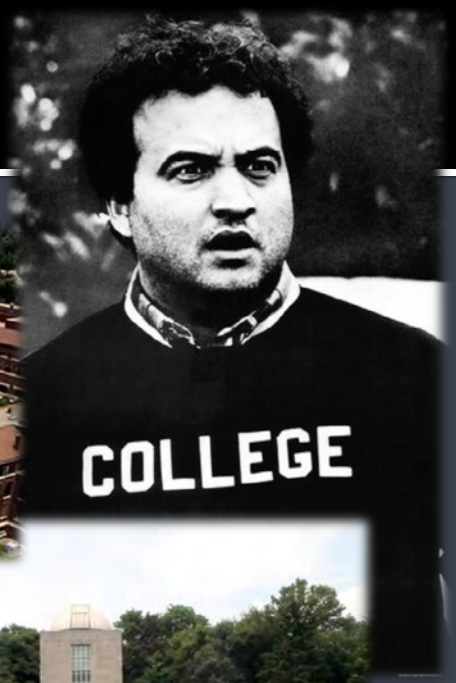
MATH

- Algebra
- Statistics
- Geometry
- Trigonometry
- Calculus I
- AP/Honors

SCIENCE/TECHNOLOGY

- Lab sciences
- Biology
- Physics
- Chemistry
- Environmental science
- Computer sciences
- AP/Honors

College



What should I major in?

UNDERGRADUATE/ BACHELOR'S

- Biology
- Chemistry
- Ecology
- Mathematics
- **Environmental science**
  (There are more specific majors)
- **Environmental engineering**
- Science and technology studies

GRADUATE/ MASTER'S AND PH.D

- Any science
- Environmental policy
- Environmental science
- Natural resource management
- Human dimensions
- Urban planning
- Landscape architecture
- Public/environmental affairs
- MPA/MPP

Internships: Summers matter!

- High school *and* college
- Paid and unpaid
- Research experience for undergraduates (REU)
- Government
- Non-profits
- Universities
- Private companies

Tools

- Strong Interest Inventory
- Strengths Quest
- Myers-Briggs
- Career assessment
- **Talk to a scientist!**
- Informational interview
- Internships
- Volunteering
- Summer jobs
- Shadowing
- Counselors
- Teachers
- Time

Diana Mally and Scott Ireland

Life of an Environmental Scientist/Engineer

Lesson 5

The Real Deal—Cleanup in the Field

Grade Level: 9-12

Time: 90 minutes

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 about the engineering and science behind the cleanup by seeing it firsthand.

Vocabulary: banks, erosion control, water flow, hydrology

Materials provided by IISG: Engineering design plans, before and after pictures, gloves, trash bags, and hand sanitizer

Materials provided by the teacher: Transportation*

Procedure: The IISG specialist makes introductions to students, including any guest speakers. The teacher splits students into two groups. One group goes on a site tour for 45 minutes with the teacher and a project manager. The project manager points out interesting scientific and engineering features, using before and after pictures and diagrams. The IISG specialist leads the other group in performing the litter cleanup. For this portion, students are split into teams of two or three each. The IISG specialist gives gloves to each of the students and a trash bag to each team. At the end of the cleanup activity, students are provided with hand sanitizer. The groups, including teachers, chaperones, and IISG specialists, switch and repeat the activity.

Assessment: Teacher gives the test on a following day.

Great Lakes Literacy Principles
Great Lakes Literacy Principle 6
The Great Lakes and humans in their watersheds are inextricably interconnected.
Concepts D, E, and F (www.greatlakesliteracy.net/principles/6)

*Under the current grant, Illinois-Indiana Sea Grant is not allowed to fund bus transportation for schools. The school will need to provide its own funding for bus transportation. If this is not possible, the school may speak with Illinois-Indiana Sea Grant to explore alternative options.

Name _____ Date _____

Cleanup Posttest (9-12)

Part I: Vocabulary

Read each question carefully and print the letter of the best answer next to the question.

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 that came from industrial discharges _____.
   a. and cannot clearly be traced to a viable entity
   b. and can clearly be traced to a viable entity
   c. after modern-day environmental regulations like the Clean Water Act were passed

Part II: Data Analysis and Reporting

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 air 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	0.31
5-Aug	1.2	0.79	0.89	0.73	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	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: Short Answer

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 sand, silt, and clay found at the bottom of the river.

Part III: Complete Sentence

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 _____

Cleanup Posttest Answer Key (9-12)

Part I: Vocabulary (5 points each)

Read each question carefully and print the letter of the best answer next to the question.

1) B _____ 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) A 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) D _____ 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) A _____ The Great Lakes Legacy Act targets pollution that came from industrial discharges _____.
   a. and cannot clearly be traced to a viable entity
   b. and can clearly be traced to a viable entity
   c. after modern-day environmental regulations like the Clean Water Act were passed

Part II: Data Analysis and Reporting

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

5) 1.00 **Mean**

6) 0.71 **Median**

7) 1.2 **Mode**

8) 3.5 **Outlier(s)**

Table 1. Levels of contaminant "x" detected in air 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	0.31
5-Aug	1.2	0.79	0.89	0.73	0.31
2-Aug	0.68	0	0	0	0.31
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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: Short Answer

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

10) A native species is supposed to live in the local ecosystem; it belongs there.

11) An invasive species does not belong in the local ecosystem. It harms the species that belong in the ecosystem.

12) Sediment is the sand, silt, and clay found at the bottom of the river.

Part III: Complete Sentence

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

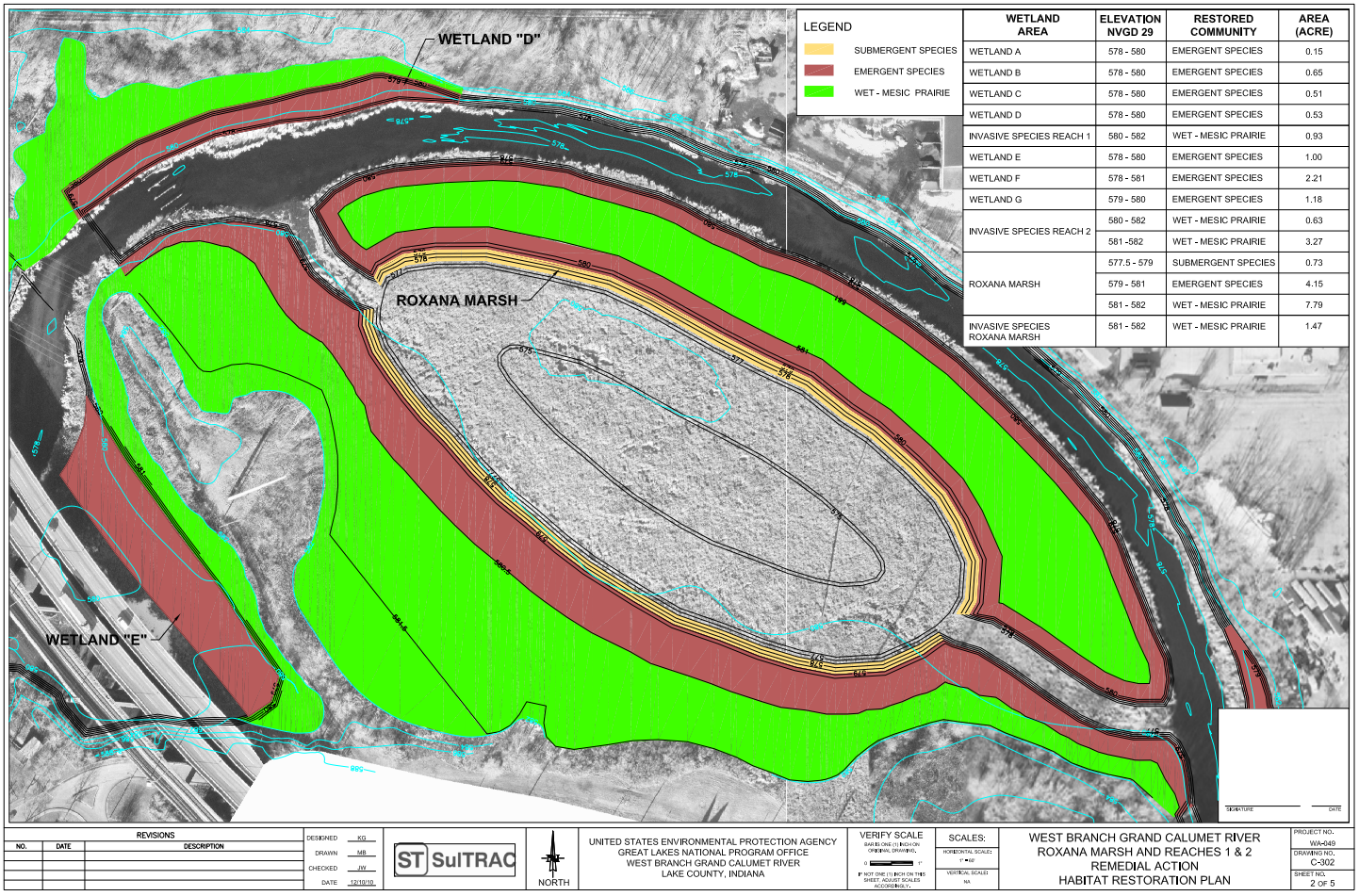
13) What are three environmental, social, or economic benefits that people derive from the Great Lakes?

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.

Sample Engineering Diagram



WETLAND AREA	ELEVATION NVGD 29	RESTORED COMMUNITY	AREA (ACRE)
WETLAND A	578 - 580	EMERGENT SPECIES	0.15
WETLAND B	578 - 580	EMERGENT SPECIES	0.65
WETLAND C	578 - 580	EMERGENT SPECIES	0.51
WETLAND D	578 - 580	EMERGENT SPECIES	0.53
INVASIVE SPECIES REACH 1	580 - 582	WET - MESIC PRAIRIE	0.93
WETLAND E	578 - 580	EMERGENT SPECIES	1.00
WETLAND F	578 - 581	EMERGENT SPECIES	2.21
WETLAND G	579 - 580	EMERGENT SPECIES	1.18
INVASIVE SPECIES REACH 2	580 - 582	WET - MESIC PRAIRIE	0.63
	581 -582	WET - MESIC PRAIRIE	3.27
ROXANA MARSH	577.5 - 579	SUBMERGENT SPECIES	0.73
	579 - 581	EMERGENT SPECIES	4.15
	581 - 582	WET - MESIC PRAIRIE	7.79
INVASIVE SPECIES ROXANA MARSH	581 - 582	WET - MESIC PRAIRIE	1.47

REVISIONS			
NO.	DATE	DESCRIPTION	
			DESIGNED KG
			DRAWN MB
			CHECKED JW
			DATE 12/10/10

SulTRAC

NORTH

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
GREAT LAKES NATIONAL PROGRAM OFFICE
WEST BRANCH GRAND CALUMET RIVER
LAKE COUNTY, INDIANA

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SCALES:
HORIZONTAL SCALE: 1" = 60'
VERTICAL SCALE: NA

WEST BRANCH GRAND CALUMET RIVER
ROXANA MARSH AND REACHES 1 & 2
REMEDIAL ACTION
HABITAT RESTORATION PLAN

PROJECT NO. WA-049
DRAWING NO. C-302
SHEET NO. 2 OF 5

Lesson 6

Meeting the Press

Grade Level: 9-12

Time: 60 minutes

Materials provided by teacher: transportation*

Summary: There are many options. Students can simply attend and listen to speakers. A student representative could give a speech about their involvement or read a poem about the cleanup. They could help the younger students plant their plants. Another suggestion is displaying a poster and answering questions about their water sampling project. If possible, have a student videotape the event and write a blog post or article for the school website.

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