Alliance for the Great Lakes

Ensuring a Living Resource for all Generations

Great Lakes in My World

9-12 Calumet

CONNECT | EXPLORE | INVESTIGATE | RESTORE | SYNTHESIZE

In collaboration with Chicago Public Schools, The Field Museum, and the BOLD Chicago Institute for the Calumet Is My Back Yard Program.

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A Great Lakes educator's guide focused on the Calumet region with 66 Great Lakes Creature Cards and an accompanying USB flash drive with supplemental materials.

This book is printed on totally chlorine free, recycled paper using soy inks.

ALLIANCE FOR THE GREAT LAKES

WWW.GREATLAKES.ORG

Formed in 1970, the Alliance for the Great Lakes (formerly the Lake Michigan Federation) is the oldest independent citizens' organization in North America. Our mission is to conserve and restore the world's largest freshwater resource using policy, education and local efforts, ensuring a healthy Great Lakes and clean water for generations of people and wildlife.

Great Lakes in My World 9-12

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Introduction

When we think of the Great Lakes, a lot of us think of home. Indeed, the first thing many of us learned in school about the Great Lakes was that we could remember the names of these vast, magnificent natural treasures by their mnemonic: Huron, Ontario, Michigan, Erie, Superior.

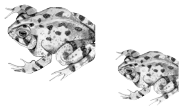
For those of us who work, play and live in the region, the Great Lakes are HOME. They provide a place for family getaways to local beaches and parks. They provide jobs. They provide drinking water. And, often overlooked for education purposes, they provide an example of how natural systems can both thrive and struggle depending on human decisions and actions.

Today's high school students are the next generation of scientists, engineers, educators, advocates, professionals, parents, problem-solvers . . . and more. This curriculum uses the Great Lakes, broadly, and the Calumet region, specifically, as the starting point for teaching and learning while emphasizing hands-on, inquiry-based, real-world experiences. The intent of *Great Lakes in My World 9-12: Calumet* is to give students a meaningful way to learn scientific, geographic and research skills while learning about the Great Lakes and the Calumet Region – a rich, living ecosystem in its own right, and a cherished resource that defines our lives and, yes, our home.

We hope that *Great Lakes in My World 9-12: Calumet* will motivate you and your students to engage in meaningful learning about the natural world in a way that makes it personally relevant and exciting, and that lays the groundwork for a lifetime of learning about this wonderful corner of the world we inhabit.

Happy teaching,

Katie Larson
EDUCATION COORDINATOR



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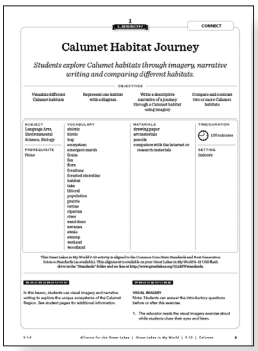


1

Educator Instructions
guidelines for 20 activities

How to Get the Most from this Curriculum

The curriculum follows the school year calendar and associated stewardship field experiences and special events of the Calumet is My Back Yard (CIMBY) program.

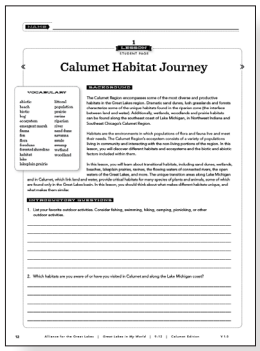
CONNECT activities help students build a personal bond with the natural areas they're about to study. By appreciating and caring about these natural treasures, students will see the relevancy of their studies.

EXPLORE activities contain the unit's essential content. This is where concepts and vocabulary are shared, allowing mysteries to unfold and secrets to be revealed.

INVESTIGATE activities confront current issues facing the Great Lakes and the Calumet region. Students analyze data and articles, weigh solutions and consider viewpoints of opposing positions.

RESTORE activities provide service-learning opportunities for students at local natural areas.

SYNTHESIZE activities teach students to draw conclusions, integrate their learning and develop real-world solutions to protect the Great Lakes and the Calumet Region.

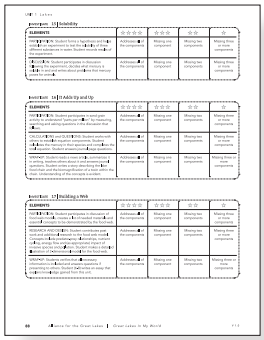


2

Student Pages
student worksheets designed in a journal format

Have students keep PORTFOLIOS, using the originals provided. Copy and distribute these pages for each student to place in a binder or folder. We recommend binders, as they provide a hard surface to write on during field trips.

The student pages provide questions and data sheets for the activities, along with space for required diagrams, sketches, essays and stories. By allowing creativity and frequent sharing, students will be excited and proud to maintain a portfolio of what they are learning. As lessons build upon each other, students will be able to refer to earlier notes. Teachers and students will both find the journals useful in reviewing the student's learning.

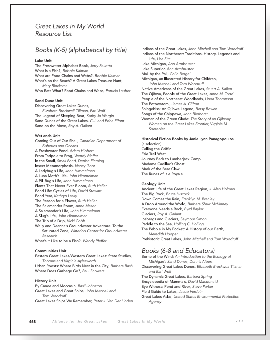


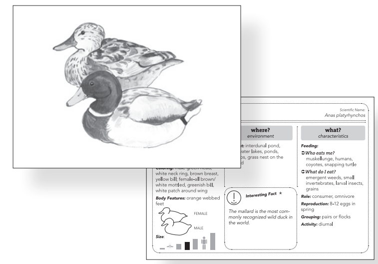
3

Assessment Rubrics
specific evaluation criteria for each activity

☆☆☆☆

Check student progress with the ASSESSMENT RUBRICS provided for each activity. We recommend giving each student a copy of the rubric (located at the end of each student page) as they begin each new activity so they understand expectations for grading. Feel free, of course, to modify them as you see fit, and perhaps even involve students as a way to increase their commitment.





4

USB Flash Drive Supplement
additional resources to supplement the activities

What you'll find on the USB Flash Drive

+ **Images of the Great Lakes** - These provide visual context for activities when a field trip is not possible
+ **Glossary** - Share this list of vocabulary terms and definitions with the students before or during the activities. Students can make flashcards, create their own vocabulary journal or learn the words using any number of study techniques.
+ **Media Articles** - You'll need these for certain activities.
+ **Learning Standards Chart** - Use the chart to identify the standards that each activity addresses.
+ **Student Pages** - In addition to the printed set in the curriculum book
+ **Assessment Rubrics** - Use the benchmarks provided for each activity to help you evaluate students' progress.
+ **Set of Creature Cards** - A set at these 66 Great Lakes creature cards that can be printed out
+ **Resource List** - For additional background and support materials, this is a great collection of helpful websites, agencies, books, etc.
+ **Calumet Natural Area Slides**

5

Resource List
additional resources to supplement the activities

What you'll find on the Resource List

For additional background and support materials, this is a great collection of helpful websites, organizations, agencies, books, etc. Use this list to find resources for students' research or additional background for units and activities.

6

Creature Cards
illustrations and information on 66 notable plants and animals

How to use the Creature Cards

These 66 cards of plants and animals can be used to supplement a variety of the activities. You may also use them as flashcards, for background information, for research, as a tool for charades or have students sort them into various groups (by type, kingdom, class, habitat, role in food web, etc.). With two sets, students can play a variety of card games such as Memory, Go-Fish, Old Maid or Rummy.

We value your thoughts and feedback on Great Lakes in My World 9-12: Calumet. Please let us know about any oversights, errors or omissions you find, or if there are things you or your students particularly like.

Send your comments to: education@greatlakes.org

Some Notes on Our Philosophy

Every educator has his or her own style of teaching, and we've designed this program with that in mind. Likewise, every student has his or her own style of learning, and we've given great consideration to that, too. Here is some brief background on the key teaching theories employed in this curriculum. We hope you find it helpful.

➜ A SENSE OF PLACE

At the root of a flourishing relationship between a young person and their local ecosystem is the ability to acknowledge and build upon connections with places. "If you don't know where you are, you don't know who you are," says author Wendell Berry. We encourage students to explore their personal connection to the landscape. Ecosystems evoke feelings. Acknowledging that a place holds meaning, and inquiring about its special characteristics, gives new definition and importance to the word "home."

Through these activities, students ask questions that explore the science, history, beauty and mystery of the Great Lakes watershed and the Calumet Region. This moves students toward developing a greater sense of place—a connection to the area through new awareness, reflection and experience. As students build relationships with the ecosystem, they gain a new understanding that can inspire a lifetime of learning and care.

➜ INQUIRY-BASED ACTIVITIES

This curriculum encourages students to learn through asking questions and finding answers. Students are challenged to formulate their own questions and find ways to answer them. In order to answer their questions, students must come to understand the concepts and material involved. They develop essential problem-solving skills.

Inquiry-based learning can be challenging to plan, as questions and solutions are driven by the students. This curriculum supports teachers in their planning by constructing an inquiry-driven learning process and by suggesting projects and models students are likely to come up with.

➜ A POSITIVE FOCUS

Environmental issues can be daunting to students of all ages. According to educator David Sobel, author of "Beyond Ecophobia: Reclaiming the Heart in Nature Education," when students are confronted by environmental issues, they may become overwhelmed and turned off. An ethic of care is more likely to develop if students are allowed to first find joy in the natural world, especially if it is in a local context. As their world view expands, from local to regional to global, students will have an easier time making connections.

NOTE: In presenting an issue to students, it is important that they understand both the concepts and their own ability to make positive changes.

➜ LEARNING FOR UNDERSTANDING

Though these activities teach material specific to the Calumet Region, their broader aim is for students to understand core principles that they can apply to other ecosystems. Assessments reflect this emphasis on understanding the big-picture concepts.

➜ A PROBLEM-SOLVING APPROACH

For older students, a problem-solving approach to learning about environmental issues can turn negative topics into positive experiences. In these activities, students learn what they can do to keep their local ecosystem healthy. They become both researcher and problem-solver, and by doing so they become empowered to take action that can impact the future of their own community. This is known as "authentic learning." Unlike simulated problems, real issues provide truly meaningful experiences for students. Student involvement in local issues can lead to mutually beneficial partnerships with the community, and can even lead to revitalization projects.

NOTE: When presenting issues to students, endeavor to provide balanced and complete information. Informed decisions take effort, and here is an opportunity for students to discover the difference between a superficial review and a deep exploration.

➜ SERVICE LEARNING

Several activities in this curriculum use service learning—a method by which students develop new skills through participating in a community service project that is integrated into the curriculum. These are thoughtfully organized activities that support an academic curriculum while meeting actual community needs.

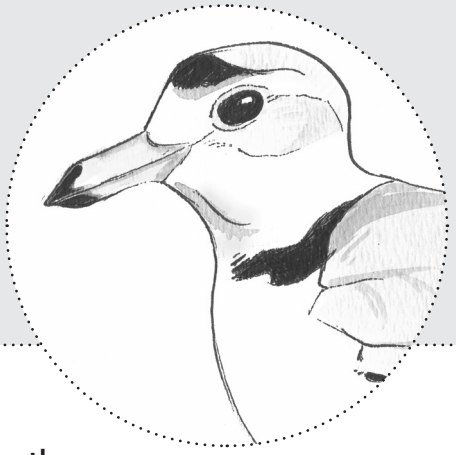
➜ THE CALUMET IS MY BACK YARD (CIMBY) PROGRAM

CIMBY is a service-learning program that builds environmental and leadership skills as well as regional knowledge. CIMBY uses a classroom-based environmental leadership curriculum and stewardship opportunities outside of the classroom to put students at the center of exciting eco-restoration efforts currently being initiated by public, private, and civic organizations throughout the Calumet region.

Through this program, CIMBY teachers and their students adopt an ecosystem and complete three or more stewardship outings during the school year. Students attend additional multi-school events, implement pre- and post-site classroom lessons, and submit evaluative surveys to assess their growth over the school year. Select students are invited to participate in summer internships.

CIMBY provides opportunities and resources for teachers and students to develop interest about and knowledge in their local environment. CIMBY supports students in identifying mechanisms and developing skill sets to sustain and improve the environment. Students are also inspired to take personal action to improve the environment, to consider careers and leadership roles in environmental fields, and to teach the next generation of environmental caretakers.

Great Lakes in My World 9-12: Calumet



essential questions

- **How was the Calumet region formed and how have the natural habitats changed over time?**
- **How do human communities and the Calumet region's natural habitats affect each other?**
- **Why should humans work to restore and enhance the Calumet region?**
- **How can humans have a positive influence on the Calumet region?**
- **What are the regional benefits for Calumet of a healthy Great Lakes system?**

curriculum overview

Students experience and discuss their connections to their home, the Calumet region. Concepts are explored first through the understanding of place, followed by the role humans play in the Calumet region and then to an understanding of the diversity of ecosystems within Calumet. Students reflect on and examine how human relationships with the environment affect Calumet communities. Through mapping, research and stewardship, students study how human and wildlife needs are met within the region. Students learn about the interplay and balance essential in maintaining a healthy relationship with the Great Lakes. Field trips to local habitat(s) allow students to collect and analyze data through observations of plants and animals in their native habitat. Students explore the biodiversity and the abiotic components of an ecosystem and explore how urban ecosystems are dependent on natural resources. Through data analysis and synthesis, students investigate issues that face the Great Lakes and the human role in creating, perpetuating and helping to solve these problems. Students study careers related to the environment and plan and implement service-learning action projects related to habitat restoration. Students restore local ecosytems and synthesize ideas related to natural resource protection and environmental stewardship through their service-learning experiences.

concepts

- The Great Lakes serve the Calumet 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 and on each other.

- Natural habitats contain tremendous biodiversity and are essential for the healthy functioning of the Calumet ecosystem. They are made up of connected, yet diverse, microecosystems formed by sunlight, wind and waves, and change over time.

- Humans can both create and solve problems for the Calumet region and the Great Lakes. In order to conserve, restore and have a healthy relationship with our Great Lakes, we need to understand the impact our actions have on them and develop skills to restore vital ecosystems.

- Stewardship is essential for the long-term health of an ecosystem. Fostering a connection to the ecosystem and taking action, whether through restoration, education, speaking out or a career choice can help achieve a healthier, more sustainable Calumet region.

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Great Lakes in My World 9-12: Calumet

A high school curriculum focused on understanding and stewarding Calumet habitats

Calumet Habitat Journey

Students explore Calumet habitats through imagery, narrative writing and comparing different habitats.

OBJECTIVES

Visualize different Calumet habitats	Represent one habitat with a diagram	Write a descriptive narrative of a journey through a Calumet habitat using imagery	Compare and contrast two or more Calumet habitats

SUBJECT
Language Arts, Environmental Science, Biology

PREREQUISITE
None

VOCABULARY
abiotic
biotic
bog
ecosystem
emergent marsh
fauna
fen
flora
foredune
forested shoreline
habitat
lake
littoral
population
prairie
ravine
riparian
river
sand dune
savanna
swale
swamp
wetland
woodland

MATERIALS
drawing paper
art materials
pencils
computers with the internet or research materials

TIME/DURATION
120 minutes

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

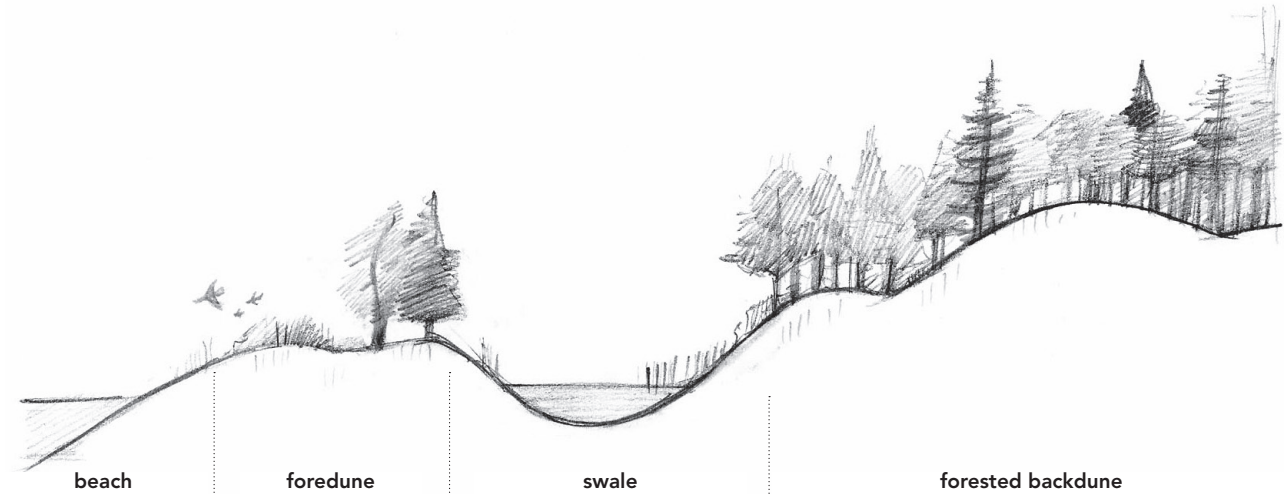
In this lesson, students use visual imagery and narrative writing to explore the unique ecosystems of the Calumet Region. *See student pages for additional information.*

PROCEDURE

VISUAL IMAGERY
Note: Students can answer the introductory questions before or after this exercise.

1. The educator reads the visual imagery exercise aloud while students close their eyes and listen.

COASTAL HABITATS DIAGRAM



beach	foredune	swale	forested backdune
bronze tiger beetle	antlion	Canada goose	American beech
herring gull	beach pea	dragonfly	bald eagle
ladybug	beach wormwood	eastern box turtle	black oak
piping plover	common milkweed	great blue heron	gray squirrel
sea rocket	eastern hognose	mallard duck	pileated woodpecker
spotted sandpiper	Fowler's toad	mosquito	poison ivy
	hairy puccoon	water strider	red fox
	Lake Huron locust		song sparrow
	little black ant		white tailed deer
	marram grass		
	monarch		
	Pitcher's thistle		
	riverbank grape		
	sand cherry		
	snake		
	wolf spider		

DUNE HIKE

Imagine you are at the beach. Even if you have never been to a beach, think about what it would be like. Your bare feet push into the cool, wet sand, which feels soft under your toes. You hear waves crashing into the shore. As you walk away from the water, you see hills of sand, called sand dunes. They are beautiful and mysterious, and they beckon to you, inviting you to explore them. You wonder how far you might be able to see if you climbed to the top.

There are long green and brown grasses growing on these massive sand dunes. These grasses seem to draw you towards them. There is a path leading up the side of one of these hills. You decide to follow it. The sand is very warm and dry on your feet. The sound of the waves grows dim. It becomes very quiet. You feel the wind in your hair. Notice that your hair is not the only thing affected by the wind. The sand is, too. You watch some sand grains skipping along, until they are all captured by the tall marram grass on the hill. This first dune, nearest the lake, is called the foredune.

As you walk along the path, you see that the dunes create a series of hills that lead away from the beach. You wonder where all of this sand came from. As you continue to walk, the sun shines warmly on your skin. The only sound you hear is that of a gull calling in the distance. You see that the dune dips down into a low area, called a swale, which has water in it. It has a low area called a trough that is filled with water and plants. You cool your feet in the water and wonder what sorts of animals might live in the dunes or might be living in this pond in the trough.

Your heart begins to pound as you climb the second hill of sand, and when you reach the top you turn and look toward the lake. The spot on the beach where you once stood seems so small and you can see far over the lake. You feel as if you have the vision of a bird high in the sky. You turn to continue your journey across the dunes. You hike up and down the hills until you enter a shady forest and sit down under a black oak tree in the backdune forest to take a rest from your hike. As you listen to song

sparrows singing from their nest in a nearby shrub, you notice that even here, in the woods, it is sandy.

2. On a separate piece of paper, students draw part of, or the whole, journey they made in their imaginations. Have them write one or two words that describe how the journey made them feel.

3. After students finish drawing, the educator draws a side view of the "journey" (lake, beach, foredune, trough, and backdune) on the board, or uses a projector to share the image from this lesson with the students. Explain to students that some areas around the Great Lakes and in Calumet have the same type of sand dune ecosystem that they just "hiked" through. Ask students to identify which area(s) they illustrated (according to the diagram) and what type of flora/fauna they would expect to find in that habitat. Students are to label their drawings with these areas.

OBSERVATIONAL WRITING

4. Students select one Calumet habitat (from the vocabulary list or from a list you create as a class) and write a narrative essay that details their observations during a "Habitat Hike." This could be a walk through another ecosystem, such as a prairie, emergent marsh, wetland or woodland, or they could swim through the lake ecosystem.

5. Students complete the pre-writing graphic organizer (see student page). Students use imagery to detail the observations they would make while exploring a particular habitat. Students focus on their observations, using the five senses, as they "walk" or "swim" through the habitat. They can use books or the internet (see resource list) for research, searching for the information they need to complete the graphic organizer.

6. Each student writes a "Habitat Hike" narrative essay that answers the following questions: What native plants and animals do they see? What is the temperature? How do the animals they see and the students themselves move through the ecosystem?

WRAP-UP

7. Each student shares his/her "Habitat Hike" narrative with a peer. When sharing, students will note the similarities and differences between the different ecosystems. As a class, discuss what makes the different habitats unique and similar. How are they dependent on one another? How might a positive or negative influence impact the habitat? If time permits, several students can share their narratives with the class.

8. While students present their "Habitat Hike" stories, the other students complete the Venn diagram (see student page). Each student selects one other Calumet habitat which with to compare and contrast their habitat. Their comparison should focus on characteristics such as location, climate, geographic features and native species. Students also select at least one additional characteristic to compare and contrast.

9. Most of the sand dunes in the Great Lakes basin occur along the east side of Lake Michigan in Michigan and on the south side of Lake Michigan in Indiana. Show students a map that includes this area, or use the internet to look at maps online (see resource list for more information). Have them locate Lake Michigan and the area where the dunes are found. Additional dunes are found in Wisconsin, on the northern portion of the Illinois shoreline, and throughout Northern Ohio along the lake. Also, there is a smaller complex of dunes from Maumee Bay to Pennsylvania, which is largely paved over but can still be identified by the road names (i.e. Ridge Road). Students can locate these spots, as well as emergent marshes, ravines, prairies, woodland, wetlands or other ecosystems in the Calumet Region or around the Great Lakes. Discuss what makes each of these habitats unique, and what makes them similar. What plants and animals might students find in each of these habitats?

EXTENSION

A. Students create a book, either written and illustrated for children or illustrated as a scientific magazine, detailing their observational hike through a Calumet ecosystem.

B. Students create a poster or collage for their particular habitat with quick facts to post on classroom walls for later reference.

C. Use GIS or Google Maps to research different habitat landscapes and provide a report or presentation on the visual aspects and features.

ASSESSMENT

See rubric on page 15.

RESOURCES

See Visual Media in the Resource List for additional information, including The Field Museum: N.W. Harris Learning Collection - Prairie Life Experience Box.

NAME _____

1
LESSON
STUDENT PAGE

Calumet Habitat Journey

VOCABULARY

abiotic
beach
biotic
bog
ecosystem
emergent marsh
fauna
fen
flora
foredune
forested shoreline
habitat
lake
lakeplain prairie
littoral
population
prairie
ravine
riparian
river
sand dune
savanna
swale
swamp
wetland
woodland

BACKGROUND

The Calumet Region encompasses some of the most diverse and productive habitats in the Great Lakes region. Dramatic sand dunes, lush grasslands and forests characterize some of the unique habitats found in the riparian zone (the interface between land and water). Additionally, wetlands, woodlands and prairie habitats can be found along the southeast coast of Lake Michigan, in Northwest Indiana and Southeast Chicago's Calumet Region.

Habitats are the environments in which populations of flora and fauna live and meet their needs. The Calumet Region's ecosystem consists of a variety of populations living in community and interacting with the non-living portions of the region. In this lesson, you will discover different habitats and ecosystems and the biotic and abiotic factors included within them.

In this lesson, you will learn about transitional habitats, including sand dunes, wetlands, beaches, lakeplain prairies, ravines, the flowing waters of connected rivers, the open waters of the Great Lakes, and more. The unique transition areas along Lake Michigan and in Calumet, which link land and water, provide critical habitats for many species of plants and animals, some of which are found only in the Great Lakes basin. In this lesson, you should think about what makes different habitats unique, and what makes them similar.

INTRODUCTORY QUESTIONS

1. List your favorite outdoor activities. Consider fishing, swimming, hiking, camping, picnicking, or other outdoor activities.

2. Which habitats are you aware of or have you visited in Calumet and along the Lake Michigan coast?

GRAPHIC ORGANIZER

Habitat: _____

SIGHT What do you see? What plants or animals do you see? What is on the ground? Are there water sources? How much light do you see?

_____

_____

_____

_____

_____

SOUND What do you hear? What animal noises do you hear? What sounds do your feet make as you walk or swim through the habitat? Do you hear the wind or waves? What sounds are made by leaves or grasses moving in the wind?

_____

_____

_____

_____

_____

TOUCH What are you able to touch? What is the temperature? Is there humidity in the air? What do your hands feel as you walk through the habitat? What do your feet feel? Is the habitat wet or dry?

_____

_____

_____

_____

_____

SMELL What do you smell? Do you notice any fragrant, flowering plants?

_____

_____

_____

_____

_____

TASTE What (if anything) do you taste? Did you find any edible plants along your "hike"?

_____

_____

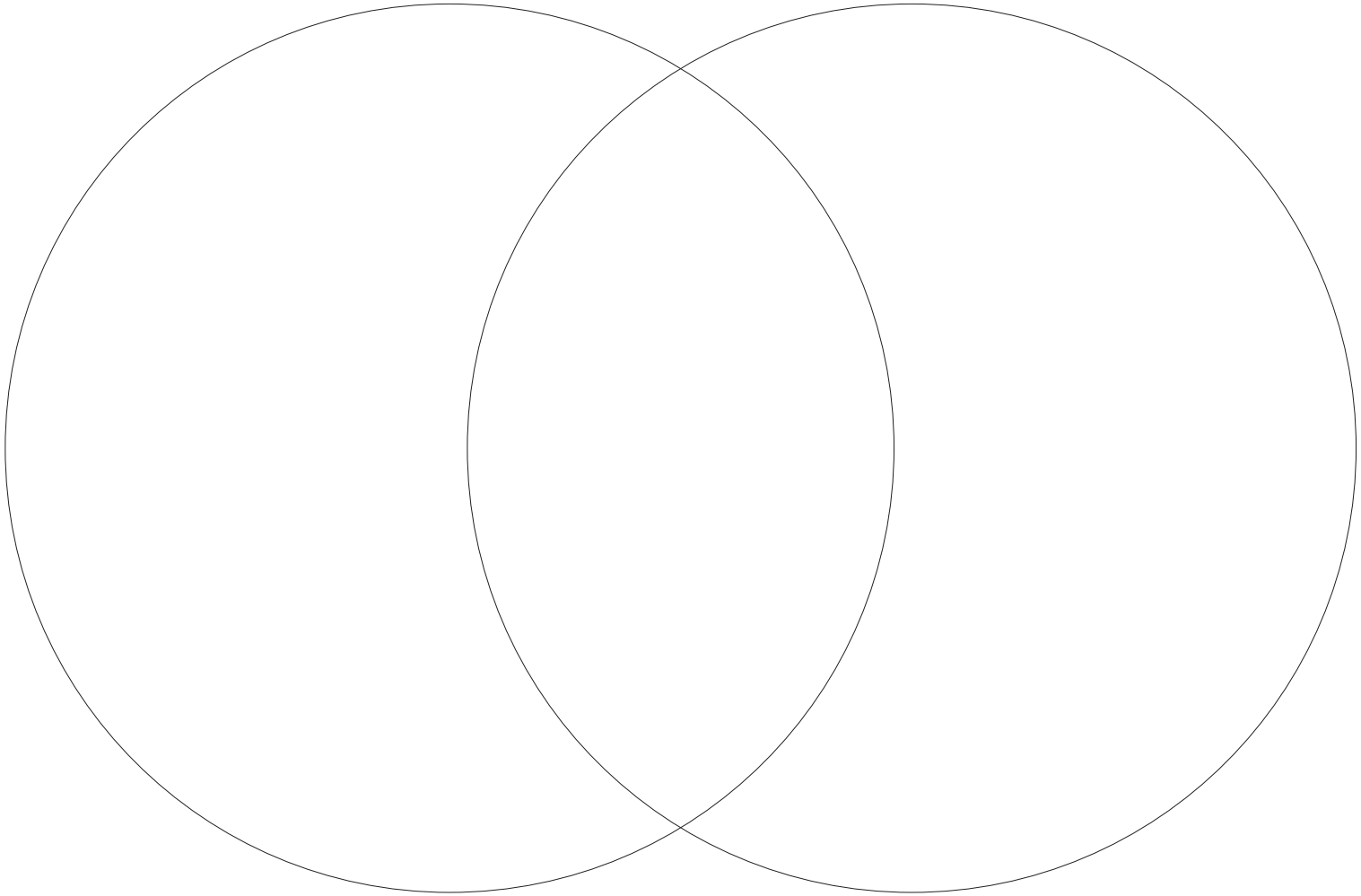
_____

_____

_____

My Habitat: _____ Another Habitat: _____

Compare and contrast your habitat and a classmate's habitat according to these characteristics: Plants (flora), animals (fauna), location, climate, and by one other feature.



NARRATIVE WRITING ASSIGNMENT

3. Write a narrative essay of your observations as you "explore" your habitat. Compose this essay on a separate page, or on a computer.

WRAP-UP

4. What makes different habitats unique and similar?

_____

_____

_____

_____

5. How are habitats dependent on one another? How are plants, animals and humans dependent on these habitats?

_____

_____

_____

_____

6. What are two new things you learned about Calumet habitats? What additional questions do you have about Calumet habitats?

_____

_____

_____

_____

_____

_____

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DISCUSSION: Student contributes any prior knowledge of habitats to the discussion. Student uses active listening skills (eye-contact, confirming or referencing others' comments, affirmative gestures or comments).	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
LISTENING: Student attentively listens to the description of the Calumet dune journey without distracting others. Personal investment is obvious.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
DRAWING: Student draws a representation of her/his imagined dune journey and reflects on which part of the dunes s/he drew. Students share drawing with a partner.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ESSAY: Student completes the pre-writing graphic organizer and then writes a narrative essay. Essay has a central theme developed throughout. Student explains and illustrates the unique characteristics of the habitat. This includes sensory or observational details related to all five senses. Essay has minimal spelling and grammatical errors. Sources are cited.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
COMPARE AND CONTRAST: Student completes the graphic organizer to compare and contrast two habitats on all five characteristics.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student demonstrates an overall understanding of ecosystems of the Calumet Region by answering the wrap-up questions and reflecting on their own learning.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

National Public Lands Day

Students learn about biodiversity and natural history at the Indiana Dunes National Lakeshore.

OBJECTIVES

Explore pristine natural habitats and observe and draw native plant and animal species

Identify and describe invasive plant species and support ecological restoration by removing invasive species from natural habitats

Understand transitional habitats by taking a geology hike through a sand dune

SUBJECT
Ecology, Biology, Environmental Science

PREREQUISITE
Calumet Habitat Journey

VOCABULARY
bog
ecosystem
fauna
flora
foredune
forested shoreline
habitat
invasive species
lake
sand dune

MATERIALS
old clothes
long pants
close-toed shoes or tennis shoes
clipboards
pencils

TIME/DURATION
7 hours

SETTING
Outdoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

National Public Lands Day is the nation's largest, single-day volunteer effort for public lands. As Calumet Is My Backyard (CIMBY)'s inaugural all-school event, National Public Lands Day introduces students to the Indiana Dunes National Lakeshore, an expansive park rich in biodiversity. This trip is an opportunity for CIMBY students to see how efforts to restore and protect natural areas result in beautiful parks such as the Indiana Dunes. Students will also make connections between Lake Michigan and the Calumet Region.

Indiana Dunes National Lakeshore is a treasure of diverse natural resources located within an urban setting. Indiana Dunes National Lakeshore is situated on the shoreline of Lake Michigan, one of the Five Great Lakes and part of the largest complex of freshwater lakes in the world (the Great Lakes).The National Lakeshore features communities that have both scientific and historic significance to the field of ecology. In addition, four National Natural Landmarks and one National Historical Landmark are located within its boundaries.

The park is comprised of over 15,000 acres of dunes, oak savannas, swamps, bogs, marshes, prairies, rivers, and forests. It contains 15 miles of Lake Michigan shoreline spanning the distance from Gary to Michigan City, IN.

PROCEDURE

GENERAL AGENDA

8:00am	Buses depart from schools
9:00am – 12:00pm	Cowles Bog Natural Area and Mnoke Prairie ecological restoration projects
12:00 – 1:00pm	Lunch and scavenger hunt at Bailly-Chellberg picnic area
1:15 – 2:00pm	Dunes ecology and geology walk at Mt. Baldy
2:30 – 3:00pm	Buses return to schools

PART ONE: ECOLOGICAL RESTORATION SERVICE-LEARNING PROJECT

1. Students follow restoration technicians to Cowles Bog and Mnoke Prairie to learn about invasive species and their effect on the natural habitat. Cowles Bog is an 8,000 year old fen in the Indiana Dunes National Lakeshore. The Mnoke Prairie is an active prairie restoration in the central portion of the Lakeshore.

2. Students receive tools and training to remove invasive species. Explain to students that invasive species are non-native species that adversely affect the habitat they are introduced to.

3. Students work in teams to safely collect invasive species. If using tools, students should handle tools with care, in order to assure safety.

PART TWO: SCAVENGER HUNT

4. Students search for plants and animals at the Bailly-Chellberg natural area and collect results on the scavenger hunt worksheet. Ask students to name one invasive plant that they remove from the environment and one native plant they want to thrive in its place. Ask students to draw or describe a bird they observe.

5. Students work in teams to answer additional questions. Why is Mount Baldy moving inland several feet every year?

PART THREE: ECOLOGY AND GEOLOGY HIKE AT MOUNT BALDY

6. Students walk the transitional sand dune habitat, learning about the history and progression of the area over time. Mount Baldy is a sand dune located at the east end of the Indiana Dunes National Lakeshore and is one of the tallest sand dunes on the southern shore of Lake Michigan.

WRAP-UP

7. Teacher collects student pages and reviews for accuracy, common themes and completeness.

8. Discussion: What was your favorite part about National Public Lands Day? What is one thing you learned about the Calumet region today?

EXTENSION

A. Students choose their favorite part about National Public Lands Day to present to the class. Students use a creative method to explain the significance of their topic to the overall Calumet region.

ASSESSMENT

See rubric on page 20.

RESOURCES

See Visual Media in the Resource List for additional information, including The Field Museum: N.W. Harris Learning Collection - Prairie Life Experience Box.

TEAM NAME

2
LESSON
STUDENT PAGE

National Public Lands Day

VOCABULARY

bog
ecosystem
fauna
flora
foredune
forested shoreline
habitat
invasive species
lake
sand dune

BACKGROUND

Today you are exploring and restoring a local habitat in celebration of National Public Lands Day. Form a team of five or six students - you'll stay in this group all day. Pick a team name and write it above. Assign one person to be the recorder who will keep charge of this sheet (feel free to switch off as needed). As you work and during time between activities, examine the environment around you and respond to the questions below. Report your findings to your team's recorder who will note your team's responses. Take a picture if you can. Your teacher will collect and review all the sheets for complete answers.

INTRODUCTORY QUESTIONS

1. Find evidence of an animal – tracks, scat, or fur. Draw what you found in this box. Write what animal you think left the evidence and what it was doing at the time.

2. Name one INVASIVE plant that we are removing from the environment today.

_____

3. Name one NATIVE plant that we want to thrive in place of the invasive plants.

_____

4. Draw or describe a bird that you observe. Try to record wing and breast colors, stripes or spots; beak shape, beak and bird size; where you see the bird; and its name, if you know it.

5. Choose one wildflower to study for five minutes. Observe and draw the shape, number, color and arrangement of the petals; the number and colors of the pistils and stamens; any insects you find on the flower or leaves below. Write what the flower smells like to you.

6. Why is Mount Baldy moving inland several feet every year?

7. Name 3 plants or animals that depend on sand dune habitats for survival.

WRAP-UP

8. Write your favorite thing about National Public Lands Day, plus one thing you learned about the Calumet region today.

Team Member 1: _____

Team Member 2: _____

Team Member 3: _____

Team Member 4: _____

Team Member 5: _____

Team Member 6: _____

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
LISTENING: Student learns about invasive species and his/her effect on the natural habitat by actively listening to restoration technicians at Cowles Bog and Mnoke Prairie. Student is not disruptive and demonstrates his/her understanding throughout the training.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
COLLECTING: Student participates in the training to remove invasive species and safely works in his/her team to collect invasive species with received tools. Student is cooperative and actively participates in his/her groups.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
GROUP FINDINGS: Student searches for plants and animals in his/her group and records results on the scavenger hunt worksheet. Groups complete all drawings and answer the additional questions.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student writes his/her favorite part about the National Public Lands Day and one thing learned about the Calumet region. Answers are complete and demonstrate learning about biodiversity and natural history at the Indiana Dunes National Lakeshore.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

A Sense of Place

Students draw maps of their local area, weaving in the importance of the Calumet Region.

OBJECTIVES

Develop a personal map relating students' school and adopted natural area to Lake Michigan and the Calumet Region

Explore students' local area and the Calumet Region using a variety of maps

Draw a map of the school grounds that includes elements, such as a title, legend, scale, cardinal directions and labels

SUBJECT
Engineering, Geography, Math, Topography, Language Arts

PREREQUISITE
None

VOCABULARY
cartography
Geographic Information System
map
mental map
physical map
political map
topography

MATERIALS
paper
a variety of maps (see procedure and resources list)
8.5" x 11" tracing paper
ruler for each student
tape measurer for the class (if needed)
colored pencils or markers

TIME/DURATION
120 minutes

SETTING
Indoors/Outdoors, Classroom, Computer lab

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

As the poet and bioregionalist Wendell Berry says, "If you don't know where you are, you don't know who you are." This activity focuses on using a variety of maps to understand and identify your location within the Calumet Region. Students will be able to create their own map or visual representation of their local area. Mapmaking is a skill used in many school subjects, including language arts (story mapping), social studies (geography), and science (topography). It is also a skill needed by community planners, engineers, surveyors and those traveling to new places.

Educator David Sobel says, "Mapmaking, in the broad sense of the word, is as important to making us human as language, music, art and mathematics. Just as young children have an innate tendency to speak, sing, draw and count, they also tend to make maps. … The stories of their lives are folded into the niches of their neighborhoods; their maps are the weaving together of inner emotion and external forays." *(Mapmaking with Children: Sense of Place Education for the Elementary Years,* David Sobel, Heinneman 1998).

In this lesson, students will use mental mapping and look at local maps to develop their spatial reasoning abilities, their mapping skills and a greater sense of place – a connection to the Calumet Region – through new awareness, reflection and experience. Mental maps (or "sense of place" maps) show a location's shape and the mapmaker's context in relation to his/her surroundings. Not only is this type of map geographically accurate, but it also tells the story of a place from the point of view of the mapmaker(s). Kevin Lynch says, "A common exercise in urban design and urban planning courses is to ask students to draw a map of their neighborhood or city (or of a common geographical area such as the university campus) in order to develop a better understanding of the differences between the physical map and layout of an area and how people actually perceive the same area." (*The Image of the City*. Boston: The M.I.T. Press. http://dels-old.nas.edu/dels/rpt_briefs/learning_to_think_spatially_final3.pdf, 1960)

These maps are an introduction to community planning and to the Calumet Region. Students will learn (or review) the key components of maps and create their own maps of their local area. These community-based maps will build a link between students and their physical surroundings and help them make sense of their world. The basic premise is that the better we know our communities and experience our connection to them, the more willing we are to act to ensure that they are socially- and environmentally-healthy places to live. Students begin to learn how to translate spatial reasoning in the form of cognitive maps into standardized maps. Students will learn to appreciate the differences and similarities between their perspectives and those of their classmates. They start to grasp spatial concepts, including location, distance, relationships and networks, and they learn which key components are included in a wide variety of maps.

PROCEDURE

INTRODUCTION

Students read background information and answer introductory questions on the student pages which ask them to name three or more different types of maps and describe what elements most maps include.

PART ONE: MENTAL MAPS

1. Ask students to picture their neighborhoods. Have them think about where the following things are located in relation to each other: their school, home and the nearest natural area. Also, have them think about what they like and don't like about their neighborhood. What features make their neighborhood unique? What helps them feel good about their community?

2. Students follow the directions and answer the questions on the student pages. Each student will draw a mental map of his/her neighborhood, which includes his/her school, home and the nearest natural area. They should each think of their map as a personal recollection of a space, or as a mental map, rather than as a geographical map. Students draw these maps from memory, rather than with physical measurements. *Please see example below.*

a. Students first brainstorm a list of 10 to 15 important landmarks in their neighborhood and/or near their school. Students should include several of these landmarks on their maps. They may also include natural objects, plants and animals and their habitats.

b. In the center of their mental maps, students draw their school or home. Note: If all students choose to place the school in the center, all of the maps will have a common starting point, which can lead to a discussion of what makes each person's mental map unique and similar. See Kevin Lynch's *The Image of the City (1960)* for research on the common features of students' mental maps.

c. After drawing the places on their maps, students then make connections between features of the map, by identifying what makes these places important and how they are interconnected. For example, a student may draw an arrow from their school to the park and from the park back to the school. The student would then write "place to play, socialize, explore" and/or "nature, family" to explain the connection and the importance.

d. There is no right or wrong way to make these mental maps. Things that are more important to students may naturally be more prominent in their maps. They may go into as much detail as they like and as time allows.

3. Discussion:

a. Allow each student to present his/her mental map to large or small groups. Ask students about the prominent features in their maps. Why are these features important?

b. Students answer wrap-up questions on their student pages: Ask them where nature is, where the lake is, and how far they think it is from their school and homes. Ask students if they have visited a forest preserve or a park. As if they have visited the lake. Ask if they consider the lake to be a part of their neighborhoods. Why or why not?

PART TWO: LOOKING AT LOCAL MAPS

4. As a class, review some basic map-reading skills, including how to use the key, the scale and the cardinal directions.

5. Break students into groups of four. Distribute one map of the local area to each group. If possible, distribute different types of maps to each group (e.g. transportation map, topographical map, zoning map, land-use map, natural resources map, navigation map, bathymetric map, utilities map). You can also distribute maps from different years to show that maps are dynamic, not static.

6. Discussion: Ask students to think about why we have so many different types of maps. Why doesn't one map include roads, land use, zoning, natural resources, topography and utilities? *The answer is that maps have various purposes. They model the world in order to be useful, and if there is too much information on one map, it is no longer useful.*

7. In their groups, have students circle the following things on their local map: their school, their homes, their local Great Lake, the Calumet River, and any local habitats (i.e. sand dunes, wetlands, prairies, forests) and/or shoreline (cliffs, beach).

8. Students should also circle or discuss the common elements of these maps, including the title, key/legend, cardinal directions or north arrow, scale and labels.

9. Discussion:

a. Describe the route from your school to the nearest Calumet Region natural area.

b. What method of transportation do you use to get to the nearest natural area from school or home? In which county do you live? In which aldermanic ward or senatorial district?

c. What makes living near a natural area interesting?

d. Students answer questions on the student pages: What different types of maps did you see in class? What common elements did these maps have?

PART THREE: MAPPING THE SCHOOL

10. Each student maps out the school grounds, either on-site or from memory. Each student will have one 8.5" x 11" piece of paper (plain white or graphing paper) on which to draw their map and can use drawing/art materials.

11. These maps should display the unique aspects of the school and the school grounds. To integrate mathematics, students should include the ruler measurements and the scale.

12. After creating these maps, the teacher can bring up an aerial map of the local place on a projector or interactive whiteboard. Students should compare their maps of the school grounds to the aerial image of the area.

13. Discussion: Ask students to think about the features shown on the aerial map and those they included in their maps of the school grounds. Did they include any habitats for animals? Do animals live on their school grounds? What other features were included in these maps? Do these maps show elevation, heights or depths? *No*. Why not? *They are one-dimensional*. Have students think about why it could be important to have two-dimensional or even three-dimensional maps.

14. Use Google Earth or Google Maps to print an aerial map or image of the school grounds. How does this bird's eye view compare to the mental maps that students have drawn of the school grounds? Have they forgotten to include any of the features of the school grounds?

WRAP-UP

15. As a class, look at a large map of North America. Use the map to identify important features of the local area, the distance from the school to the nearest natural area, the Great Lakes ecosystem, and other features.

16. Discussion: What states or provinces does Lake Michigan border? How many states or provinces border the Great Lakes? *The Great Lakes have approximately 10,900 miles of coastal shoreline*. How does this compare to the Atlantic Ocean coastline on the eastern edge of our country? *The Atlantic coastline is 2,165 miles long, which is less than 1/5 the length of the Great Lakes coastal shoreline.*

17. Point out the Great Lakes watershed or the Great Lakes Basin using a map of the region, or using the "The Great Lakes Watershed" map on the USB. Point out that the entire coastal shoreline is part of the watershed, but that some cities and states are only partially included in the watershed. What else do the students notice about the watershed? Where does the Calumet Region fit in?

18. Select a city in the United States. Use road maps, a Web-based mapping program or Google Earth to calculate its distance from the Great Lakes. Compare this with the distance from Lake Michigan to your school.

19. Look again at the mental maps. Were students' perceptions of their proximity to the nearest natural area or to the lake correct? How does the location of natural areas and the lake influence experiences with them? If some of their maps include plants, animals or their habitats, discuss why they are not included in the local maps that you looked at.

20. Discussion: What makes a good map? How does the purpose of the map influence its design?

21. Students answer wrap-up questions on the student pages: Which natural area is nearest to you? Which state(s) or province(s) does your nearest natural area border? How does the location of the natural area or the nearest lake (Lake Michigan) influence your experiences with them? Include your ideas on how a location's proximity to nature could influence recreation, municipalities, transportation, tourism, industry and more. What habitats are found in the Calumet Region? What types of organisms live in and around Calumet and Lake Michigan?

EXTENSION

A. Students can visit the website: http://maps.google.com, and then type in any location to see what that land looks like on satellite photo images. Have the students discuss the similarities and differences among the different natural areas. Ask them to write these down in their own notebooks, or on a classroom chart. Develop a table with "differences and similarities" forming the top of the table and comparisons lining the vertical edge.

B. Have a group of students, or the entire class visit: http://cfpub.epa.gov/surf/locate/index.cfm to learn the name of the nearest watershed or any other watershed they would like to learn about. Type the name of that creek, stream, river, or lake into Google Maps to see a satellite photo of that particular watershed. Have students observe the land and topography of that area, and do research online to learn about the natural history and formation of that watershed. Have students create a report, presentation, diagram, model or other project on their watershed to educate the class on the area's various watersheds.

C. As a class, use a Geographic Information System (GIS) (see resource list) to find out the quantities of particular vegetation, types of water, or animal species in a chosen Calumet habitat and provide a report for the class (PowerPoint or another type).

ASSESSMENT

See rubric on page 28.

RESOURCES

See Resource List for additional information related to mapping, geographic information systems (GIS) and more.

NAME

3
LESSON
STUDENT PAGE

A Sense of Place

VOCABULARY

cartography
Geographic Information System
map
mental map
physical map
political map
topography

BACKGROUND

Learning about where we live helps us to understand who we are. The Calumet Region is defined by a number of diverse habitats, Lake Michigan, the Calumet River, and the confluence of natural, residential, commercial and industrial spaces.

Maps are tools that help us orient ourselves on streets, in cities, in states, in countries, on the planet and more. If you have a current map, you can always find where you are, if you know how to use it. Every day we make decisions based on geography: where to go, how we will get there and what we will do when we get there. We think geographically when planning simple events, such as going to school in the morning, or when planning major events, such as a diving trip in one of the Great Lakes. In this activity, you will map your local area or "place." You will also review various maps to learn how maps are useful to many different people. By understanding our places in this world, we can make better decisions about the ways we choose to live on our planet.

INTRODUCTORY QUESTIONS

1. Name and describe three or more types of maps.

2. What elements do most maps include?

ACTIVITY

PART 1: MENTAL MAPS

3. List 10 to 15 important features of your neighborhood, including your home, your school and the nearest natural area (forest, park, beach, riverbank, prairie, etc.).

4. What makes these features (or places) important?

5. On a separate sheet of paper, draw a "sense of place" map or a mental map of your home, school, the nearest natural area and the local features that you listed above.

6. After drawing your mental map, draw arrows to show how different features of your local place are connected and what makes them important. For example, you may draw an arrow from the school to the park and/or from the park to the school. You would then write "place to play, socialize, explore" and/or "nature, family" to explain the connection and the importance of each feature.

7. Where is the nearest natural area (forest, park, beach, riverbank, prairie, etc.) in relation to your school and home? Where is the nearest Great Lake? Do you consider the natural area or the lake to be a part of your neighborhood? Why or why not?

PART TWO: LOOKING AT LOCAL MAPS

You will explore some common (and not-so-common) types of maps. No map can depict all of the physical, biological and cultural (or political) features in even the smallest area. Most maps of the world are therefore either categorized as "physical" or "political".

8. What different types of maps did you see in class? What common elements did these maps have?

PART THREE: MAPPING THE SCHOOL GROUNDS

Now, draw a map of the school grounds on a separate sheet of paper. You can either go outside to do this, or you can map the school grounds from memory. If you are going outside, you can take measurements of the features of the school grounds using tools and mathematics. If you are mapping from memory, try your best to be accurate in drawing things to scale.

9. Think about what features you will include on this map. Make a list of what you will include here:

10. Was the map you drew one-, two- or three-dimensional? What features could be shown on a two-dimensional map that could not be shown on a one-dimensional map? What features could be shown on a three-dimensional map?

11. Compare the map you drew of the school grounds to the aerial image your teacher printed. How were the two maps similar? How were they different?

WRAP-UP

12. Which natural area is nearest to you? Which state(s) encompass the Calumet Region? Which state(s) border Lake Michigan?

13. How does the location of a natural area influence your experiences with it? Include your ideas on how a location's proximity to the area could influence recreation, municipalities, transportation, tourism, industry and more.

14. What habitats are found in the Calumet Region? What types of organisms live in and around the Calumet Region?

15. What habitats are found on your school grounds, or in your neighborhood? What types of organisms live in your neighborhood?

16. Choose one type of map, and list all of the components of that type of map.

17. What determines whether a map is a good map? How does the purpose of a map influence its design?

18. Summarize the discussion you and your classmates had on the topic of maps. Overall, what did you learn from this lesson? How does this new knowledge change the way you think about maps and your location?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
MENTAL MAPPING: Student imagines their school, neighborhood and nearest natural area and lists 10 to 15 important features of their local area. Student draws a mental map of their local "place". Student explains the importance of and connection between the features they included in their maps. Students share maps in small groups and answer wrap-up questions together.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
MAPS: Student recognizes there are many different types of maps, how to use all the features included in a map, and the differences and similarities between different types of maps.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
MAP: Student creates a map of the school grounds including important features. Student recognizes the difference between 2-D and 3-D maps and which features are characteristic to each.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student is able to get a "sense of place" of where they are in relation to the larger Calumet Region and the Great Lakes by looking at a map of North America. Student is able to distinguish the different types of environments that exist within the Calumet Region.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Source: Nautical Charts, http://www.oceangrafix.com/chart/zoom?chart=14929

Introduction to Restoration and Monitoring

Students learn about the value of ecological monitoring and practice vegetation data collection skills.

OBJECTIVES

- Discuss the value of ecological restoration
- Practice monitoring skills using transects and quadrats
- Making inferences about ecosystem health based on data

SUBJECT
Biology,
Ecology,
Mathematics

PREREQUISITE
None

VOCABULARY
forb
gramminoid
habitat
invasive species
monitor
native species
percent cover
photo point
quadrat
stewardship
transect
woody plant

MATERIALS
50 meter measuring tape and/or 50 meters of string marked off at 5 meter intervals.
4 orange marking flags per 4-5 students or plastic PVC quadrat frames (made from 4 1-meter pieces of PVC pipe and 4 elbows) or 4m length of rope
pens/pencils/clipboards

TIME/DURATION
3 hours

SETTING
Outdoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

The Calumet Region includes many natural areas, and the Calumet is My Back Yard (CIMBY) program has "adopted" a number of these habitats. These natural areas are remnants of an extraordinarily rich landscape that evolved here, at the intersection of three biomes: the vast Midwestern tallgrass prairie, the North Woods, and the eastern deciduous forest. In this schoolyard-based ecological monitoring activity, students will learn about the value of ecological monitoring and will practice the vegetation data collection skills they will need when performing the annual fall vegetative monitoring survey during their first fall visit to their adopted natural area.

Although some Calumet natural areas still harbor a fascinating array of plant and animal species – some of them listed on state and federal threatened and endangered species lists – the native biological diversity and ecological functioning of many of these sites has been significantly degraded by the pressures of urban civilization. These pressures include the introduction of aggressive invasive species such as European buckthorn and purple loosestrife, loss and fragmentation of habitats due to commercial and residential development and roads, changes to the natural hydrological flows within sites, pollution and dumping and other impacts.

The long-term goal of ecological restoration is to restore native species and ecosystem functioning to a sufficient level that the ecosystem is essentially self-sustaining with humans only having to provide small amounts of regular maintenance such as prescribed fire or occasional control of invasive species that penetrate natural area borders.

In this lesson, students will learn about restoration efforts, including invasive plant removal (i.e. buckthorn and garlic mustard) and litter removal and monitoring. These efforts are just one part of the work to preserve biodiversity and protect the health of vital ecosystems. Another component is monitoring as it is critical to understand whether and how restoration makes an impact in order to adjust faulty methods and maximize successful techniques.

Habitat restoration experts use sound scientific methods to accurately evaluate what is happening with the plant and animal communities in natural areas and what the effect of restoration work is on native biodiversity. With

this information, management practicies can quickly and efficiently be shifted in response to the needs of the ecosystem.

Restoring an ecosystem cannot be completed in a quick, one-year project. It requires multi-year – and perhaps multi-generational – engagement. Conservationists need to inspire ongoing support for this work from neighbors and governing officials by reminding them of the bigger picture and showing them hard evidence of the slow but measurable restoration progress.

PROCEDURE

1. Explain to students that they will be learning more about and participating in restoration and monitoring efforts in their local area. Discuss with students what monitoring means to them and why monitoring a designated area in an ecosystem over time might be important (see background section for more information).

2. Discuss what "percent" and "percent cover" mean and practice estimating percent cover by walking students through questions found on the Percent Cover Worksheets (pages 31-33).

a. Show the layout of the transect/quadrat system (see Vegetation Monitoring instructions and datasheet on pages 33-37) and discuss concepts of "percent cover" and "tree survey."

b. Discuss what percent coverage information could tell us about the health of various natural areas.

c. Discuss what changes in the composition of trees in the sampling area over time could tell us about the natural area.

3. Choose an outdoor area outside of the school, which is the size of your classroom or larger. Divide the class into groups of 3-4 students. Give each group a quadrat, datasheet, pens, and a clipboard or hard surface to write on. Go outside to practice setting up the transect and 25m^2 sections and determine placement of quadrat in section (see Vegetation Monitoring instruction sheet). Ideally, teachers set up a 50 meter transect line ahead of time in a grassy area, so students will simply need to find a 25m^2 section to work on. They will then determine a random placement of their quadrat, lay the quadrat on the ground and document percent coverage of plants within their quadrat. With enough time, students can also do the survey of trees within their 25m^2 section.

4. Discuss and compare results from the different groups. Ask students how accurate they believe their estimates to be. Tell students that you will perform this activity during the fall stewardship day as a way of monitoring plant biodiversity. Ask how the experience might be different when performed during their field trip to their adopted natural area.

5. Practice photo point monitoring: Locate two sites in this outdoor area to photograph. Use GPS to mark points, and take photos according to the instructions.

WRAP-UP

5. Discuss the following questions with the class.

a. How will this experience be different when performed in the actual natural area? *Most likely there will be greater biodiversity in the natural area. Students may have larger obstacles to deal with in the natural area (i.e. trees, brush).*

b. What can information about percent coverage of different types of plants tell us about the health of various natural areas? *The more biodiversity, the healthier the ecosystem. Animals and plants depend on each other within an ecosystem and the more plants there are, the better support there is for the whole system.*

c. What could information about percent coverage of each individual species of plant in a quadrat tell us about the natural area? *If one species shows a high percentage, it could be an indication that it is invasive. Those plants that are more prevalent may also be better adapted to the area where the quadrat was placed. Some plants are also more prevalent during certain seasons.*

EXTENSION

A. All CIMBY schools' fall field trips include a stewardship component and a vegetation monitoring component. CIMBY staff will facilitate the vegetation monitoring with students in the field, but practicing these skills and exploring these concepts in class before the trip will allow the students to get started right away and efficiently use the short amount of time in the field to gather data on the full 50 meters of the transect.

B. Select several native and invasive species to practice identifying; try estimating percent cover of each different species within the quadrats.

C. Using the above method, calculate the biological diversity index of the area monitored. Scientists use the biodiversity index to describe the amount of species diversity in a given area. A simple biodiversity index is calculated by dividing the number of species in an area by the total number of individuals in that area.

ASSESSMENT

See rubric on page 42.

RESOURCES

See Resource List for additional resources on Restoration and Invasive Species.

SOURCES

Fermilab Science Education, http://ed.fnal.gov/ntep/f98/projects/fnal/student/skills/wksheets/

NAME

4
LESSON
STUDENT PAGE

« Introduction to Restoration and Monitoring »

BACKGROUND

Natural areas in the Calumet region are remnants of an extraordinarily rich landscape that evolved here, at the intersection of three biomes: the vast Midwestern tallgrass prairie, the North woods, and the eastern deciduous forest.

Although some of our Calumet natural areas still harbor a fascinating array of plant and animal species – some of them listed on state and federal threatened and endangered species lists – the native biological diversity and ecological functioning of many of these sites has been significantly degraded by the pressures of urban civilization. These pressures include the introduction of aggressive invasive species such as European buckthorn and purple loosestrife, loss and fragmentation of habitats due to commercial and residential development and roads, changes to the natural hydrological flows within sites, pollution and dumping, and many more impacts.

In this schoolyard-based ecological monitoring activity, you will learn about the value of ecological monitoring. You will practice the vegetation data collection skills you will need when performing the annual fall vegetative monitoring survey during your first fall visit to your adopted natural area.

VOCABULARY

forb
graminoid
habitat
invasive species
monitor
native species
percent cover
photo point
quadrat
stewardship
transect
woody plant

PERCENT COVERAGE
Estimating Percentages

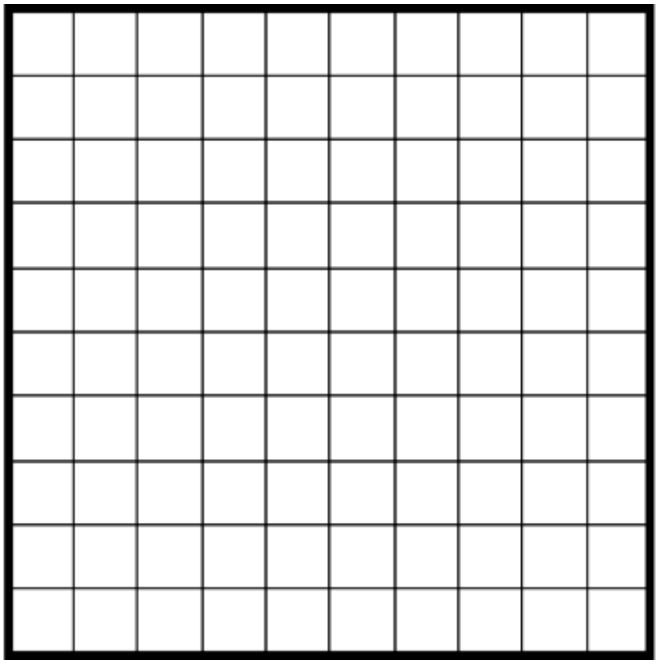
1. How many little squares are there in the big square?

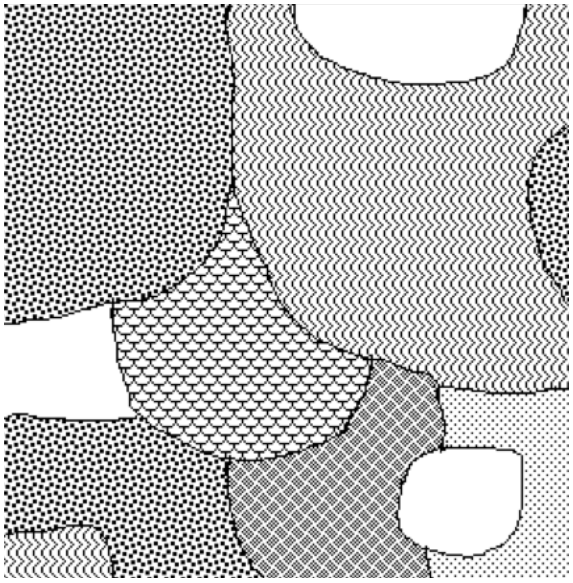
   _____

2. Each little square is equal to _____ percent of the big square because the big square is made up of _____ little squares.

3. Color any ten little squares. What percent of the big square did you color? _____

4. How many more times can you color ten little squares before the big square is all colored? _____





Example Quadrat Analysis

Plant Key	%:
Yellow Coneflower	_____%
Indian Grass	_____%
Compass Plant	_____%
Big Bluestem Grass	_____%
Rosinweed	_____%
Bare Ground	_____%

The square is an example of a prairie quadrat. The scientists roughly drew in the location of the plants in the square (quadrat). Fill in the table with an estimate of the percentages (%) for each plant. (Remember that the "Key" identifies the plants.)

5. Which plant is there the most of? _____

6. Which plant is there the least of? _____

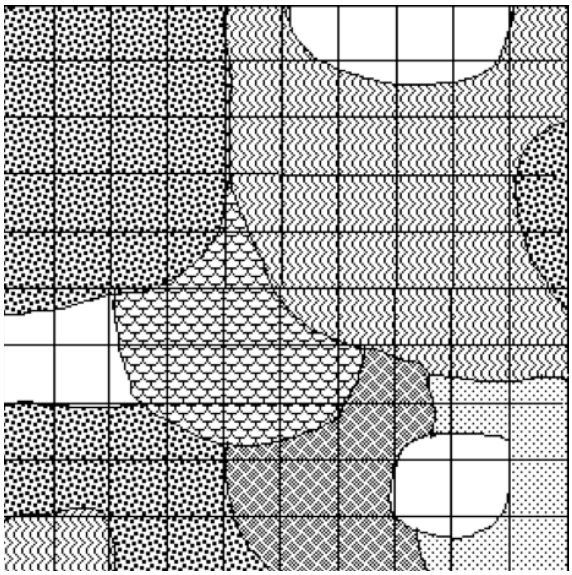
7. Which plants are in nearly equal amounts? _____

8. Which plant takes the largest single area? _____

9. Find an easy and accurate way to measure the percentage of space each plant takes up in the quadrat.

PERCENT COVERAGE

Calculating Actual Percentages: Quadrat Drawn on a Grid



Plant Key

- Yellow Coneflower
- Indian Grass
- Compass Plant
- Big Bluestem Grass
- Rosinweed
- Bare Ground

10. How many small squares is the quadrat divided into? _____

11. What percent of the quadrat is each small square equal to? _____

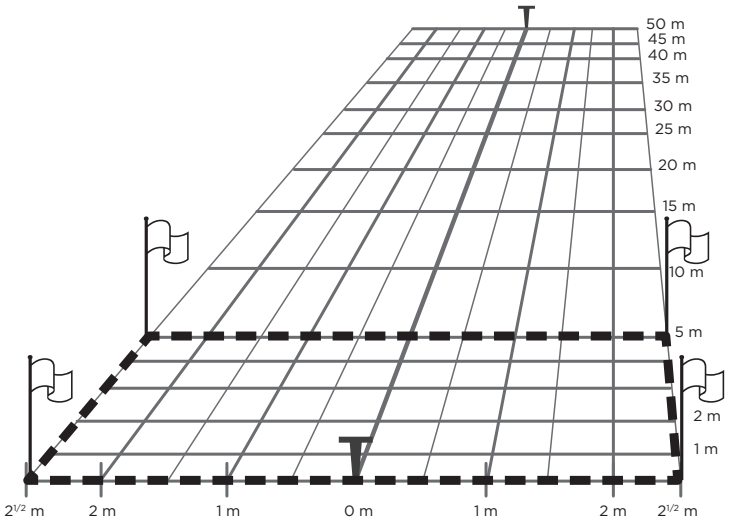
12. Estimate the percentage of each plant. Record your answers on the next page.

NAME OF PLANT	NUMBER OF SQUARES	PERCENT OF QUADRAT COVERED
Yellow Coneflower		
Indian Grass		
Compass Plant		
Big Bluestem Grass		
Rosinweed		
Bare Ground		

VEGETATION MONITORING
Instructions

Step 1: Set up 5m x 5m sections along transect and determine location of quadrats.

13. With the help of CIMBY staff or a dedicated site steward, locate the two stakes in the ground that mark the beginning of the site's permanent 50 meter transect. The stake at the beginning of the transect will be marked as the "zero stake" and the stake at the end will be marked the "50 meter stake." Tie a long string between the stakes and make a mark on the string every five meters.



14. Divide into teams of 2 or 3. Each team claims a 5 meter section of the transect and begins measuring and staking out a 5 meter by 5 meter square as follows:

At section beginning and end (e.g., at the zero and 5 meter mark, or the 15 and 20 meter marks, etc.), measure out 2½ meters perpendicularly from both sides of the transect so that you end up with a 5 meter x 5 meter (25 m^2) box, with the transect going straight down the middle. Plant a flag in each corner of your square.

Answer the following questions to determine placement of your 1/4m^2 quadrat frame within the section:

15. Stand on the transect at the beginning of the section, facing toward the 50 meter stake. Will your quadrat go on the right or left side of the transect? FLIP A COIN. Heads = left side. Tails = right side.

_____

16. How far to the left or right of the transect will your quadrat go? Choose a location 0 meters (right on the transect line) to 2 meters away from the transect.

_____

17. How far along the transect (heading toward the 50 meter stake) will your quadrat go? Choose a location 0 meters away (right at the beginning of your section) to 4½ meters from the beginning of your section.

_____

18. CAREFULLY, without trampling the plants, plant a flag at the point you selected, line up the bottom left or right corner of your quadrat frame with the flag (see the NOTE below to determine whether you line up the right or left corner) and gently lay it down on the ground.

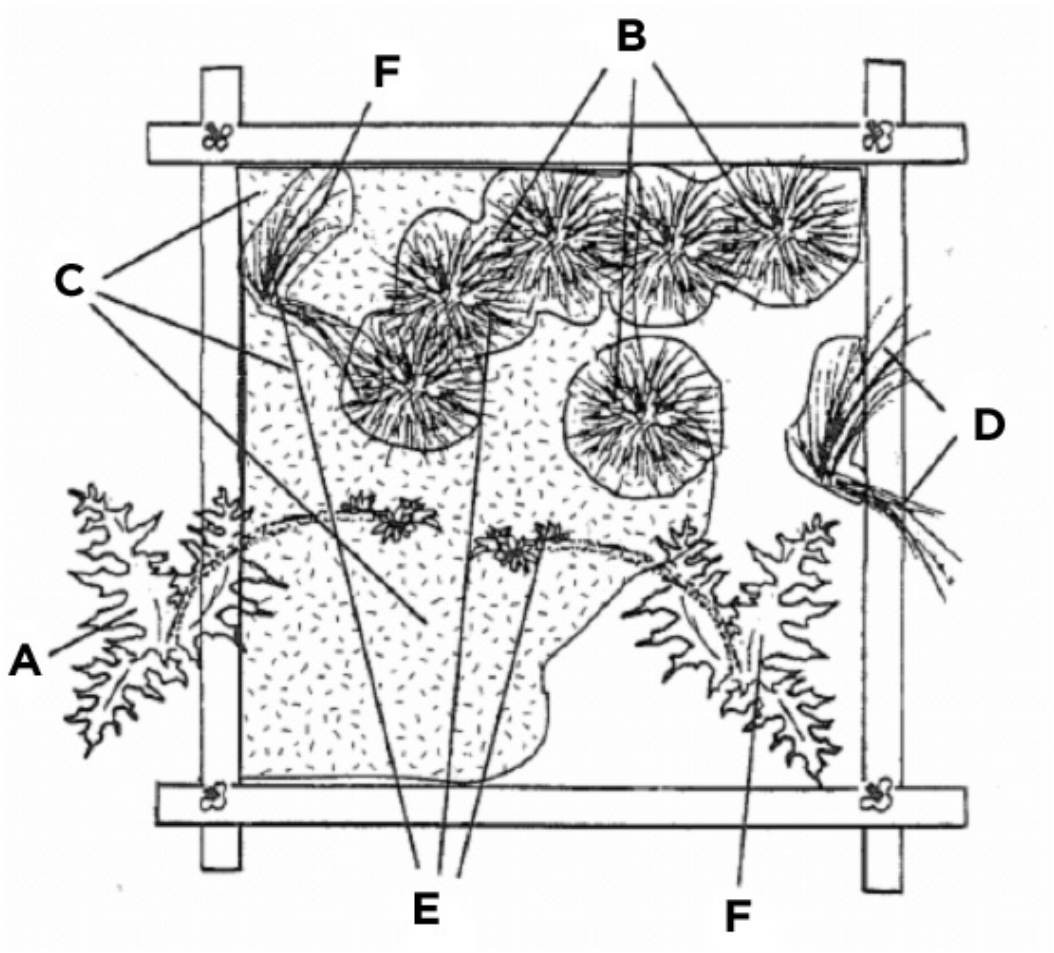
NOTE: If you went LEFT at the 1st question, line up the bottom right hand corner of your quadrat point. If you went RIGHT, line up the left hand corner of your quadrat with the point.

Step 2: Practice Reading Your Quadrat (or, What to Count and What NOT to Count)

19. Look at the following example of what the plants in a quadrat might look like from above, looking straight down on the quadrat.

20. Read through guidelines a) through f) below the illustration and find the corresponding plants in the illustration.

21. Look down at your own quadrat and try to find one example of each situation described in the illustration (e.g., a plant that seems to cover a lot of space in your quadrat, but that is actually rooted outside the frame; low-growing plants that have other larger plants towering over them, etc.).



Looking down on prairie plants within a 'quarter meter square quadrat' frame
Courtesy IDNR Forest Watch Manual

22. To determine percent cover of a type of plant, look straight down and estimate the percent of the ground within the quadrat that is covered by that plant. Include only plants that are rooted in the quadrat. Do not include dead plants, although brown areas of living plants should be included.

    a. If plant is not rooted in transect, do not include.

    b. If plants are all one species, add percent of area covered by all plants.

    c. If low-growing plants have other plants towering over them, include the total area they cover and areas where other plants are above them.

    d. If plant hangs out of quadrat but is rooted within it, include the area that the plant covers within the quadrat only.

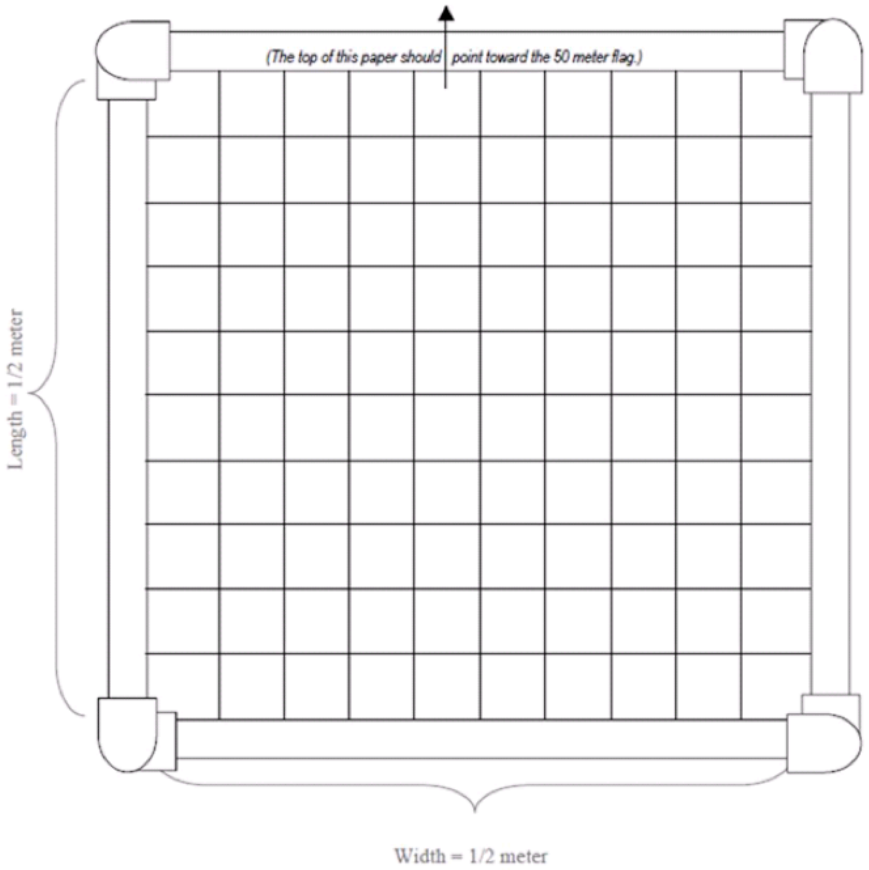
    e. If plants overhang other plants, include the entire area the plants cover, even where they overhang other plants.

    f. If there is an irregularly shaped plant, include only area plant covers, not gaps between plant parts.

Step 3: Measure percent cover of three types of plants and/or bare ground in your quadrat.

23. Carefully remove all dead leaves and plants hidden under leaves.

24. While looking down on your quadrat, draw all the plants you see in the frame on this page. Try to exactly copy the shapes, sizes and placement of plants on the ground.



25. Begin estimating what percent of ground each type of plant is covering. Start with woody plants less than 1 meter tall (tree seedlings, ½ shrubs and vines). What percent of the quadrat does each individual woody plant cover? Write the estimate for each plant next to your drawing of it. When each woody plant has been assigned a percent, add up all percents and write them in the "Woody Plants" box at the bottom of the page.

26. Repeat this process with graminoids (grasses and sedges with long, thin, flat three-sided leaves) and then with forbs (remaining broad-leafed plants that aren't woody).

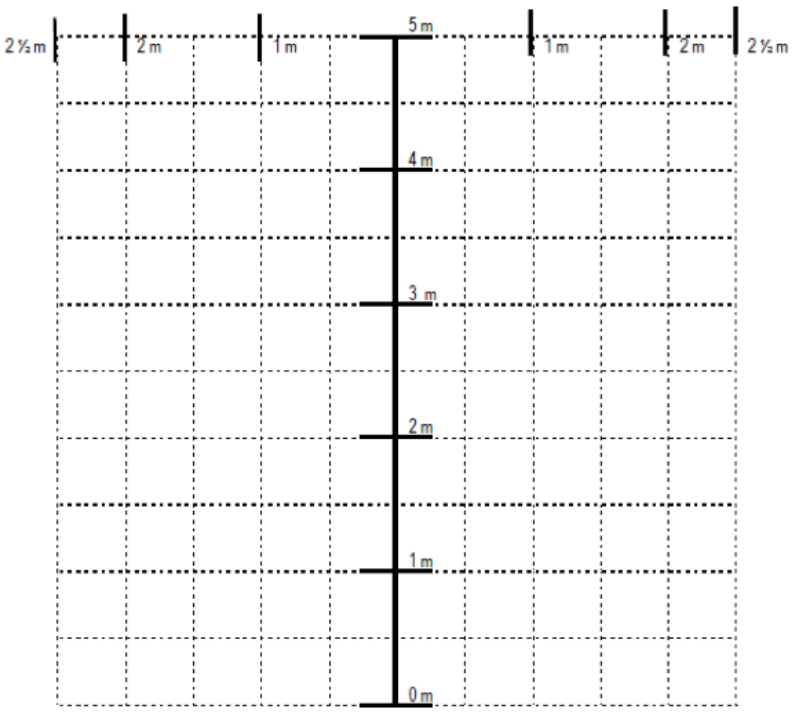
27. Estimate what percent of the ground is bare and write that percent in the Bare Ground/Leaf Litter box below.

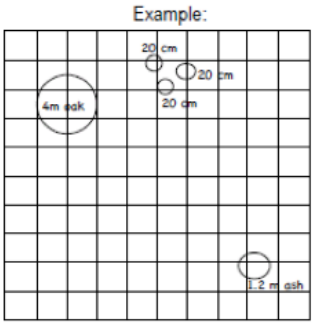
28. Important: When finished recording percent cover, do not move your quadrat until a CIMBY staff person has come by to check your work! If waiting for the staff person, turn page over & begin recording location & diameter of trees & shrubs 1 meter tall or taller in your 5m^2 area.

Woody plants:	**Gramminoids:**	**Forbs:**	**Bare ground/leaf litter**
Have hard bark, stems and roots woody. Includes trees, shrubs and vines.	Grasses (long, thin, flat leaves) and sedges (stems have three sides)	Broad-leafed, flowering plants	
			
Percent cover: _____%	**Percent cover: _____%**	**Percent cover: _____%**	**Percent cover: _____%**

Step 4: Collect data on all trees, shrubs and vines over 1 meter tall within your 25m² section

29. Sketch in the diagram below approximately where all the trees, shrubs and vines taller than 1 meter are growing within your 25m² section. Simply draw a circle to indicate where the trunk is coming out of the ground. Measure the circumference of each tree, shrub and vine at breast height, or 1.3 meters above the ground. Label each circle with the circumference of the plant and species name, if known.





30. Fill in the following table with information about each of the trees, shrubs or vines in your sketch. Give each individual plant its own row in the table.

	Mark if the plant is a tree (single trunk, usually tall), a shrub (multiple stems, shorter) or a vine (woody twining cord).	**Description: Opposite or alternate branched? Leaves are compound or simple? Texture of bark? Fruits or seeds?**	**Circumference**
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			

PHOTO POINT MONITORING

Photo point monitoring is an easy, inexpensive and effective method of monitoring vegetation and ecosystem change (Figure 1). It consists of repeat photography of an area of interest over a period of time, with photographs taken from the same location and with the same field of view as the original photo. With appropriate site marking and documentation, photos can be precisely replicated by different people many years apart.

STEP 1: DEFINE THE OBJECTIVE

A well defined objective is key to successful photo point monitoring. Photo points may be established for a variety of reasons such as evaluating the efficacy of management activities, assessing the ecological impact of a weed infestation or determining whether management objectives are being met. Different objectives will generally require different photo points. Therefore, to obtain relevant and accurate information, the objective for monitoring must be carefully considered and defined before establishing photo points.

Figure 1. Photo point monitoring of a leafy spurge infestation before (A) and after (B) the introduction of copper leafy spurge flea beetles. [Photos adapted from Norman E. Rees, USDA ARS, www.forestryimages.org]

STEP 2: SELECT AND ESTABLISH PHOTO AND CAMERA POINTS

A photo point is an established location that defines the orientation of a camera located at a camera point (Figure 2). Care should be taken when establishing photo and camera points to ensure that the points chosen address the objectives. The following steps outline items for consideration and procedures for establishing photo points in areas selected for monitoring.

1. Identify photo points. Within selected monitoring areas, identify elements in the landscape that are most critical to document in order to achieve the project objectives. General photography can be used to document a whole scene. Topic photography, on the other hand, narrows the target from a scene to specific elements (subjects) in the landscape. Ensure that enough photo points are established to adequately document changes that are expected to occur.

2. Establish camera points. Based on the project objective, establish camera points for each photo point. Pay particular attention to the distance between the photo and camera points to ensure that the photographs will adequately document the scene or subject and the expected changes.

3. Mark photo and camera points. Photo and camera points should be permanently marked so they can be relocated in the future. Metal fence posts work well for this purpose. However, if fence posts are obtrusive or otherwise undesirable, steel rebar driven flush with the ground can be used instead. A metal detector may be needed to relocate rebar markers. Measure the distance and direction from camera points to photo points. Obtaining coordinates of the points using a global positioning system (GPS) unit can aid in relocating them in the future.

4. Identify a witness site. A witness site is (preferably) an immovable object in the monitoring area that can be easily identified when returning to the area. It serves as a reference to quickly locate the monitoring area and also as a reference point from which the camera and photo points can be located. Measure the distance and direction from the witness site to the camera points, photo points, or both. It is helpful to attach a permanent identification tag to the witness site with the distance and direction to the photo and/or camera points inscribed on the tag.

5. Assign identification numbers. Assign identification numbers to all photo and camera points.

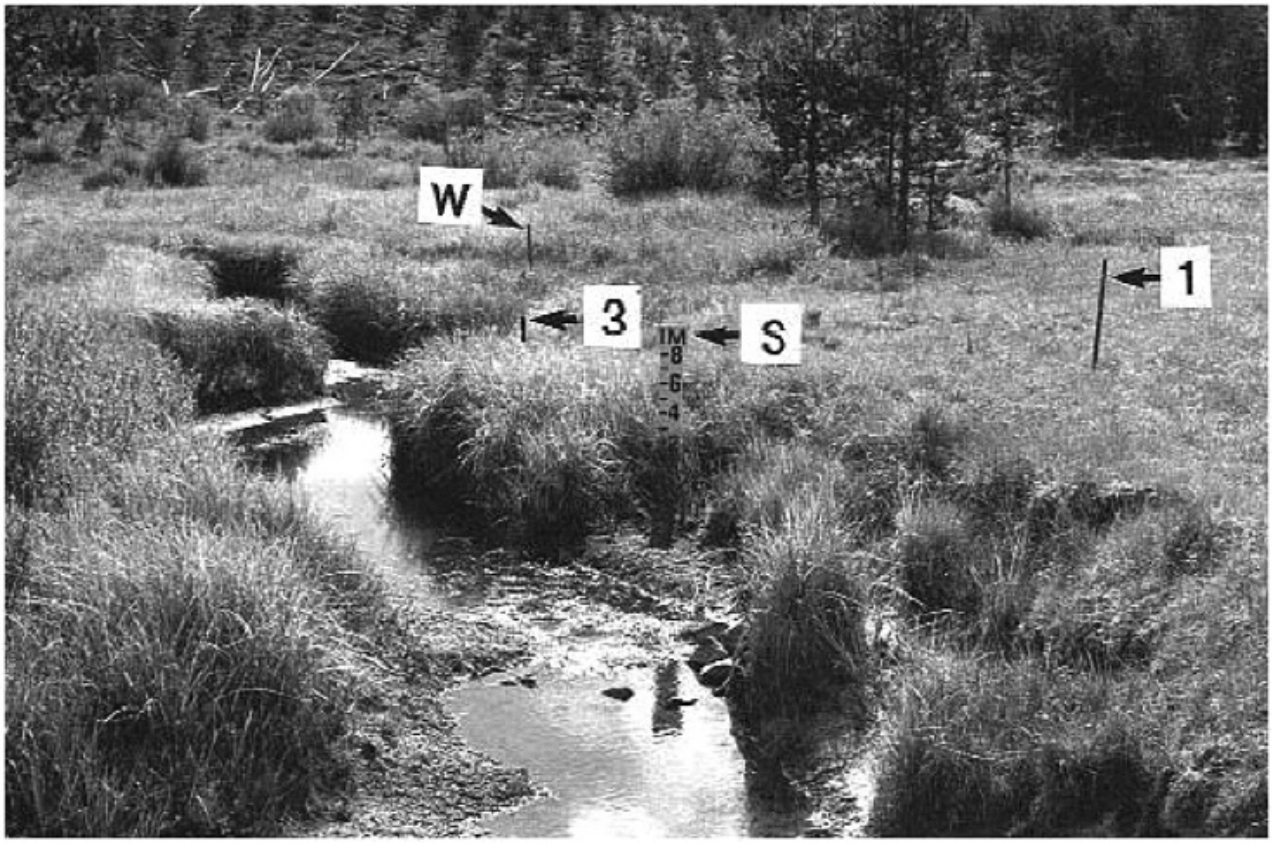


Figure 2. Photo point monitoring site showing photo points (S and W), and camera points (1 and 3), marked by fence posts. (Adapted from Hall 2002.)

6. Record pertinent site information. Record pertinent information about the monitoring site on a map, aerial photograph, and/or site description form. Information such as date, observer, location, site description, objectives, identification numbers, and locations of witness site, photo points, and camera points, including distances and directions between points, should be recorded.

7. Determine when to photograph, including how frequently the photo points should be photographed, the duration of monitoring, as well as the time of year at which photographs should be taken. For example, if the efficacy of a treatment is to be monitored, photographs might be taken immediately before the treatment and two months after the treatment. If weed spread is to be monitored, then the photos might be collected once per year at the time when the weeds are most visible (e.g., during peak flowering).

8. Create a site locator field book which is a book that can aid in locating the monitoring location and witness, camera, and photo points during subsequent visits to the area. The field book should contain copies of the original photo point photographs and directions from the witness sites to each camera location and orientation of the photo point.

STEP 3: PHOTOGRAPH THE SCENE OR SUBJECT

The following steps outline basic considerations and procedures for photographing the scene or subject.

9. Create photo identification cards to be placed within the camera's field of view each time a photo point is photographed to embed pertinent information about the site into the picture (Figure 3). The card should contain the site name, photo point number, camera point identification, and date. Other information such as the photograph number, time of day, and the photographer's initials may also be included. Copying the identification card onto blue paper for best visibility is recommended. Laminated cards can be reused by writing pertinent information with dry erase markers. Small chalk boards can also be used as photo identification markers.

10. Locate photo and camera points. Using site location information (e.g., information found on a "Photographic Site Description and Location" form) and a site locator field book and/or a GPS unit, locate the photo and camera points.

11. Photograph the scene/subject. It is recommended that original and repeat photographs be taken using a tripod at a designated height. For repeat photography, point the camera toward the photo point and compare the view through the camera to a copy of the original photograph. Adjust the camera until the view through the camera is the same as the original photograph. You may want to record the aperture, shutter speed, focal length of the lens, and film speed (if not using a digital camera).

12. Describe the scene/subject. For each photograph, describe the scene or subject. For example, you might record weed density, condition of desired vegetation, and environmental factors (e.g., drought, hot or cool temperatures) affecting the overall health of the weeds and desired vegetation.

Figure 3. Photo point monitoring site showing a photo identification card and a meter board. (Adapted from Hall 2002.)

STEP 4: ORGANIZE AND FILE THE DATA

A well-organized, easily accessible filing system is required for photo point monitoring. This may consist of a series of expandable folders (one for each monitoring area), each containing maps, directions, a site locator field book, site descriptions, other descriptive data, prints, slides, negatives, and/or CDs or DVDs containing digital photographs. If digital cameras are used for photo point monitoring, a computer database may be the ideal system for organizing and filing the data. Databases to organize and archive pictures are available commercially. A simple hypertext markup language (HTML) database can also be developed and used to organize and file the photo point monitoring data. An HTML database allows easy access and updating capabilities using a web browser. In addition to archiving pictures on a database, maps can be scanned and entered into the database. Descriptive information can also be scanned or entered directly into the database.

Source: http://www.fs.fed.us/eng/rsac/invasivespecies/documents/Photopoint_monitoring.pdf

9. CIMBY PHOTO POINTS

Camera location: _____

Area: _____ Date: _____

Number of photo points: _____ Observer: _____

Comments: _____ Slope: _____

_____ Aspect: _____

_____ Slope position: _____

Photo point A

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point B

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point _____

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point _____

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point _____

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

WRAP-UP

31. How accurate do you think your estimates were during the percent cover activity? Explain.

_____

_____

32. How will this experience be different when performed in the actual natural area? Explain.

_____

_____

33. What can information about percent coverage of different types of plants tell us about the health of various natural areas?

_____

_____

34. What can information about percent coverage of each individual species of plant in a quadrat tell us about the natural area?

_____

_____

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DISCUSSION: Student contributes their definition of monitoring and why it is important to monitor a designated area in an ecosystem over time. Student uses active listening skills (eye-contact, confirming or referencing others' comments, affirmative gestures or comments).	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
PERCENT COVER: Student actively engages in "percent cover" learning and completes all questions found on the Percent Cover Worksheets. Student is attentive in additional percent cover discussions.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
VEGETATION MONITORING: Student participates in group work and demonstrates understanding of the Vegetation Monitoring instruction sheets through proper placement of quadrats and documentation of percent coverage. If time allows, student collects all data on trees within their $5m^2$ section.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student is involved in the concluding discussion about percent coverage of plant species and what information it can provide about a natural area.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Notes

Fall Stewardship

Students clear invasive brush, utilize quadrat and transect monitoring skills and take part in a drawing reflection.

OBJECTIVES

Participate in a service-learning field experience at a local adopted natural area

Practice monitoring skills using transects and quadrats, and photo point monitoring

Reflect and evaluate the experience of being in nature

SUBJECT
Biology, Art
Ecology,
Mathematics

PREREQUISITE
Introduction to Restoration and Monitoring

VOCABULARY
bittersweet
brush
buckthorn
forb
gramminoid
habitat
invasive species
monitor
photo point
quadrat
stewardship
transect

MATERIALS
waterproof shoes
long pants
warm coat
gloves, scarf, and hat
pencils
clipboard
workday data sheets (one copy per group)

TIME/DURATION
3 hours

SETTING
Outdoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

During this service learning field trip, students will participate in a Fall Stewardship Day at the adopted natural area. This will include monitoring and restoring your adopted natural area through invasive removal, vegetative monitoring, photo point monitoring and litter removal. To prepare for the Exploration and Monitoring activity on the Stewardship Day, refer to Lesson 4: Introduction to Exploration and Monitoring and to this lesson for more information.

PROCEDURE

GENERAL AGENDA

9:00 - 9:10am Introduction with whole group
9:15 - 10:20am 1st Station Rotation Activity

Group 1: Stewardship Station Rotation Activity

9:15 - 9:20am	Safety overview and demonstration
9:20 - 10:05am	'Before' photograph and stewardship activities
10:05 - 10:20am	Measure and estimate area of work done, 'after' photo, and wrap up

Group 2: Exploration and Monitoring Station Rotation Activity

9:15 - 9:20am	Demonstration and explanation of monitoring
9:20 - 9:55am	Students monitor vegetation along transect
9:55 - 10:10am	Students conduct photopoint monitoring
10:10 - 10:20 am	Share results and drawing reflection activity

10:20 - 10:30am Break
10:30 - 11:35am 2nd Station Rotation Activity

Group 1: Exploration and Monitoring Station Rotation Activity

10:30 - 10:35am	Demonstration and explanation of monitoring
10:35 - 11:10am	Students monitor vegetation along transect
11:10 - 11:25am	Students conduct photo point monitoring
11:25 - 11:35am	Share results and drawing reflection activity

Group 2: Stewardship Station Rotation Activity

10:30 - 10:35am	Safety overview and demonstration
10:35 - 11:20am	'Before' photograph and stewardship activities
11:20 - 11:35am	Measure and estimate area of work done, 'after' photo, and wrap up

11:35am-12:00pm Clean up and wrap-up

STATION #1: STEWARDSHIP

1. Before beginning your stewardship work, take a photograph of the work area.

2. Invasive species control: This activity is primarily done in the fall. Invasive plants have taken over certain natural areas, and there are different means for their removal and prevention. Students will participate in invasive species removal, by "pulling", or removing the weeds manually.

3. Seed collecting and dispersal: To increase the biodiversity and support native plants in thriving, students will collect native plant seeds and disperse seeds into soil.

4. Litter removal: Using gloves and garbage bags, students remove litter from the natural area.

5. Measure/estimate work completed: Students report data from their stewardship activities (e.g. 100m^2 of brush removed, number of garbage bags of trash collected, gallons of seed collected/dispersed).

6. After completing your stewardship work, take another photograph of the work area, to document your group's stewardship work.

STATION #2: EXPLORATION AND MONITORING

7. Vegetation Monitoring: Students in groups of 3 record percent cover of plant types (e.g. woody plants, forbs, graminoids) in 1/4 m^2 quadrats every 5 meters along a permanent 50 meter transect. If each group completes 2 quadrats, all 10 quadrats along the transect can be completed.

8. Photo point monitoring (instructions found on pages 37-39): Locate the site's permanent photo points (2-4 points, pending steward's needs). Use GPS to mark points, and take photos in specified directions.

WRAP-UP

9. For five minutes, students create a detailed drawing of a plant or animal, then record observations and reflections.

10. Discuss the following questions with the class: What issues did you observe at this natural area? What actions did your group take to steward or protect this habitat?

EXTENSION

A. Students work in their groups to create a visual representation compiling data collected during the Fall Stewardship Day. Students are encouraged to use pictures from their photo points, charts, graphs, and vocabulary to present their findings in a visually appealing way.

B. Each group presents their project to the rest of the class.

C. Students circulate to critique and praise the other groups' projects.

ASSESSMENT

See rubric on page 58.

RESOURCES

See Resource List for additional resources on Restoration and Invasive Species.

SOURCES

U.S. Department of Agriculture, Forest Service http://www.fs.fed.us/eng/rsac/invasivespecies/documents/Photopoint_monitoring.pdf

CIMBY FIELD TRIP SIGN IN SHEET

School: _____

Site: _____ Date: _____

	Student Name	Grade	Number of previous CIMBY trips you attended this year.	Did you participate in Might Acorns or Earth Force? If yes, what school?
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
	Adult Name		Teacher/Chaperone	Is this your first CIMBY trip?
1				
2				
3				
4				
5				

Notes

NAME

5
LESSON
STUDENT PAGE

Fall Stewardship

VOCABULARY

bittersweet
brush
buckthorn
forb
graminoid
habitat
invasive species
monitor
photopoint
quadrat
stewardship
transect

BACKGROUND

During your Fall Stewardship Day, you will help monitor and restore your adopted natural area through vegetative monitoring, invasive removal, photo point monitoring and litter removal. Participating in this service-learning field experience will allow you to practice different skills while reflecting on the experience of being in nature. To prepare for the Exploration and Monitoring activity on the Stewardship Day, refer to Lesson 4: Introduction to Exploration and Monitoring and to this lesson for more information.

Start by choosing a role:

PHOTOGRAPHER	RECORDER #1	RECORDER #2	BRUSH PILE SUPERVISOR
(1 person)	(1 person)	(1 person)	(1 person, If applicable)

STATION 1: STEWARDSHIP

Instructions

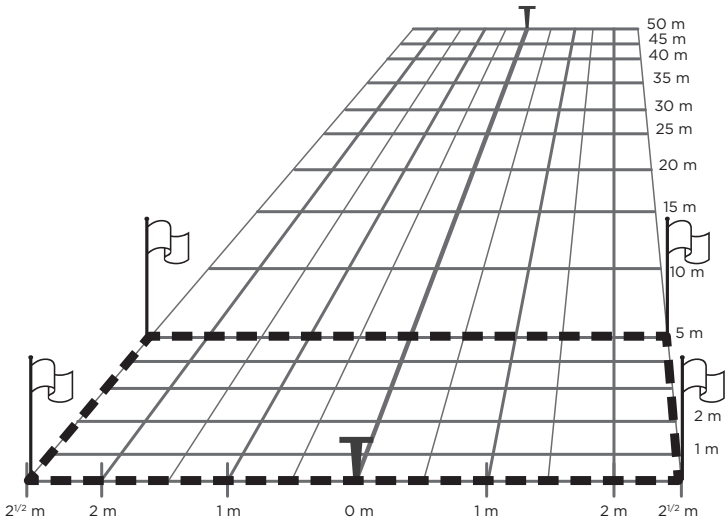
1. Everyone: Listen to the site steward's introduction to the site, stewardship, and tool safety. The steward will assign CIMBY a specific area in which to work, and explain how to do the specific stewardship task.
2. Photographer: Choose a place to set up the tripod for a before and after photo (leave tripod in that location). This photograph should show a wide view of the area where you will be working, and include some natural feature that will be recognizable in both the "before" and "after" photos (make sure it isn't a tree that will be cut down).
3. Photographer: Take one "before" photo with your group. Ask the group to step to the side, and take another "before" photo of the area where you will be working. You will be taking another photo from the same point at the end of your stewardship work. These photos will help us actually see and document the great changes happening because of your efforts.
4. Everyone: Spend the majority of your time working hard. Cut brush, pull weeds, plant plants, etc. Learn about healthy habitats and why some are out of balance. Think about why we are doing what we are doing.
5. Brush Pile Supervisor: If applicable, make sure that all cut brush is no longer than 8 feet. Then, lay brush in same direction.
6. Recorders: With 20 minutes left in your stewardship time, ask 2 students to measure/estimate the work you have complete, using the CIMBY Workday Data Sheet. This information is very important, as it will help us track the accomplishments of your group, the effectiveness of stewardship work in improving the health of the ecosystem, and the impact of CIMBY as a whole. Please record as much information as you can about today's work. Use a measuring tape to measure the approximate area (in square meters) in which you have done stewardship work, and record any other stewardship tasks accomplished.
7. Photographer: From the same point as the "before" photo, take an "after" photo of the area in which you worked. Please feel free to document your work along the way, and to include a group photo.

STATION 2: RESTORATION AND MONITORING ACTIVITY

VEGETATION MONITORING

Instructions

Step 1: Set up 5m x 5m (25 m^2) **sections along transect and determine location of quadrats.**



8. With the help of CIMBY staff or a dedicated site steward, locate the two stakes in the ground that mark the beginning of the site's permanent 50 meter transect. The stake at the beginning of the transect will be marked as the "zero stake" and the stake at the end will be marked the "50 meter stake." Tie a long string between the stakes and make a mark on the string every five meters.

9. Divide into teams of 2 or 3. Each team claims a 5 meter section of the transect and begins measuring and staking out a 5 meter by 5 meter (25m^2) square as follows:

At section beginning and end (e.g., at the zero and 5 meter mark, or the 15 and 20 meter marks, etc.), measure out 2½ meters perpendicularly from both sides of the transect so that you end up with a 5 meter x 5 meter (25m^2) box, with the transect going straight down the middle. Plant a flag in each corner of your square.

Answer the following questions to determine placement of your 1/4m^2 quadrat frame within the section:

10. Stand on the transect at the beginning of the section, facing toward the 50 meter stake. Will your quadrat go on the right or left side of the transect? FLIP A COIN. Heads = left side. Tails = right side.

_____

11. How far to the left or right of the transect will your quadrat go? Choose a location 0 meters (right on the transect line) to 2 meters away from the transect.

_____

12. How far along the transect (heading toward the 50 meter stake) will your quadrat go? Choose a location 0 meters away (right at the beginning of your section) to 4½ meters from the beginning of your section.

_____

13. CAREFULLY, without trampling the plants, plant a flag at the point you selected, line up the bottom left or right corner of your quadrat frame with the flag (see the NOTE below to determine whether you line up the right or left corner) and gently lay it down on the ground.

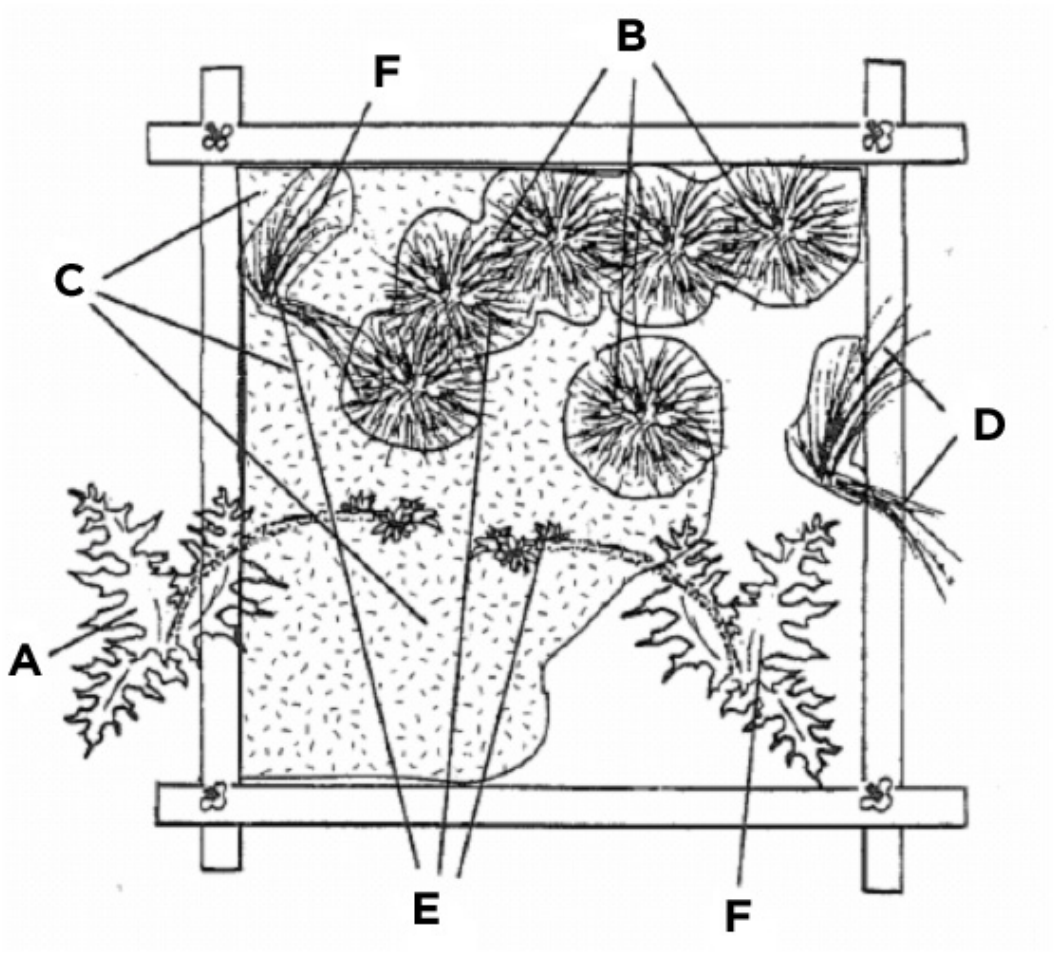
NOTE: If you went LEFT at the 1st question, line up the bottom right hand corner of your quadrat point. If you went RIGHT, line up the left hand corner of your quadrat with the point.

Step 2: Practice Reading Your Quadrat (or, What to Count and What NOT to Count)

14. Look at the following example of what the plants in a quadrat might look like from above, looking straight down on the quadrat.

15. Read through guidelines a) through f) below the illustration and find the corresponding plants in the illustration.

16. Look down at your own quadrat and try to find one example of each situation described in the illustration (e.g., a plant that seems to cover a lot of space in your quadrat, but that is actually rooted outside the frame; low-growing plants that have other larger plants towering over them, etc.).



Looking down on prairie plants within a 'quarter meter square quadrat' frame
Courtesy IDNR Forest Watch Manual

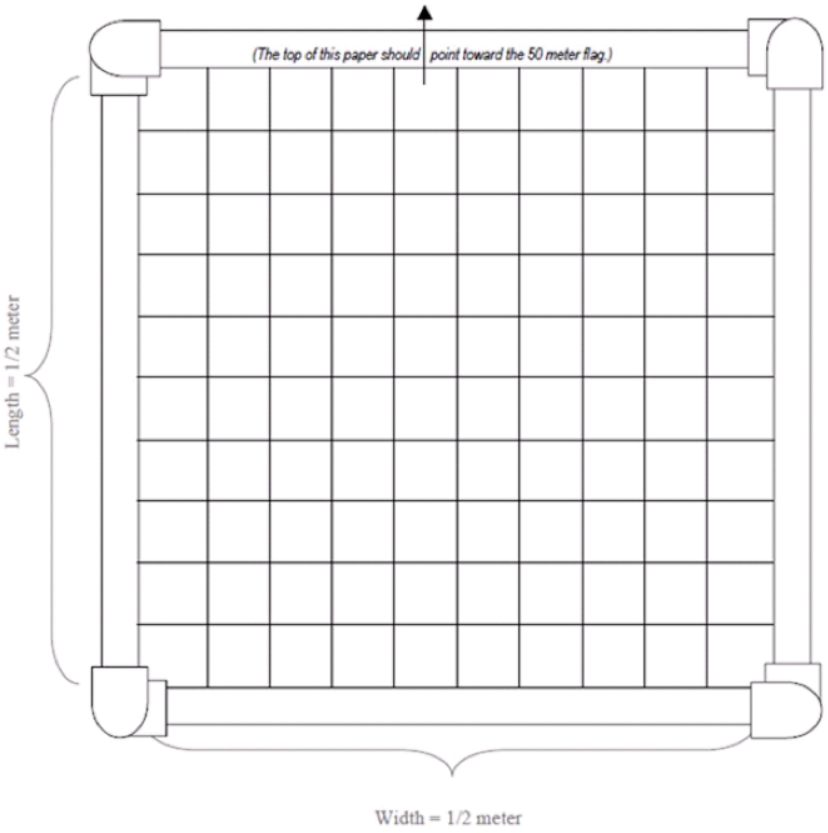
17. To determine percent cover of a type of plant, look straight down and estimate the percent of the ground within the quadrat that is covered by that plant. Include only plants that are rooted in the quadrat. Do not include dead plants, although brown areas of living plants should be included.

a. If plant is not rooted in transect, do not include.
b. If plants are all one species, add percent of area covered by all plants.
c. If low-growing plants have other plants towering over them, include the total area they cover and areas where other plants are above them.
d. If plant hangs out of quadrat but is rooted within it, include the area that the plant covers within the quadrat only.
e. If plants overhang other plants, include the entire area the plants cover, even where they overhang other plants.
f. If there is an irregularly shaped plant, include only area plant covers, not gaps between plant parts.

Step 3: Measure percent cover of three types of plants and/or bare ground in your quadrat.

18. Carefully remove all dead leaves and plants hidden under leaves.

19. While looking down on your quadrat, draw all the plants you see in the frame on this page. Try to exactly copy the shapes, sizes and placement of plants on the ground.



20. Begin estimating what percent of ground each type of plant is covering. Start with woody plants less than 1 meter tall (tree seedlings, ½ shrubs and vines). What percent of the quadrat does each individual woody plant cover? Write the estimate for each plant next to your drawing of it. When each woody plant has been assigned a percent, add up all percents and write them in the "Woody Plants" box at the bottom of the page.

21. Repeat this process with graminoids (grasses and sedges with long, thin, flat three-sided leaves) and then with forbs (remaining broad-leafed plants that aren't woody).

22. Estimate what percent of the ground is bare and write that percent in the Bare Ground/Leaf Litter box below.

23. Important: When finished recording percent cover, do not move your quadrat until a CIMBY staff person has come by to check your work! If waiting for the staff person, turn page over & begin recording location & diameter of trees & shrubs 1 meter tall or taller in your 5m^2 area.

Woody plants:
Have hard bark, stems and roots woody. Includes trees, shrubs and vines.

Percent cover: _____%

Gramminoids:
Grasses (long, thin, flat leaves) and sedges (stems have three sides)

Percent cover: _____%

Forbs:
Broad-leafed, flowering plants

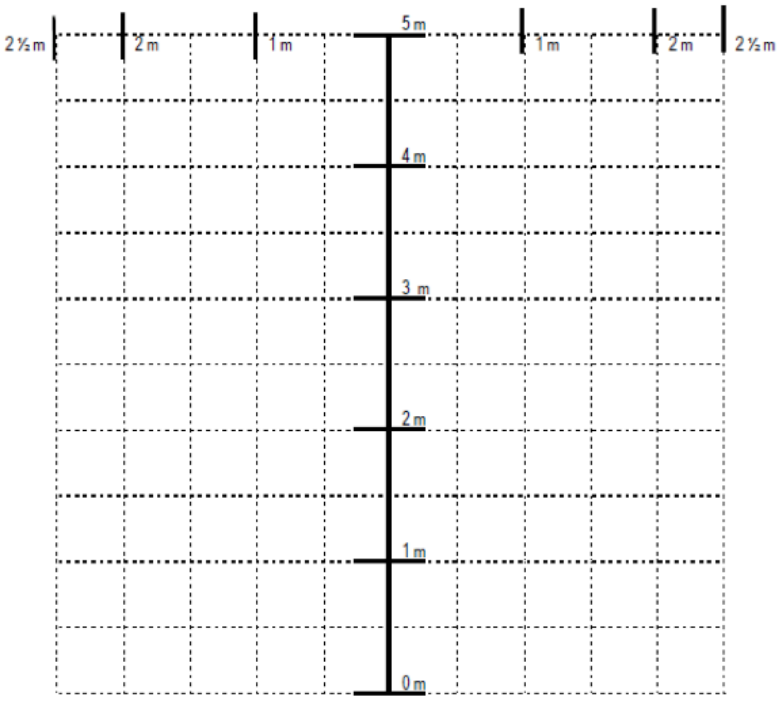
Percent cover: _____%

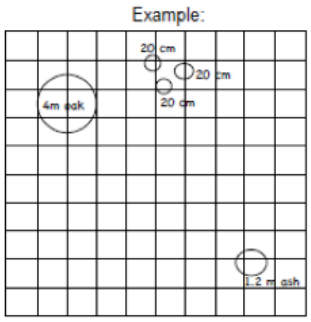
Bare ground/leaf litter

Percent cover: _____%

Step 4: Collect data on all trees, shrubs and vines over 1 meter tall within your 5m x 5m (25 m²) section

29. Sketch in the diagram below approximately where all the trees, shrubs and vines taller than 1 meter are growing within your 25m² section. Simply draw a circle to indicate where the trunk is coming out of the ground. Measure the circumference of each tree, shrub and vine at breast height, or 1.3 meters above the ground. Label each circle with the circumference of the plant and species name, if known.





30. Fill in the following table with information about each of the trees, shrubs or vines in your sketch. Give each individual plant its own row in the table. Mark if the plant is a tree (single trunk, usually tall), a shrub (multiple stems, shorter) or a vine (woody twiningcord). Description: Opposite or alternate branched? Leaves are compound or simple? Texture of bark? Fruits or seeds? Circumference

	Mark if the plant is a tree (single trunk, usually tall), a shrub (multiple stems, shorter) or a vine (woody twining cord).	**Description: Opposite or alternate branched? Leaves are compound or simple? Texture of bark? Fruits or seeds?**	**Circumference**
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			

CIMBY WORKDAY DATA SHEET

School: _____

Site: _____ Date: _____

Start time of workday: _____ Number of students at workday: _____

End time: _____ Number of adult leaders: _____

Please RECORD the type and amount of work accomplished.

1. WEATHER CONDITIONS TODAY (CIRCLE)

Precipitation	Sky Conditions	Wind	Air Temperature (oF):
None Light Moderate Heavy	Clear Partly Cloudy Overcast	Calm Light breeze Windy	

2. AMOUNT OF WORK ACCOMPLISHED TODAY

Please measure the approximate area (m^2) in which you worked as a group:

1st Rotation	_____ m2
2nd rotation, did you work in a different area than the 1st rotation?	yes no (circle one)
If yes, please measure this new area	_____ m2

3. TYPE OF WORK ACCOMPLISHED TODAY

Invasive Plant Control

Cut Brush

a. If you cut brush, which species? Check all that apply.

	Common buckthorn (Rhamnus cathartica)
	Japanese honeysuckle (Lonicera japonica)
	White Ash (Fraxinus americana) or Green Ash (Fraxinus pennsylvanica)
	Japanese barberry (Berberis thunbergii)
	Gray dogwood (Cornus racemosa)
	Wild black cherry (Prunus serotina)
	Others:

b. Were they verified by CIMBY staff? yes no

Pulled Weeds

a. If you pulled weeds, which species?

	Garlic mustard (*Alliaria petiolata*)
	Yellow sweet clover (*Melilotus officinalis*)
	Others:

b. Pounds or number of bags of invasive species pulled: _____ (lbs) or _____ (# of bags)

Scouted & Flagged

a. If you scouted and flagged, please describe specific action: _____

Trash Pick-up

Did you collect trash today? yes no

If yes, what type of trash?	
How many total bags of trash were collected?	

Seed Collection And Dispersal

Did you collect seeds? yes no

If yes, what species?	
How many gallons?	
Did you spread seeds?	yes no
If yes, what species?	
How many gallons?	

4. Other tasks accomplished:

a. _____

b. _____

c. _____

5. Animal species observed:

	Species verified by steward or CIMBY staff?	Other observations: (such as number or species observed; what do you think this animal was doing?)
a.	yes no	
b.	yes no	
c.	yes no	

6. Plants blooming:

	Species verified by steward or CIMBY staff?	Other observations: (such as number of plants in population)
a.	yes no	
b.	yes no	
c.	yes no	

7. Other notes or observations: _____

_____

_____

_____

_____

_____

_____

8. Checklist

Before you turn in this data sheet to CIMBY staff, please make sure that you have:

- ❑ Taken a "before" photo of the work area
- ❑ Taken an "after" photo of the work area
- ❑ Taken a photo of your student group
- ❑ Measured the area in which you worked

CIMBY PHOTO POINTS

Camera location: _____

Area: _____ Date: _____

Number of photo points: _____ Observer: _____

Comments: _____ Slope: _____

_____ Aspect: _____

_____ Slope position: _____

Photo point A

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point B

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point C

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point _____

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point _____

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

WRAP-UP

34. What issues did you observe at this natural area? What actions did your group take to steward or protect this habitat?

_____

_____

_____

35. Take some time to reflect on today's stewardship, restoration and monitoring activities. Spend the next 5 minutes drawing what you learned.

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
STEWARDSHIP: Student follows all appropriate CIMBY Stewardship Station Instructions for his/her assigned role as: photographer, recorder, or brush pile supervisor. Student accurately fills out all work accomplished for his/her role on the CIMBY Workday Data Sheet.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
VEGETATION MONITORING: Student participates in group work and follows the Vegetation Monitoring instructions to properly place quadrats and record percent cover of plant types (e.g. woody plants, forbs, graminoids). Student collects all data on trees within their 5 meter square section.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
PHOTO POINT MONITORING: Student records all information on the Photo Points sheet with appropriate site marking and documentation. Student uses GPS to mark points, and takes photos in specified directions.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student answers follow-up question and creates a detailed drawing demonstrating what he/she learned from the fall stewardship. Answer and drawing are complete and show a comprehensive understanding of the positive impact his/her actions had on the natural area.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

The Great Race for Survival

Students practice classification skills to understand how plants are typically organized in a field guide. Students use the information collected to create a field guide about native plants.

OBJECTIVES

Sort and classify plants by characteristics

Research native and non-native species found in the Calumet Region

Create pages for a Calumet native plant "field guide"

SUBJECT
Biology, Ecology, Botany, Art

PREREQUISITE
A visit to a habitat where students make observations about specific plants. If students did not visit a habitat, they may choose any Calumet habitat's plants to research or the teacher may bring plants, leaves, flowers and photos of plants to class.

VOCABULARY
alternate leaves
annual
basal leaves
biennial
compound leaf
dichotomous key
field guide
germination
invasive species
lobes
native species
node
opposite leaves
perennial
veins

MATERIALS
notecards with plant species written on them (for the great race for survival)
Creature Card plant cards
leaf/plant samples (a variety)
pencils
colored pencils (if students will create their field guides by hand)
research resources (books, field guides, Internet)
quart-sized sealable bags (to sort plants/leaves)
permanent markers
other field guides (Golden Books, Audubon, etc.)
hand lenses
computers (with printing access)

TIME/DURATION
120 minutes

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

This activity introduces students to the characteristics of plants, both native and invasive, and teaches them to identify plants by their characteristics using various systems. The lesson begins with a simulation of native and invasive plants competing for space in a habitat. In order to determine if a plant is native or invasive, it must first be identified. To begin, students develop and use their own system of classification to identify plants. They then use a dichotomous key to identify a group of plants. Finally, students create field guide pages for the plants that they studied in this lesson. *See the student page for additional background information.*

PROCEDURE

1. Introduction: Students read the background information on their student pages and answer the introductory questions: What invasive plants have you heard of? How did these plants arrive at a location where they are considered invasive? What are some ways to identify and classify plants?

PART ONE: SIMULATION - "The Great Race for Survival"
Note: Write the names of the native and invasive species listed below on notecards. If there are fewer than 20 students, you will not use all of the species. If there are more than 20 students, write the names of some species on more than one card.

PLANT SPECIES FOR RACE SIMULATION

Native – American beech, beach pea, beach wormwood, black oak, common milkweed, hairy puccoon, marram grass, pitcher's thistle, riverbank grape, sand cherry, sea rocket

Invasive – baby's breath, garlic mustard, Japanese barberry, Japanese honeysuckle, multiflora rose, oriental bittersweet, purple loosestrife, spotted knapweed, tree-of-heaven

MOVEMENT DIRECTIONS

2. Select an open area, such as a gym or playing field, in which to conduct a race. Use cones or a rope to designate a starting and finishing line. Position the finishing line about 50 feet from the starting line.

3. The teacher reads aloud the following information to students:

Each one of you has been magically transformed into a tiny plant seed. You are each a different kind of seed from a different kind of plant. Through the actions of wind, water, animals, and people, each one of you is now lying along the same stretch of road on a Lake Michigan beach. You have been lying dormant in the soil all winter. When this road was rerouted last year, the construction caused a disturbance in the soil. Conditions are now ideal for weed species to establish themselves here. The events that I will describe represent one year in your life. Not all of you will survive the year. Listen carefully to the instructions. When I tell you to step forward or backward, take normal walking steps.

It is early spring. Rain, snowmelt, warm temperatures, and long days result in rapid plant growth. Perennials send up new shoots from the soil, and seeds that have lain dormant all winter start to sprout. **Everyone take five steps forward.**

The soil along this new road bed contains many more seeds from some types of plants than others. **Baby's breath, spotted knapweed, oriental bittersweet and purple loosestrife take two steps forward. Garlic mustard take six steps forward.**

Some plants are taller and grow in thick patches, preventing other plants from growing so that they have more resources for themselves. **Japanese honeysuckle and multiflora rose take three steps forward.**

The growing season continues to be favorable. **All plants take 10 steps forward.**

Garlic mustard completes its life cycle the fastest, and it produces seeds before the other species. **Garlic mustard take five steps forward.**

A few species are capable of producing chemicals that they release into the soil. These chemicals inhibit the growth of nearby plants. Spotted knapweed and Japanese barberry raise your hands. **Any plant within five steps of these plants move backwards three steps.**

As the growing season continues, drought hits this area, and plant growth slows. Deep-rooted plants do best. **Tree-of-heaven move two steps forward.**

Summer storms and slightly cooler temperatures improve growing conditions for all plants. **All plants move forward six steps.**

Oriental bittersweet, raise your hand. This plant sends out long, creeping vines that can form a dense mat of vegetation, which chokes out other species in a wide area. **All plants within four steps of oriental bittersweet, move backward three steps.**

Plants continue to grow, but shortened days slow growth. **All plants move four steps forward.**

Much plant energy is now devoted to food storage and seed production. **All plants move forward two steps.**

Some plants produce numerous amounts of seeds. They are able to ensure their success by having more seedlings than other species, along with the ability to spread to new locations. One plant of purple loosestrife can produce up to two million seeds per year. **Purple loosestrife take five steps forward.**

4. End the game after one or more students have crossed the finish line.

5. Discussion: Was the "winner" a native or invasive species? Why do you think that was? In what habitat would these plants thrive? What reproductive or growth habits did the invasives display? What impact would invasive plants have on an ecosystem? Why is it important to identify and respond to invasive species in an ecosystem? Students should think about what new information they learned during this simulation.

The following activities are facilitated during Biodiversity Day. Teachers unable to bring students to Biodiversity Day should continue Part Two, Three, and Four in the classroom. All teachers will complete 'wrap up' activities in the classroom.

PART TWO: CLASSIFYING LEAVES

6. Discussion: In order to determine if a plant is native or invasive, it must first be identified. Explain to students that scientists use a system of classification to identify and organize plants, animals and other natural objects. *Plants, for example, are sorted into groups with similar traits. Within "like" groups, the differences among plants help distinguish them from each other. Field guides are arranged using a classification system to make it easier for people to find or identify specific plants.*

7. The students now practice classifying plants using their own system of classification. Break students into small groups. Give each group a set of at least six different leaves. Have each of the groups divide their leaves into two categories, based on an easily observed difference. Then have students divide those two categories in half again, based-on characteristics. It does not matter which characteristics the students choose.

PART THREE: PLANT KEY

8. Students will use the dichotomous key included in the student pages to identify native plant species of the Calumet Region and the Great Lakes. Botanists, ecologists and other scientists or natural resource managers use dichotomous keys to identify uncommon native species or invasive species. Students will identify invasive species from Part One: Simulation - "The Great Race for Survival".

PART FOUR: FIELD GUIDE ACTIVITY

9. Each of these small groups will create a field guide for the 10 native plant species from Part One: Simulation, "The Great Race for Survival" or using native tree leaves collected in the field. Students will work in groups, but each student will create his/her own field guide pages. Student journal pages include a template for creating a plant field guide page. Students should also take advantage of other resources to gain information about their plants (guide books, the internet). The Native Plant Field Guide will include information on the plant's history, description, leaves, stems, flowers, habitat, reproduction and additional comments. Each student should draw his/her plant and fill in the information for it.

10. When students have completed their pages, collect them and then pass them out randomly so that each student has another student's page. Students will assess each other's pages based-on the following questions, written on the board. Or, have students come up with the assessment criteria. They should answer these questions on a separate sheet of paper.

a. Are all of the questions answered completely? (One point for each answer - 10 points total) If you feel that there is missing information, indicate what is missing.

b. Is the drawing detailed? (1-3 points for very little detail, 4-6 points for some detail, 7-10 points for lots of detail) If students give fewer points, they should make suggestions for what details could be added.

11. Discussion: What systems do scientists, naturalists, gardeners and other people use to classify plants? What characteristics must you be familiar with to identify plants? Would you prefer to use a dichotomous key or a field guide to help with identifying native plants while out in the field? Why are there multiple classification systems?

WRAP-UP

12. To create a complete field guide that includes all of the plants studied, choose the most accurate and complete entry for each plant. Photocopy these pages to create a complete set of field guide pages. Distribute a copy of the field guide to each student.

13. Have the class come up with a classification system with which to organize the field guide. To do this, they first need to come up with one major difference between the plants to divide them into categories. From there, they should break each category down one step further until each plant has its own identity.

14. Discuss the following and have students respond to these questions in their student pages: What impacts do invasive plants have on an ecosystem? Why is it important to identify and respond to invasive species in ecosystems?

EXTENSION

A. Students research native plants from other habitats and create a field guide of these native plants.

B. The plants that students observe will change through the seasons. If it's practical, have students observe their plants several other times during the year and take note of any changes. For example, has the plant grown, flowered, or gone to seed? To be sure that students find the same plant at each visit, mark each one with a stake on the first field trip. Students may add new information to their field guides after each seasonal observation.

C. Use a dichotomous key to identify Great Lakes fish, by visiting Michigan Sea Grant's Project Flow Web site: http://www.miseagrant.umich.edu/flow/pdf/U3/FLOW-U3-L1-MICHU-08-403.pdf

ASSESSMENT

See rubric on page 67.

RESOURCES

See Resource List for additional information related to field guides, native and invasive species and more.

SOURCES

"The Great Race for Survival - Alien Invasion: Plants on the Move", modified for the Indiana Dunes from "Invaders of the Forest" 2005, WEEB, WDNR, Park People of Milwaukee County

NAME _____

6
LESSON
STUDENT PAGE

The Great Race for Survival

VOCABULARY

alternate leaves
annual
basal leaves
biennial
compound leaf
dichotomous key
field guide
germination
invasive species
lobes
native species
node
opposite leaves
perennial
veins

BACKGROUND

Invasive species travel, often accidentally, from their native ecosystem to a new ecosystem. There are hundreds of examples of invasive species (also known as exotic or nonnative species) around the world. An "introduced species" is one that has been intentionally brought from its native ecosystem to a new one. When a new species is introduced into an ecosystem, the balance is altered and competition is high until a new balance is achieved. Many times invasive or introduced species cannot survive in these new ecosystems or become a non-threatening part of this ecosystem. However, if the new species is successful, one or more native species populations can suffer, altering the ecosystem. Calumet ecosystems have been "invaded" by nonnative invasive plant species such as baby's breath (Gypsophila paniculata) and garlic mustard (Alliaria petiolata), which have spread rapidly and outcompeted native species for space and resources. Since they are not indigenous, they do not usually have any natural enemies present to control their populations, which allows them to grow rapidly and easily out-compete native species. According to the United Nations Convention on Biological Diversity, about $1.4 trillion a year is spent globally to control invasive species and to help repair the damage they cause.

Each native plant has a role. They may provide food or shelter to birds, insects, or other animals; hold soil in place; filter water; or provide a home for important bacteria or fungi. In this activity, students will observe plants from a Calumet habitat, such as a wetland, woodland, prairie, or dune, and learn about their characteristics and specific habitat. In this activity, you will characterize plants, both native and invasive, and you will learn to identify plants by their characteristics using various systems. In order to determine if a plant is native or invasive, one must be able to identify it.

Organisms can be identified with the use of a dichotomous key. Dichotomous keys have a number of different steps each with two options (just as "mono" means one, "di" means two). The user must select the option that best describes the plant in question and then he/she will be directed to a new pair of options to choose from. Eventually, the choices made will lead the user to the correct name of a given item.

This lesson begins with a simulation of native and invasive plants competing for a place in a habitat, and then continues as you learn how plants are classified and identified.

INTRODUCTORY QUESTIONS

1. What are some invasive plants that you have heard of?

_____

_____

_____

_____

_____

_____

2. How do these plants get to a location where they are considered invasive?

3. What are some ways that you know of that are used to identify and classify plants?

GREAT RACE FOR SURVIVAL

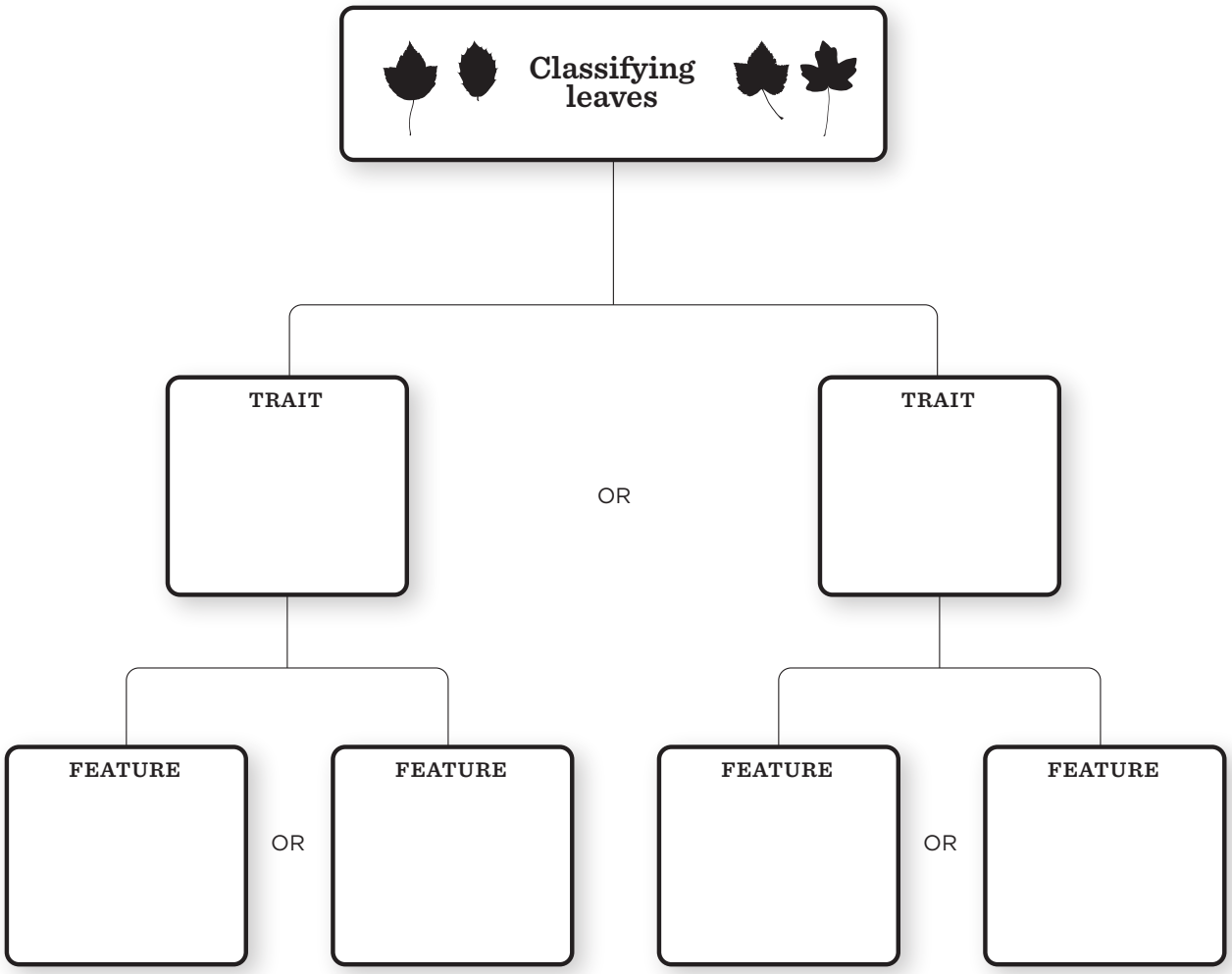
4. Your species:_____ Is it native or invasive? (circle one)

5. Was the "winner" a native or invasive plant? Why do you think that was?

6. What new information did you learn during this simulation?

CLASSIFYING LEAVES

Classify the leaves you were given based on their unique traits and features. First divide the leaves into two groups based on traits, then divide each of those groups by additional features.



DICHOTOMOUS KEY

Identify the plant species on the left by making a selection in each step. You may also use the Creature Cards.

FIGURE	STEP	DIAGNOSTIC
	1 A	Plant has "woody" growth or parts ➥ GO TO 2
	1 B	Plant does not have "woody" growth or parts ➥ GO TO 5
	2 A	Plant has one erect perennial stem (trunk) that branches out with a crown of foliage ➥ GO TO 3
	2 B	Plant has several perennial stems that may be erect or close to the ground ➥ GO TO 4
	3 A	Plant has leaves that are deeply lobed and have tiny hairs on the underside ➥ BLACK OAK
	3 B	Plant has alternate leaves that are coarsely serrated with wavy edges ➥ AMERICAN BEECH
	4 A	Plant has white flowers and purple-black fruits ➥ SAND CHERRY
	4 B	Plant has grayish green leaves and yellow flowers ➥ BEACH WORMWOOD
	5 A	Plant is found on the foredune, beaches, and along lakes and oceans ➥ GO TO 6
	5 B	Plant is found on the forested backdune, forest floor, and climbing on trees ➥ POISON IVY
	6 A	Plant has flowers ➥ GO TO 7
	6 B	Plant has no flowers, but has narrow, spike-like leaves ➥ MARRAM GRASS
	7 A	Plant has fine hairs along the stems or leaves ➥ GO TO 8
	7 B	Plant does not have any hair along the stems or leaves ➥ GO TO 9
	8 A	Plant has pink/lavender flowers, and opposite oval shaped leaves ➥ COMMON MILKWEED
	8 B	Plant has orange/yellow flowers, and alternate narrow leaves ➥ HAIRY PUCCOON
	8 C	Plant has cream/pink flowers, and finely and deeply lobed leaves up to 1ft long ➥ PITCHER'S THISTLE
	9 A	Plant is less than 2 feet in height ➥ GO TO 10
	9B	Plant is greater than 2 feet in height with vines up to 50 feet long ➥ RIVERBANK GRAPE
	10 A	Plant has purple or pink flowers in clusters at the end of the stem ➥ BEACH PEA
	10 B	Plant has white/lavender flowers with thick, fleshy leaves ➥ SEA ROCKET

FIELD GUIDE TEMPLATE

You will create a field guide page for a native plant. Draw the plant in the space provided and fill in the information below. Label any important traits on the drawing.

TYPE (CIRCLE ONE)

Woody • Herbaceous

BRANCHING

Opposite • Alternate

FLOWERS

Yes • No

Number of Petals _____

Color _____

SEEDS

Fruit • Nut • Parachute • Hitchhiker • Other

LEAVES

Color _____

Shape _____

Height _____

OTHER INFORMATION _____

_____

_____

_____

_____

_____

_____

_____

SUNLIGHT

Sunny • Shady

SOIL

Wet • Medium • Dry • Clayey

Sandy • Mixed

LOCATION

Underwater • Emerging from the water • At the edge of the water • On land

ABUNDANCE

High Number • Medium • Very Few

WRAP-UP

7. What impacts do invasive plants have on an ecosystem?

8. Why is it important to identify and respond to invasive species in ecosystems?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
SIMULATION: Student participates in "The Great Race for Survival" and actively listens to instructions about his/her assigned plant species. Student recognizes the native and invasive plant species presented and the effects they have on habitats	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
GROUP WORK: Student works with his/her group to classify leaves, based on their own set of characteristics. Student uses a dichotomous key to identify plants according to their features.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
FIELD GUIDE: Student creates a field guide for a native plant that includes the plant's history; a description of the plant and its leaves, stems, flowers; details about the plant's habitat; information about the plant's reproduction process; and any additional information. Visual representations of the plant are drawn using colored pencils.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
DISCUSSION: Student receives another student's field guide page and assesses the details of the information provided and the drawing. Student participates in group discussion and understands dichotomous keys and field guides and uses for each to classify native and invasive plants.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Biodiversity Day

Students explore biodiversity and diverse habitats at the Sand Ridge Nature Center, Forest Preserve District of Cook County.

OBJECTIVES

Understand the concept of biodiversity and learn to recognize a variety of habitats that make up the Calumet Region

Sort and classify plants by characteristics

Identify and observe native plant and animal species in a wetland, woodland, and prairie habitat

SUBJECT
Biology, Ecology
Environmental Science

PREREQUISITE
Great Race for Survival

VOCABULARY
invasive species
biodiversity
bog
ecosystem
fauna
flora
habitat
prairie
wetland
woodland
dichotomous key
field guide

MATERIALS
old clothes
long pants
close-toed shoes or tennis shoes
clipboards
pencils
set of leaves for identification

TIME/DURATION
6 hours

SETTING
Outdoors (or Indoors if unable to participate in Biodiversity Day at Sand Ridge Nature Center – portions of this lesson can be done in the classroom)

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

The Calumet Region includes many natural areas, many of which are remnants of an extraordinarily rich landscape that evolved here, at the intersection of three biomes: the vast Midwestern tallgrass prairie, the North Woods, and the eastern deciduous forest, within the watershed of Lake Michigan. During this field trip and lesson, students will become familiar with the concept of biodiversity, learn to recognize a variety of habitats that make up the biodiversity of the Calumet Region, identify and observe native plant and animal species in each type of habitat, and help combat threats to Calumet biodiversity by removing invasive species. The Biodiversity Day field trip brings students to Sand Ridge Nature Center, a Forest Preserve District of Cook County site in South Chicago in the Calumet Region. If your class is not participating in this field trip, you may complete station two and three of this lesson plan in your classroom.

PROCEDURE

GENERAL AGENDA

8:45am	Arrive at Sand Ridge Nature Center
9:00 - 9:30am	Introduction and Biodiversity IQ Icebreaker
9:30am-12:30pm	Activity Stations
	Students rotate through 3 activity stations:
	- Ecological Restoration Service-Learning Project
	- Classification and Field Guides
	- Habitat Research
12:30 - 12:40pm	Wrap up discussion
12:40 - 1:00pm	Lunch
1:30 - 2:00pm	Buses return to schools

1. BIODIVERSITY IQ ICEBREAKER: Cut out the Biodiversity fact cards on p. 70 and place these around the room. If you are participating in Biodiversity Day at Sand Ridge Nature Center, you will do this there.

2. Students will rotate through three stations: Ecological Restoration Service-Learning Project, Classification and Field Guides, and Habitat Research.

STATION ONE: ECOLOGICAL RESTORATION SERVICE-LEARNING PROJECT

3. Students follow a restoration technician to the woodland to learn about invasive species and their effect on the natural habitat. This is a guided activity at Sand Ridge Nature Center. Safety guidelines and an introduction to the habitat will be presented by the Forest Preserve District of Cook County staff. Forest Preserve staff will guide students in the removal of invasive species.

4. Students receive tools and training to remove invasive species (e.g. buckthorn).

5. Students work in teams to safely collect invasive species. Students follow the directions of the site steward for proper collection and disposal of invasive species.

STATION TWO: CLASSIFICATION AND FIELD GUIDES

6. Discussion: In order to determine if a plant is native or invasive, it must first be identified. Explain to students that scientists use a system of classification to identify and organize plants, animals and other natural objects. Plants, for example, are sorted into groups with similar traits. Within "like" groups, the differences among plants help distinguish them from each other. Field guides are arranged using a classification system to make it easier for people to find or identify specific plants.

7. The students now practice classifying plants using their own system of classification. Break students into small groups. Give each group a set of at least six different leaves. Have each of the groups divide their leaves into two categories, based on an easily observed difference. Then have students divide those two categories in half again, based-on characteristics. It does not matter which characteristics the students choose.

8. Students will use the dichotomous key included in the student pages to identify native plant species of the Calumet Region and the Great Lakes. Botanists, ecologists and other scientists or natural resource managers use dichotomous keys to identify uncommon native species or invasive species.

9. Each of these small groups will create a field guide using native tree leaves collected in the field. Students will work in groups, but each student will create his/her own field guide pages. Student journal pages include a template for creating a plant field guide page. Students should also take advantage of other resources to gain information about their plants (guide books, the internet). The Native Plant Field Guide will include information on the plant's history, description, leaves, stems, flowers, habitat, reproduction and additional comments. Each student should draw his/her plant and fill in the information for it.

STATION THREE: HABITAT RESEARCH

10. Explain that students will be making focused observations about the habitat(s) they are visiting, and they will record their observations on the Habitat Research pages. They should work in groups to record their observations. It is important that their observations are detailed. They may make notes, ask questions, sketch the ecosystem, and/or create charts to include the necessary content. They should answer the questions on the student page 73.

WRAP-UP

11. To create a complete field guide that includes all of the plants studied, choose the most accurate and complete entry for each plant. Photocopy these pages to create a complete set of field guide pages. Distribute a copy of the field guide to each student.

12. Have the class come up with a classification system with which to organize the field guide. To do this, they first need to come up with one major difference between the plants to divide them into categories. From there, they should break each category down one step further until each plant has its own identity.

13. Discuss the following and have students respond to these questions in their student pages: What new information did you learn or new experience did you have today?

EXTENSION

A. Students research native plants from other habitats and create a field guide of these native plants.

B. The plants that students observe will change through the seasons. If it's practical, have students observe their plants several other times during the year and take note of any changes. For example, has the plant grown, flowered, or gone to seed? To be sure that students find the same plant at each visit, mark each one with a stake on the first field trip. Students may add new information to their field guides after each seasonal observation.

C. Use a dichotomous key to identify Great Lakes fish, by visiting Michigan Sea Grant's Project Flow Web site: http://www.miseagrant.umich.edu/flow/pdf/U3/FLOW-U3-L1-MICHU-08-403.pdf

ASSESSMENT

See rubric on page 77.

RESOURCES

See Visual Media in the Resource List for additional information, including The Field Museum: N.W. Harris Learning Collection - Prairie Life, Great Lakes Plants Diversity, and Common Oaks Experience Cases.

BIODIVERSITY FACT CARDS

Teacher Instructions: Print this sheet, then cut and place individual hints around the room for the Biodiversity IQ Icebreaker.

The variety of life on earth includes plants, animals, microorganisms, ecosystems, genes, habitat diversity and more.

All over the world, habitats are being turned into agricultural land, harvested for wood and fuel, and destroyed or changed to build roads, schools, malls and other human developments. Because the human population is growing so quickly and consuming so many natural resources, habitat loss is occurring at a rapid pace.

Scientists have estimated that at least 1.5 million, but as many as 100 million species may actually exist – they just haven't gotten around to identifying all of them yet.

Biodiversity describes the incredible variety of life on earth – and that includes the diversity among genes (which control inherited traits like the color of your eyes), species (from huge whales to tiny soil creatures) and ecosystems (from lush cypress swamps to the harsh environmental conditions of a prairie)

An ant can carry a load up to 50 times its body weight.

Bees are worth billions of dollars to the agriculture industry. Each year bees pollinate millions of acres of almond and apple trees, cucumbers and celery. Other favorite foods we'd miss without bee pollinators include watermelons, avocados, plums, pears, blueberries, cranberries, cherries and cantaloupes.

Lots of animals are quick on their feet (or wings, or scales, or fins). Cheetahs are the fastest land animals in the world with speeds of 70 miles/hour. The fastest humans can finish a 100-yard dash in under 10 seconds. That calculates to about 25 miles per hour; although humans can't sustain that speed long term. The wart hog and domestic cat can both attain speeds of 30 miles/hour. The wild turkey can run at 20 miles/hour, and the American woodcock flies slowly at about 5 miles per hour maximum.

Certain kinds of ants eat the sugary substances excreted by aphids, which are insects that suck plant juices. The ants herd colonies of aphids by moving them from place to place and protecting them from enemies. Some slime molds have two distinct phases in their life cycle. In the reproductive phase they are stationary, like a plant with a stalk. From this stalk they produce spores. These slime molds may exist as mobile amoeba-like organisms that feed by engulfing material. Bald cypress trees grow in swamps in southern Illinois. These huge trees can grow with their roots continually submerged because of their unique feature, called "knees."

Notes

NAME

7
LESSON
STUDENT PAGE

Biodiversity Day

VOCABULARY

invasive species
biodiversity
bog
ecosystem
fauna
flora
habitat
prairie
wetland
woodland

BACKGROUND

Sand Ridge Nature Center, like other Calumet Region natural areas, encompasses a number of diverse and productive ecosystems. These are among the most diverse and productive ecosystems in the Calumet region. On your tour, take notes about the ecosystem you explore. Ask questions to fill in the blanks on the following pages, and to learn more about the species of plants and animals that live in this ecosystem. Take in all of your surroundings, and on the last page, draw features of the landscape to create a visual representation of this unique habitat.

BIODIVERSITY IQ

Instructions: Spend five minutes circulating around the room looking for hints to help you answer the eight questions below. Once you have answered all of the questions, turn in your completed sheet to your teacher or a CIMBY staff member.

1. Which of the following best describes the word biodiversity?
   a. Endangered species
   b. Different kinds of planets in the solar system
   c. The variety of all life on earth
   d. Biographies about famous biologists

2. What is the most serious threat to biodiversity?
   a. Scientists collecting specimens
   b. Habitat loss
   c. Tourists
   d. pollution

3. If you decided to throw a party to celebrate the diversity of life on earth and wanted to send an invitation to each species, how many invitations would you need?
   a. 150
   b. About 3000
   c. 652,983
   d. More than 1.5 million

4. Biodiversity includes:
   a. The color of your eyes
   b. The creatures in your neighborhood soil
   c. Illinois
   d. Your classmates
   e. All of the above

5. If we gave a prize for "the strongest creature for its size," which of the following would win?
   a. Bobcat
   b. Bald eagle
   c. Ant
   d. Turtle

6. Which of the following would people have to do without if there were no bees?
   a. Almonds
   b. Honey
   c. Cucumbers
   d. Apples
   e. Celery
   f. All of the above

7. Which of the following could the fastest human outrun in a 100-yard race?
   a. Cheetah
   b. Wart hog
   c. American woodcock
   d. Domestic cat
   e. Wild turkey

8. Which of the following actually exist?
   a. Ants that "herd" aphids for food
   b. Slime molds that creep across the ground
   c. Trees that can grow with their roots under the water
   d. None of the above

HABITAT RESEARCH

9. Name of the ecosystem:

10. Physical characteristics:

11. Description of climate:

12. Create a biodiversity inventory and write the names of plant or animal species you learn about below.

a. Flora (plant life):

b. Fauna (animal life):

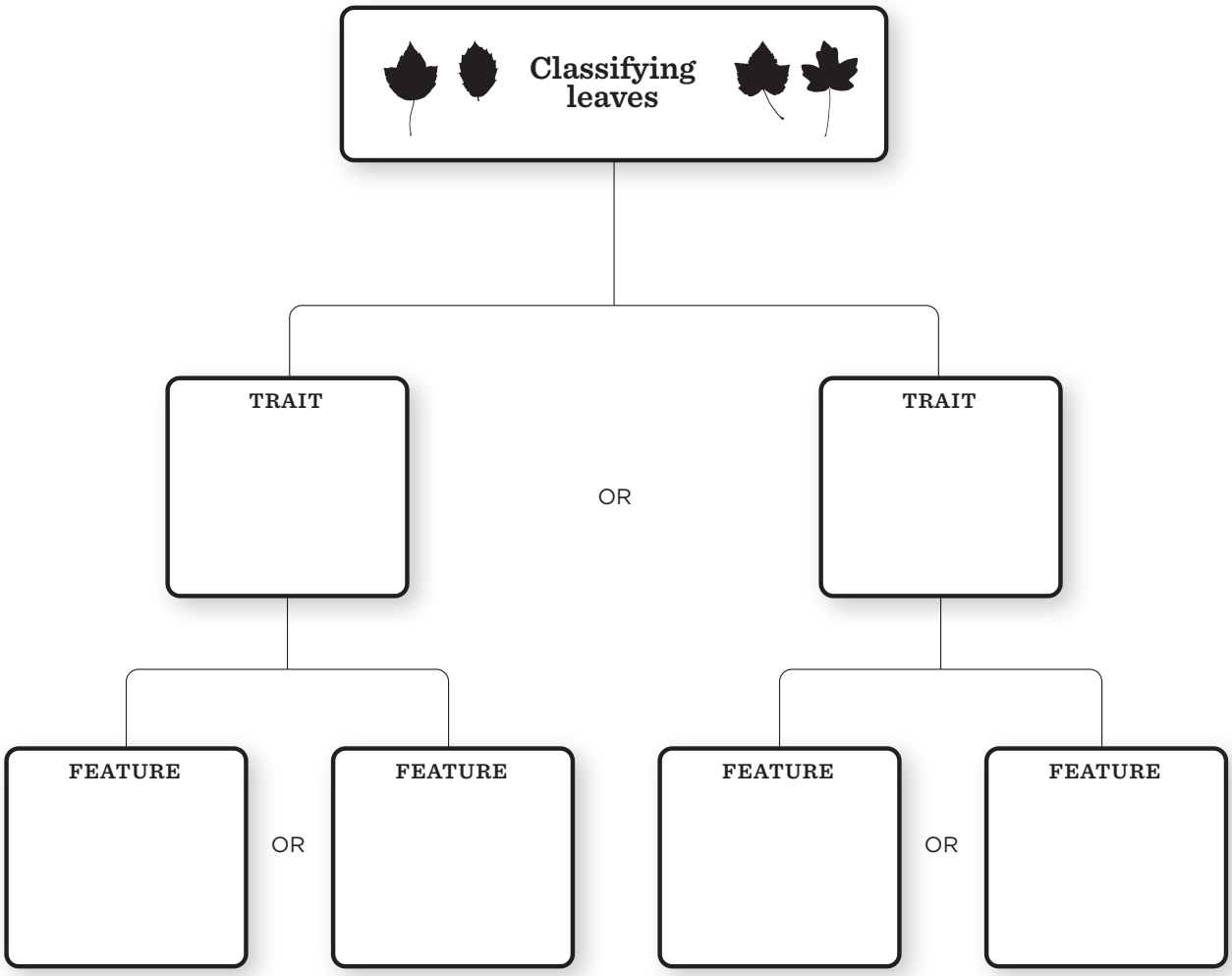
13. Human connection:

14. Biodiversity threat:

15. Interesting facts:

CLASSIFYING LEAVES

Classify the leaves you were given based on their unique traits and features. First divide the leaves into two groups based on traits, then divide each of those groups by additional features.



DICHOTOMOUS KEY

Identify the plant species on the left by making a selection in each step. You may also use the Creature Cards.

FIGURE	STEP	DIAGNOSTIC
	1 A	Plant has "woody" growth or parts ➥ GO TO 2
	1 B	Plant does not have "woody" growth or parts ➥ GO TO 5
	2 A	Plant has one erect perennial stem (trunk) that branches out with a crown of foliage ➥ GO TO 3
	2 B	Plant has several perennial stems that may be erect or close to the ground ➥ GO TO 4
	3 A	Plant has leaves that are deeply lobed and have tiny hairs on the underside ➥ BLACK OAK
	3 B	Plant has alternate leaves that are coarsely serrated with wavy edges ➥ AMERICAN BEECH
	4 A	Plant has white flowers and purple-black fruits ➥ SAND CHERRY
	4 B	Plant has grayish green leaves and yellow flowers ➥ BEACH WORMWOOD
	5 A	Plant is found on the foredune, beaches, and along lakes and oceans ➥ GO TO 6
	5 B	Plant is found on the forested backdune, forest floor, and climbing on trees ➥ POISON IVY
	6 A	Plant has flowers ➥ GO TO 7
	6 B	Plant has no flowers, but has narrow, spike-like leaves ➥ MARRAM GRASS
	7 A	Plant has fine hairs along the stems or leaves ➥ GO TO 8
	7 B	Plant does not have any hair along the stems or leaves ➥ GO TO 9
	8 A	Plant has pink/lavender flowers, and opposite oval shaped leaves ➥ COMMON MILKWEED
	8 B	Plant has orange/yellow flowers, and alternate narrow leaves ➥ HAIRY PUCCOON
	8 C	Plant has cream/pink flowers, and finely and deeply lobed leaves up to 1ft long ➥ PITCHER'S THISTLE
	9 A	Plant is less than 2 feet in height ➥ GO TO 10
	9 B	Plant is greater than 2 feet in height with vines up to 50 feet long ➥ RIVERBANK GRAPE
	10 A	Plant has purple or pink flowers in clusters at the end of the stem ➥ BEACH PEA
	10 B	Plant has white/lavender flowers with thick, fleshy leaves ➥ SEA ROCKET

FIELD GUIDE TEMPLATE

You will create a field guide page for a native plant. Draw the plant in the space provided and fill in the information below. Label any important traits on the drawing.

TYPE (CIRCLE ONE)

Woody • Herbaceous

BRANCHING

Opposite • Alternate

FLOWERS

Yes • No

Number of Petals _____

Color _____

SEEDS

Fruit • Nut • Parachute • Hitchhiker • Other

LEAVES

Color _____

Shape _____

Height _____

OTHER INFORMATION _____

_____

_____

_____

_____

_____

_____

_____

SUNLIGHT

Sunny • Shady

SOIL

Wet • Medium • Dry • Clayey

Sandy • Mixed

LOCATION

Underwater • Emerging from the water • At the edge of the water • On land

ABUNDANCE

High Number • Medium • Very Few

16. Draw a visual representation of a _____ (ecosystem) in the box below:

WRAP-UP

17. What new information did you learn or new experience did you have today?

_____

_____

_____

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
GROUP WORK: Student works with his/her group to classify leaves, based on their own set of characteristics. Student uses a dichotomous key to identify plants according to their features.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
FIELD GUIDE: Student creates a field guide for a native plant that includes the plant's history; a description of the plant and its leaves, stems, flowers; details about the plant's habitat; information about the plant's reproduction process; and any additional information. Visual representations of the plant are drawn using colored pencils.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
HABITAT RESEARCH: Student makes focused observations about the habitat(s) he/she is visiting and records detailed observations on the Habitat Research pages.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student completely answers the additional question about what he/she learned or experienced. Student actively takes part in the concluding discussion	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Notes

Calumet Habitat Research

Students research the major Calumet habitats and create a visual representation of one of them. If possible, students visit at least one of these habitats.

OBJECTIVES

Identify the major habitats in the Calumet Region	Describe how humans depend on these habitats	Identify native plants and animals in one habitat	Create a visual representation of one Calumet habitat	Present information and a visual of a Calumet habitat

SUBJECT
Ecology, Language Arts, Environmental Science, Biology

PREREQUISITE
Coastal Journey

VOCABULARY
beach
bog
emergent marsh
fen
forested shoreline
lakeplain prairie
ravine
river
sand dune
savanna
swale
swamp
wetland

MATERIALS
enlarged printout or projection of the habitats chart
research supplies, including computers with internet access
art supplies (i.e. colored pencils, markers, paints)

TIME/DURATION
3 hours

SETTING
Indoors, Computer lab, outdoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

The Calumet Region encompasses some of the most diverse and productive ecosystems in the nation. Dramatic sand dunes, lush prairies and grasslands, wetlands and forests characterize some of the unique ecosystems found in the Calumet Region and along Lake Michigan's shoreline.

Unique transition areas — linking land and water — provide critical habitats for many species of plants and animals, some of which are found only in the Great Lakes watershed. Transitional ecosystems can include a sand dune, wetland (emergent marsh, bog, fen, swamp and/or swale), beach, lakeplain prairie, savanna, forested shoreline, island, the flowing waters of connected rivers and the open waters of the Great Lakes.

PROCEDURE

1. Introduce the activity by telling the class that they're going to build upon what they've learned about habitats. You will need to project the habitat chart onto a white board, or produce a large classroom copy of the chart. Each student should also have a copy of the chart from the student pages.

2. Students read the background information and answer the questions on their student pages: How do plants, animals and people depend on natural habitats in the Calumet Region?

3. Next, on their individual charts, students fill in the first (left) column with the names of the habitats they've studied as a class. As the students fill in the left column on their individual charts, the teacher (or a student volunteer) should fill in the left column on the classroom chart.

4. Each student (or small group of students) selects one habitat to research. Students research the habitat and use the information to fill in the rows on the chart. Students record the research in their journal or notebook, then enter concise responses on their own charts with information about the following:

   Location
   Climate
   Landscape Characteristics
   Native Flora (at least five)
   Native Fauna (at least five)
   How humans use or benefit from this habitat

5. Each student creates a visual representation (i.e. picture book, Web site, poster, video) of his/her selected habitat. If students choose to make a book, consider one of the formats described on the website - Making Books: http://www.makingbooks.com/freeprojects.shtml. Visual representations should include the information from their charts, but students can also choose to include additional information (i.e. interesting facts, specific examples of habitats). These projects should include photographs and/or drawings of the habitats in addition to written or typed information.

6. Each student writes a one-page essay explaining the ecology, interrelationships and importance of the habitats they have chosen. Essays should answer: What are the characteristics of this habitat? What makes this habitat unique? Why is it important to preserve and restore these habitats?

7. Each student (or small group) should give a three-to five-minute presentation, which includes their visual representation and educates others about the habitat that they researched. While students are presenting, other students will fill in the information on their own chart. To encourage other students to be attentive, the presenter should make their presentation interactive (i.e. with a quiz for the audience, discussion questions).

WRAP-UP

8. Discuss the following questions as a class: What characteristics are shared by these habitats? What species are found in more than one of these ecosystems? How do humans depend on these habitats? What problems might humans cause for plants and animals within these ecosystems? *(Global climate change and its effects, erosion, invasive species, habitat destruction, pollution.)* What problems might nature cause for plants and animals within these ecosystems? *(Global climate change and its effects, erosion, weathering.)* Why is it important to conserve or protect these ecosystems?

9. Students answer the wrap-up questions from above on their student pages.

EXTENSION

A. As a class, take a field trip to an off-campus habitat, or visit a local habitat. Students can take photographs of the habitat and its flora and fauna. Another option would be to ask students to visit a local habitat as a homework or extra-credit assignment to observe and take photographs.

B. Students share their habitat projects with another class or the community (e.g. town/village hall, library, local business). Students can host a "Calumet Habitats Fair" or display their visual representations in the library or during a parent visit night.

ASSESSMENT

See rubric on page 85.

RESOURCES

See Visual Media in the Resource List for additional information, including The Field Museum: N.W. Harris Learning Collection - Burrowing Crawfish and Birds' Nests Exhibit Cases.

NAME

8
LESSON
STUDENT PAGE

Calumet Habitat Research

VOCABULARY

beach
bog
dune
emergent marshes
fen
forested shoreline
lakeplain prairie
ravine
river
sand dunes
savanna
swale
swamp
wetlands

BACKGROUND

Th Calumet Region encompasses some of the most diverse and productive ecosystems in the area. Dramatic sand dunes, lush prairies and grasslands, wetlands and forests characterize some of the unique coastal ecosystems found in the Calumet Region and along Lake Michigan's shoreline.

Unique transition areas — linking land and water — provide critical habitats for many species of plants and animals, some of which are found only in the Great Lakes watershed. Transitional ecosystems include sand dune, wetland (emergent marsh, bog, fen, swamp and swale), beach, lakeplain prairie, savanna, forested shoreline, island, the flowing waters of connected rivers and the open waters of the Great Lakes. Keep in mind all of the different aspects of habitats and how they impact your daily life.

INTRODUCTORY QUESTIONS

1. How do plants, animals and people depend on natural habitats in the Calumet Region?

_____

_____

_____

_____

_____

_____

_____

HABITATS: RESEARCH
On your own or in a small group, research one of the ecosystems of the Calumet Region. Take notes on notecards or on a separate sheet of paper, then fill in one row of the information table with the facts that you learned while researching. Later, while your classmates present information about their ecosystems, fill in the other rows of the table.

HABITATS: A VISUAL REPRESENTATION
It's time to be creative. Create a visual representation of the habitat you researched. This could be a poster, picture book, Web page or other representation. Your visual representation should include the information from the chart above, but you can also choose to include additional information (i.e. interesting facts, specific examples of natural habitats). Your project should include photographs and/or drawings of the habitat.

HABITATS: A WRITTEN REPRESENTATION
Using a computer or a separate sheet of paper, write a one-page essay explaining the ecology, interrelationships and importance of the habitat that you researched. Your essay should answer the following questions: What are the characteristics of this habitat? What makes this habitat unique? Why is it important to preserve and restore natural habitats?

NAME: _____

HABITATS: RESEARCH

ECOSYSTEM	DESCRIPTION	LOCATION	PHYSICAL CHARACTERISTICS	CLIMATE

NAME

FLORA	FAUNA	HUMAN CONNECTION	BIODIVERSITY THREAT	INTERESTING FACTS

Use this space for research notes, to sketch ideas for your visual representation or to outline your essay.

WRAP-UP

2. What characteristics are shared by these habitats?

3. What organisms are found in more than one of these ecosystems?

4. How do humans depend on these habitats?

5. What problems might nature cause for plants and animals within these ecosystems? What problems might humans cause?

6. Why is it important to conserve and protect these ecosystems?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
RESEARCH: Student recognizes different types of habitats and chooses one habitat to research. Student is able to report the location, climate, landscape characteristics, five native plants, five native animals and the human connection to this habitat.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
VISUAL REPRESENTATION: Student creates a visual representation of their selected habitat. Visual representations include all information described in the table, any interesting facts, specific examples of habitat, photographs and/or drawings.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ESSAY: Student explains the ecology, interrelationships, and importance of the habitat they have chosen in a one-page essay. Essay describes the characteristics of the habitat, any unique features, and why it is important to preserve and/or restore this habitat. The essay is well developed and thorough. All ideas are supported with evidence from research. Spelling and grammar are accurate. Sources are cited.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
PRESENTATION: Student educates the class about the habitat they researched through giving a three- to five-minute presentation. Student uses the visual aid they created and interacts with classmates in a group discussion.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
SYNTHESIS: While other students are presenting, student completes the remainder of the habitat table with information presented by their peers. Student asks questions, if needed, to fully complete the table.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Food Web Invasion

Students develop a food web with ten native species and show the impact of two invasive species.

OBJECTIVES

List at least 10 connections between Calumet organisms in a food web

Explain the impacts of changes on a Calumet habitat food web

Diagram a food web that shows the interconnectedness of native species and two invasive species

SUBJECT
Ecology, Biology, Environmental Science

PREREQUISITE
The Great Race for Survival

VOCABULARY
autotroph
decomposer
food chain
food web
heterotroph
invasive species
primary producer
primary consumer
quaternary consumer
secondary consumer
tertiary consumer

MATERIALS
Calumet food chain and food web images
paper
pencils
drawing supplies

TIME/DURATION
90 minutes + presentations

SETTING
Indoors
Outdoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

INVASIVE SPECIES IN THE CALUMET REGION

Invasive species can be native or nonnative species which take over (invade) an area, creating a monoculture which is unhealthy for the ecosystem. Many invasive species travel, often accidentally, from their native ecosystem to a new ecosystem. Waterborne commerce moves millions of tons of cargo annually through the Great Lakes. Shipping is an economically efficient method of transporting raw materials, finished goods and agricultural products. However, shipping can accidentally introduce nonnative species which may be detrimental to the Calumet Region and the Great Lakes ecosystem. There are hundreds of examples of invasive exotic or nonnative species around the world. *See student pages for additional information.*

FOOD CHAINS AND FOOD WEBS

Food chains that show feeding relationships in an ecosystem are part of large and complex foodwebs. By exploring these relationships, students become familiar with the concept of food webs, as well as the different plants and animals that inhabit Calumet habitats. There are many ways to model a food web. It is important that the information on organisms is accurate. Students may be creative with this project – it might be a two-or three-dimensional model. It may take the shape of a puzzle, a web, a mural, a graphic computer-design, or visual model.

PROCEDURE

INTRODUCTION

PART ONE: CALUMET FOOD CHAINS AND FOOD WEBS

1. Students read the background information and answer the introductory questions. Students use the Creature Cards to connect the parts of the food web. The teacher shows the ecosystem food chain and food web as models, pointing out the multiple levels. Discuss how energy is transferred throughout the food web.

2. Assign each student a habitat: sand dune, wetland or prairie. Then, each student will create a food chain of organisms within that habitat. This food chain should include one autotroph (producer) and at least two heterotrophs (consumers): one primary consumer and one secondary consumer.

3. Students divide into groups based on their habitat to create a food web as a group for a sand dune, wetland or prairie. Students who created a sand dune food chain gather with other students who created a sand dune food chain. Each group will combine organisms and connections from their food chains to create a food web with at least 10 organisms from their habitat.

PART TWO: CALUMET FOOD WEBS INVASION

4. Students then "introduce" an invasive species (from the background information on the student pages) into their habitat's food web and discuss the following in a group: What type of impact does the invasive species have on the habitat's food web? Does it eat something that is a food source for another species? Does it occupy the same habitat or niche as another species? Does it eat species that do not have a natural predator (i.e. another invasive species)?

5. Then students introduce a second invasive species into their habitat's food web and discuss the impacts of the second species.

6. Each student then re-draws the food web to show the effect that these invasive species could have on other organisms in the habitat. All of the students' food webs might not look exactly the same, as the invasive species may have different effects on the ecosystem. Students are expected to make predictions based-on learned facts, as scientists do; these should not be considered correct or incorrect, but rather as possible implications to the invasion of a non-native species.

DISCUSSION

7. Make clear the difference between the short- and long-term time scales. The imbalance in ecosystems caused by invasive species may be corrected through evolution, but this happens over a very long period of time (thousands of years). In the more immediate future, invasive species may do considerable damage to an ecosystem.

8. Discuss the following questions with your students. Help them to be inquisitive and to problem-solve: What is the answer to problems caused by invasive species? Do students think that the best solution to this problem is to let the food web take its own course in finding a new balance or to try to control the invasive species? What are the possible ways in which invasives could be controlled in the water? *Preventative measures include: washing off a boat so it does not transport invasive species, electric barriers, regulations on shipping ballast water, separation of waterways. Measures to reduce existing numbers of invasives in the Great Lakes include selective poisoning, introducing predators and interfering with reproduction.* What are the possible ways in which they could be controlled on land? *Remove plant seeds and fragments from clothing, hiking boots, and equipment after enjoying outdoor activities. Learn to identify common invasive plants in your backyard and in the natural areas of your neighborhood, and report these plants to the local Department of Natural Resources.*

PART THREE: INVASIVE SPECIES RESEARCH

9. Students return to their food web groups to research potential solutions to the damage caused by their species.

10. Have students research by looking for articles on their species on the following web site: http://www.glerl.noaa.gov/res/Programs/glansis/glansis.html or http://www.great-lakes.net/envt/flora-fauna/invasive/invasive.html. Each group should read at least two articles on their species and one article on another species.

11. After reading the articles and doing additional research as necessary, students should brainstorm a list of potential solutions. Have each group choose one solution from their list on which to expand.

WRAP-UP

12. Students each write a one-page essay explaining the impact of the invasive species they have chosen and a possible solution to the problem.

13. Student groups each take five minutes to present their issue and the proposed solution to the class.

14. As a class, discuss what can be done to bring about these proposed solutions. What parties (organizations or individuals) in their community or state would be able to affect change?

EXTENSION

A. Integrate Language Arts: Turn essays into proposal letters to send to the local, state or federal political officials who are in the best positions to affect change. If you choose to do this, it is important to first discuss with students that while they are capable of making change, people are not always successful on their first attempt.

ASSESSMENT

See rubric on page 94.

RESOURCES

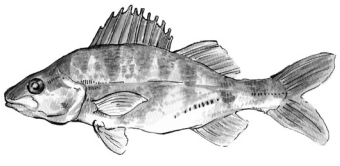
See Resource List for additional information related to native and invasive species.

sun

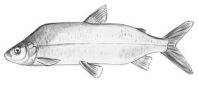
humans

green algae

water strider

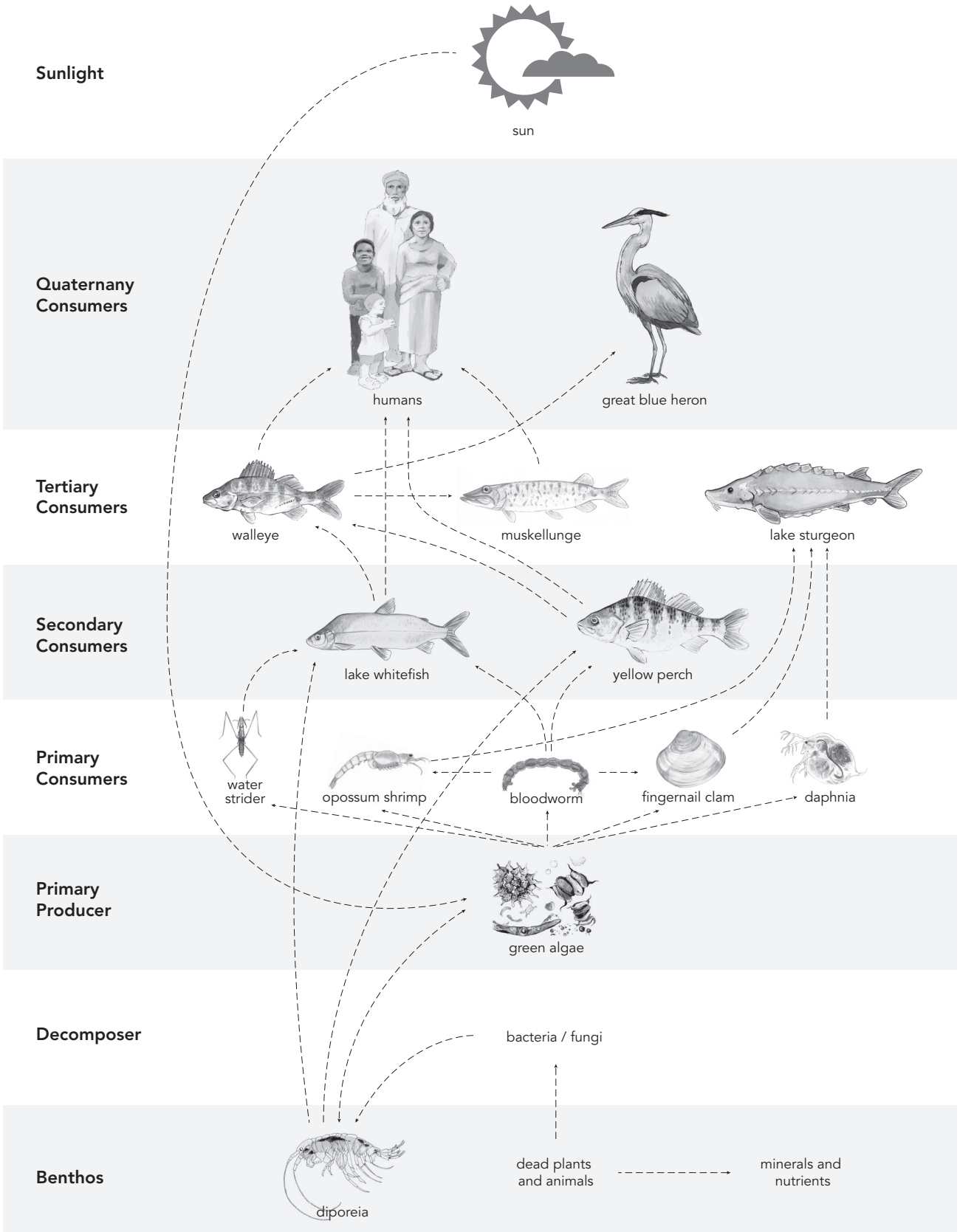


walleye



lake whitefish

CALUMET FOOD WEB



NAME

9
LESSON
STUDENT PAGE

Food Web Invasion

VOCABULARY

autotroph
primary consumer
decomposer
food chain
food web
heterotroph
invasive species
primary producer
primary consumer
quaternary consumer
secondary consumer
tertiary consumer

BACKGROUND

Invasive species arrive, often accidentally, from their native ecosystem to a new ecosystem. There are hundreds of examples of invasive species (also known as exotic or nonnative species) around the world. An "introduced species" is one that has been intentionally brought from their native ecosystem to a new one. Many times invasive or introduced species cannot survive in these new ecosystems or become a non-threatening part of the ecosystem. However, if the new species is successful, one or more native species populations can suffer, altering the ecosystem. The Calumet Region has been altered and has rebalanced throughout history. Our region is dynamic. In this lesson, you should think about how humans and other species have altered the region.

Asian carp are just one of many nuisance animal and plant species that have moved or are poised to move between the Great Lakes and Mississippi River basins via the manmade Chicago Waterway System that has connected the basins for more than 100 years. Other invasive species introduced into the Great Lakes and into the Calumet Region and its many habitats are: rusty crayfish, spiny water flea, common carp, Eurasian ruffe, sea lamprey, zebra and quagga mussels, Eurasian water milfoil, garlic mustard, Japanese barberry, Japanese honeysuckle, multiflora rose, oriental bittersweet, purple loosestrife, spotted knapweed, and tree-of-heaven. Life cycles, behaviors, habitats and the abundance of organisms in the region have been altered by the intentional and unintentional introduction of invasive plant and animal species.

Food chains show feeding relationships, which are woven into larger and more complex food webs within ecosystems. By exploring these feeding relationships, you will become familiar with the concept of food webs, as well as with the different plants and animals that inhabit habitats in the Calumet Region. Throughout this lesson, you will learn about possible problems from, and solutions to, the introduction of invasive species.

INTRODUCTORY QUESTIONS

1. Draw (or write) an example of a simple food chain. Include at least three organisms (plants or animals). These organisms can be from the Calumet Region, or from a habitat with which you are familiar. Use arrows to show the connections between these organisms.

2. What do you think will happen when an invasive species is introduced to an ecosystem?

CALUMET FOOD WEB

Connect the creatures in this food web. Draw arrows to show how energy is transferred from one organism to its consumer. Use the Creature Cards to help you.

Sunlight


sun

Quaternany Consumers

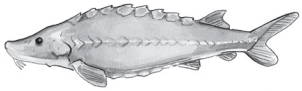

humans


great blue heron

Tertiary Consumers


walleye


muskellunge


lake sturgeon

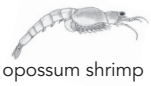
Secondary Consumers


lake whitefish


yellow perch

Primary Consumers


water strider

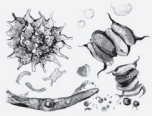

opossum shrimp


bloodworm


fingernail clam


daphnia

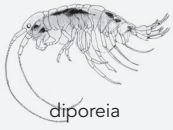
Primary Producer


green algae

Decomposer

bacteria / fungi

Benthos


diporeia

dead plants and animals

minerals and nutrients

FOOD CHAINS

3. Draw an example of a food chain in a _____

Include at least four native species. (write the name of your habitat on the line above)

FOOD WEBS

4. In a group, combine your food chain with the food chains of your classmates who focused on the same habitat. This food web should include at least 10 organisms. These organisms should include both autotrophs and heterotrophs, or producers and consumers. Food webs are complex, and they can be messy. Try to organize your food web by showing the layers of the food web from producer to primary consumer all the way up to quaternary consumers and finally to the top predators. Include the sun and decomposers, too. Connect the organisms with arrows to show how energy moves through an ecosystem's food web.

Sketch a food web for your assigned habitat here. Then, as a group, draw your food web on a large poster or chart paper.

FOOD WEB INVASION

As a group, you will "introduce" an invasive species (chosen from the background section) into the habitat's food web and discuss the following:

5. What type of impact does it have on the habitat's food web?

_____

_____

6. Does it eat species that do not have a natural predator (i.e. another invasive species?)

_____

_____

7. Does it eat something that is a food source for another species?

_____

_____

8. Does it occupy the same habitat or niche as another species?

_____

9. Now, introduce a second invasive species into the habitat's food web. What type of impact does it have?

_____

_____

10. On your own, draw the food web again, but this time include these two invasive species. Show the effect these invasive species would have on other organisms in the habitat. Your food web might not look exactly the same as your classmates'.

WRAP-UP

11. Do you think it is a better solution to let the food web take its own course in finding a new balance or to try and control the invasive species? Why?

12. What are the possible ways in which invasive species could be controlled in the water? On land?

13. What organizations or individuals in their community or in their state would be able to affect change?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
FOOD CHAIN: Student participates in discussion of food web models. Given a specific habitat, student independently draws a food chain that includes at least one autotroph and two heterotrophs.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
FOOD WEB: In a group, student shares his/her food chain and compares it to other possible food chains within their assigned ecosystem. As a group, students draw a food web that includes at least ten organisms from this habitat. Student then introduces invasive species into their habitat and reflects on the effects of invasive species on a food web. Independently, student re-draws the food web to display these changes in the habitat. This food web will include ten native species and two invasive species.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
DISCUSSION: Student actively participates in class discussion about the problems invasive species cause and any solutions to balance or control these organisms.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
INVESTIGATING SOLUTIONS: Student works in their ecosystem groups to research potential solutions to the damage caused by the invasive species using the internet and other resources. Student reads at least three articles (two on their species and one on another) to brainstorm possible solutions.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ESSAY: Student writes a one-page essay explaining the effects of invasive species on an ecosystem. The essay outlines at least one possible solution to a food web invasion. Essay is well-developed and thorough. All ideas presented are supported with evidence from research. Spelling and grammar are accurate. Sources are cited.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Winter Stewardship

Students clear invasive brush, create brush piles, participate in a winter scavenger hunt, and create eco-sculptures.

OBJECTIVES

- Participate in a service-learning field experience at a local adopted natural area
- Identify tree species using a rapid color guide and field guides
- Create sculptures using natural objects

SUBJECT
Biology, Ecology, Art

PREREQUISITE
None

VOCABULARY
biodiversity
brushpile
eco-sculpture
ephemeral
rapid color guide

MATERIALS
waterproof shoes
long pants
heavy winter coat
gloves, scarf, winter hat

TIME/DURATION
3 hours

SETTING
Outdoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

Calumet natural areas contain much diversity, even though it might be difficult for students to see this during the winter months when many plants and animals are dormant. In this lesson, students search for signs of winter life using a rapid color guide (p.100) with images of tree species and a field guide of key animal species' tracks and scat. Students will conduct basic winter tree identification and search for key tree/shrub species (e.g. oak, hickory, ash, maple, buckthorn, honeysuckle) using a rapid color guide (p.100) with images of bud/branch characteristics. Key animal species, including deer mouse, deer, owl and other birds of prey, and coyote, will be identified with field guides. Students may take photographs of uncertain signs for later identification by natural resource staff. All verified species will be added to a site inventory. Students will also look for items on the site steward's "watch list" of potential new invasive species and/or evidence of inappropriate land uses (e.g. all terrain vehicle tracks).

As a reflection activity, students will create outdoor art, called eco-sculptures, an idea from Andy Goldsworthy a British artist who utilizes elements of the natural world to create ephemeral, impermanent pieces. He has created work in England, Scotland, the North Pole, Japan, the Australian Outback, and the United States. Goldsworthy attempts to understand nature by experiencing it closely and participating directly with it, using whatever materials are at hand. Leaves, stones, feathers, snow and ice, twigs, thorns: all make up the unique creations that he then photographs before leaving them in their place to evolve and change. See p. 103 for more information and images of Goldsworthy's eco-sculptures.

For more information about Calumet natural areas, stewardship and service learning, review p. 44 in the Fall Stewardship Day lesson and the student pages of this lesson (pages 97-104).

GENERAL AGENDA

10 minutes **Welcome and overview, including goals for the day and safety brief**
65 minutes **1st Station Rotation Activity**

Group 1: Stewardship Station Rotation Activity

5 minutes Safety brief and demonstration
5 minutes Before photograph
40 minutes Stewardship activities
- Invasive species control (in winter, primarily invasive brush removal; brushpile fire, if possible)
- Seed dispersal, if available
- Litter removal

15 minutes Wrap-up
- Measure and estimate area of work done
- 'After' photo
- Reflection

Group 2: Exploration and Monitoring Station Rotation Activity

5 minutes Explanation of Rapid Color Guides
10 minutes Biodiversity Scavenger Hunt while walking to site
25 minutes Students conduct photopoint monitoring
15 minutes Eco-sculptures
5 minutes Reflection and wrap-up

10 minutes **Break**
65 minutes **Groups rotate to other activity**
15 minutes **Clean up, wrap-up and reflection**

PROCEDURE

STEWARDSHIP ACTIVITIES

1. Photograph the work area at the beginning of the stewardship activities time.

2. Perform invasive species control activities (in winter, primarily invasive brush removal; brushpile fire, if possible, for reflection activities).

3. If available, perform seed dispersal in a designated area.

4. Complete litter removal in the same designated area.

5. Measure/estimate work completed: (e.g. 100 meters2 of brush removed, number of garbage bags of trash collected, gallons of seed collected/dispersed).

6. Take a photo of the work area after the stewardship activities are completed.

EXPLORATION ACTIVITIES

7. Students search for signs of winter life using a field guide and a checklist with images of key species' tracks, scat and other evidence of site use. Key species: deer mouse, deer, owl and other birds of prey, and coyote.

8. Students may take photos of uncertain signs for later identification.

9. All verified species will be added to the site inventory, including basic winter tree ID: students will search for key tree/shrub species (e.g. oak, hickory, ash, maple, buckthorn, honeysuckle) using a checklist with images of bud/branch characteristics.

10. New invaders watch: students should look for items on site steward's "watch list" of potential new invasive species and/or evidence of inappropriate land uses (e.g. ATV tracks).

WRAP-UP

ECO-SCULPTURE ACTIVITY

11. Students divide into small groups and use natural objects to create ephemeral, installation-type sculptures.

12. Discussion: How has the eco-sculpture activity affected your personal connection to nature?

EXTENSION

A. Each group creates a presentation showcasing their eco-sculptures and knowledge on Great Lakes biodiversity. Students include data collected during the Winter Stewardship Day as well as additional research on winter life. There should be an emphasis on native and invasive plant and animal species as covered throughout the lesson.

ASSESSMENT

See rubric on page 104.

RESOURCES

See Visual Media in the Resource List for additional information. In particular, The FIeld Museum: N.W. Harris Learning Collection: Winter Forms of Insects, Winter Trees Identification, and Year Round Residents Exhibit Cases.

NAME: _____

10
LESSON
STUDENT PAGE

Winter Stewardship

BACKGROUND

The natural areas around your home, community and nearest Great Lakes contain much diversity, even though it might be difficult to see this biodiversity during the winter. During the winter season, many plants and animals are dormant. In this lesson, you will search for signs of winter life, by identifying native and invasive plant and animal species.

VOCABULARY

biodiversity
brushpile
eco-sculpture
ephemeral
invasive species
native species
rapid color guide

CIMBY WORKDAY DATA SHEET

School: _____

Site: _____ Date: _____

Start time of workday: _____ Number of students at workday: _____

End time: _____ Number of adult leaders: _____

Please RECORD the type and amount of work accomplished.

1. WEATHER CONDITIONS TODAY (CIRCLE)

Precipitation	Sky Conditions	Wind	Air Temperature (oF):
None Light Moderate Heavy	Clear Partly Cloudy Overcast	Calm Light breeze Windy	

2. AMOUNT OF WORK ACCOMPLISHED TODAY

Please measure the approximate area (m^2) in which you worked as a group:

1st Rotation	_____ m^2
2nd rotation, did you work in a different area than the 1st rotation?	yes no (circle one)
If yes, please measure this new area	_____ m^2

3. TYPE OF WORK ACCOMPLISHED TODAY
Invasive Plant Control

Cut Brush
a. If you cut brush, which species? Check all that apply.

	Common buckthorn (*Rhamnus cathartica*)
	Japanese honeysuckle (*Lonicera japonica*)
	White Ash (*Fraxinus americana*) or Green Ash (*Fraxinus pennsylvanica*)
	Japanese barberry (*Berberis thunbergii*)
	Gray dogwood (*Cornus racemosa*)
	Wild black cherry (*Prunus serotina*)
	Others:

b. Were they verified by CIMBY staff? yes no

Pulled Weeds
a. If you pulled weeds, which species?

	Garlic mustard (*Alliaria petiolata*)
	Yellow sweet clover (*Melilotus officinalis*)
	Others:

b. Pounds or number of bags of invasive species pulled: _____ (lbs) or _____ (# of bags)

Scouted & Flagged

a. If you scouted and flagged, please describe specific action: _____

Trash Pick-up

Did you collect trash today? yes no

If yes, what type of trash?	
How many total bags of trash were collected?	

Seed Collection And Dispersal

Did you collect seeds? yes no

If yes, what species?	
How many gallons?	
Did you spread seeds?	yes no
If yes, what species?	
How many gallons?	

4. Other tasks accomplished:

a. _____

b. _____

c. _____

5. Animal species observed:

	Species verified by steward or CIMBY staff?	Other observations: *(such as number or species observed; what do you think this animal was doing?)*
a.	yes no	
b.	yes no	
c.	yes no	

6. Plants blooming:

	Species verified by steward or CIMBY staff?	Other observations: *(such as number of plants in population)*
a.	yes no	
b.	yes no	
c.	yes no	

7. Other notes or observations: _____

_____

_____

_____

_____

_____

_____

8. Checklist

Before you turn in this data sheet to CIMBY staff, please make sure that you have:

- ❑ Taken a "before" photo of the work area
- ❑ Taken an "after" photo of the work area
- ❑ Taken a photo of your student group
- ❑ Measured the area in which you worked

9. CIMBY PHOTO POINT MONITORING

Camera location: _____

Area: _____ Date: _____

Number of photo points: _____ Observer: _____

Comments: _____ Slope: _____

_____ Aspect: _____

_____ Slope position: _____

Photo point A

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point B

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Notes

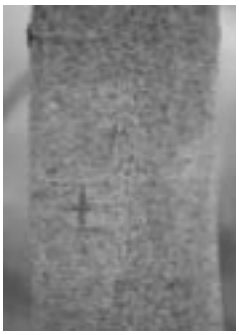
RAPID COLOR GUIDE

version 1 08/2013

An Introduction to Trees of the Chicago Region
Winter Trees of the Chicago Region
The Field Museum

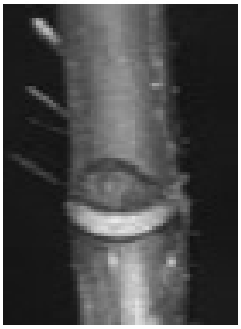
Photos by: John Balaban and Laura Milkert
Produced by: Laura Milkert


1 Acer negundo
Boxelder


2 Acer rubrum
RED MAPLE

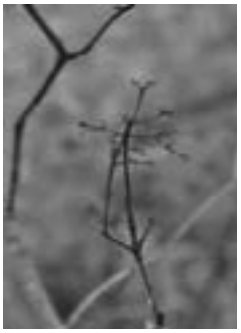

3 Acer saccharinum
SILVER MAPLE

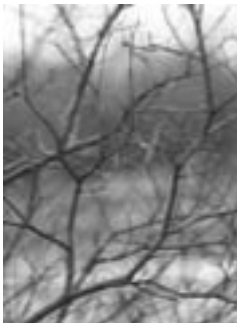

4 Fraxinus sp.
ASH

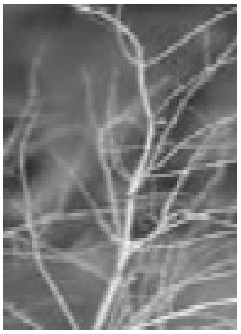

5 Fraxinus sp.
ASH


6 Viburnum opulus
EUROPEAN HIGHBUSH CRANBERRY
EJ


7 Viburnum lentago
Nannyberry


8 Cornus racemosa
GRAY DOGWOOD


9 Cornus stolonifera
RED-OSIER DOGWOOD


10 Lonicera sp.
HONEYSUCKLE


11 Quercus macrocarpa
Bur Oak


12 Quercus macrocarpa
Bur Oak


13 Ramnus cathartica
COMMON BUCKTHORN


14 Rhamnus cathartica
COMMON BUCKTHORN


15 Rhamnus frangula
GLOSSY BUCKTHORN


16 Crataegus
HAWTHORN


17 Prunus serotina
BLACk CHERRY


18 Prunus serotina
BLACk CHERRY

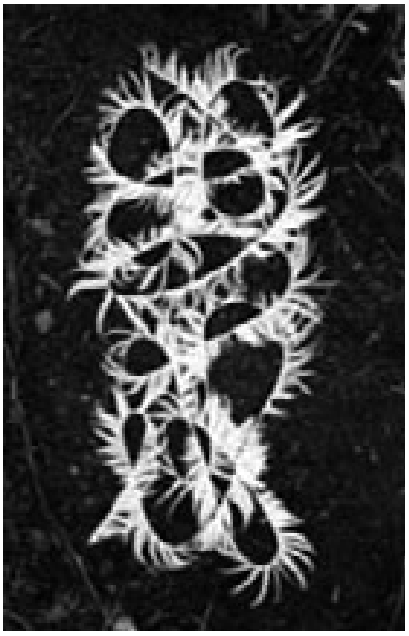

19 Populus deltoides
COTTONWOOD


20 Morus alba
WHITE MULBERRY

WINTER EXPLORATION: ECO-SCULPTURES

Andy Goldsworthy is a British artist who utilizes elements of the natural world to create ephemeral, impermanent pieces. He has created work in England, Scotland, the North Pole, Japan, the Australian Outback, and the United States. Goldsworthy attempts to understand nature by experiencing it closely and participating directly with it, using whatever materials are at hand. Leaves, stones, feathers, snow and ice, twigs, thorns: they all make up the unique creations that he then photographs once before leaving them in their place to evolve and change.

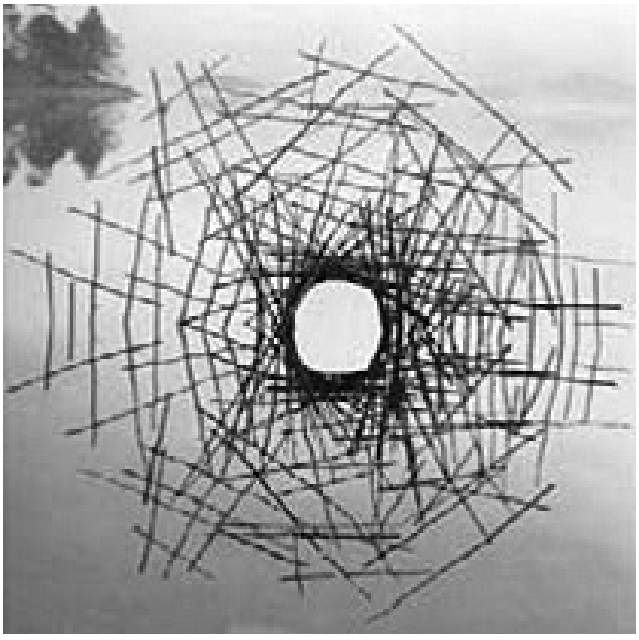
Fine, dry sand



Goose feathers

Ice Spiral: treesoul

"The underlying tension of a lot of my art is to try and look through the surface appearance of things. Inevitably, one way of getting beneath the surface is to introduce a hole, a window into what lies below." - Andy Goldsworthy



Branches, reflections in water

Pebbles, broken and scraped

"Movement, change, light, growth and decay are the lifeblood of nature, the energies that I try to tap through my work. I need the shock of touch, the resistance of place, materials and weather, the earth as my source. Nature is in a state of change and that change is the key to understanding. I want my art to be sensitive and alert to changes in material, season and weather. Each work grows, stays, decays. Process and decay are implicit. Transience in my work reflects what I find in nature." - Andy Goldsworthy

WRAP-UP

How has the eco-sculpture activity affected your personal connection to nature?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
STEWARDSHIP: Student follows all appropriate CIMBY Stewardship Station Instructions for his/her assigned role as: photographer, recorder, or brush pile supervisor. Student accurately fills out all work accomplished for his/her role on the CIMBY Workday Data Sheet.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
RAPID COLOR GUIDE: Student participates in scavenger hunt using Rapid Color Guides. Student searches for key tree/shrub species (e.g. oak, hickory, ash, maple, buckthorn, honeysuckle) using a checklist with images of bud/branch characteristics.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
PHOTO POINT MONITORING: Student records all information on the Photo Points sheet with appropriate site marking and documentation. Student uses GPS to mark points, and takes photos in specified directions.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student works in his/her group to create an eco-sculpture using natural objects. Eco-sculpture is complete and demonstrates a reflection on nature.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Environmental Careers

Students interview environmental professionals to learn about environmental professions, current issues and restoration efforts.

OBJECTIVES

Ask questions related to environmental professions and issues

Self-analyze to identify professions of interest

SUBJECT
Careers, Language Arts, Science

PREREQUISITE
None

VOCABULARY
career
cover letter
job
profession
resume

MATERIALS
Computers with Internet access

TIME/DURATION
75 minutes in class, 30 minutes outside of class

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

This lesson supports students in understanding how diverse the professional field is for environmental careers. Students review a list of careers and conduct interviews with environmental professionals.

Exploring, understanding and communicating about the environment, the Calumet Region, and the Great Lakes are interdisciplinary efforts. They require close collaboration among professionals in science, technology, engineering and math, as well as in public outreach and education.

ENVIRONMENTAL CAREERS

Aquaculture Biologist
Aquarium Curator
Aquatic Biologist
Aquatic/Environmental Chemist
Arborist
Biologist
Botanist
Climate Change Specialist
Coastal Engineer
Coastal Project Manager
Coastal Resources Specialist
Conservation Law Enforcement Officer
Environmental Educator
Environmental Engineer
Environmental Lawyer
Executive Director
Field Specialist
Fisheries Biologist
Forest Ranger
Geologist
GIS Analyst
Information Technology (IT) Specialist
Invasive Species Technician
Inventor
Horticulturalist
Hydrologist
Landscape Architect
Landscaper
Maritime Archaeologist
Naturalist
Natural Resource Manager
Outreach Coordinator
Park Ranger
Physical Limnologist
Planner
Policy Advocate
Principal Investigator
Professor
Recreational Guide and Instructor
Research Scientist
Science Writer
Sustainable Farmer
U.S. Coast Guard
Underwater Filmmaker
Urban Gardener
Urban Planner
Volunteer Coordinator
Water/Wastewater Plant Operator
Water Quality Specialist
Watershed Manager
Wetland Specialist

And many more…

Ask your students to think about and/or research other jobs, careers or professions that are focused on the environment.

PROCEDURE

1. Students read the background information on the student pages and answer the introductory questions: What jobs are of interest to you in the near future and why? Have you researched careers previously? If so, what careers might be of interest to you in the near future, andy why?

2. Explain to students that a job is different than a career, but that a job can lead to a career. For students, choosing a career is an involved process that is based-on a number of aspects, including an individual's interests, skills, work-related values and personality.

3. Students respond to the introductory questions on the student pages: What jobs are of interest to you in the near future? Why? Have you researched careers during school, or on your own? If so, what career(s) might be of interest to you in the future? Why?

CAREER INTEREST INVENTORY

4. If students have not already done so (in another class or with their guidance counselors), ask them to complete a career interest inventory. See the resource list for suggested, web-based, career interest inventories.

CAREER EXPLORATION

5. Students identify environmental professions and professionals to research. Students may choose from the list of professionals on pages 88 and 89, from a career of interest, or by using the following method:

a. Students identify an issue, such as pollution, invasive species, climate change or another current issue.

b. Students identify a location, such as a habitat in water, along the coast, or on land. Student identify whether this is in their local community, state, or country, or if it is international?

c. Students identify a related profession: Using the environmental careers list, students identify a career related to Chicago, or another career that might involve focusing on the issue they identified or living in the location that they chose.

d. Students identify a professional within that career: Teachers assist students in identifying someone within this profession.

6. Students interview a professional using some or all of the following questions:

How did Chicago and/or the Calumet Region and/or the Great Lakes influence your career decision?

Describe a typical day at work.

What skills are necessary for someone in your position?

What entry-level positions are available in your field?

What current issues, such as invasive species, pollution, habitat loss, climate change, or other current issue(s) affect your career?

What change(s) have you affected in the region or in your field?

What goals do you have for your career or your field?

What advice would you give to a high school student interested in an environmental career?

What is your current job and what does it entail?

What was the key factor in your career decision?

What do you like most about your career?

What do you like least about your career?

What are your hobbies?

Who are your heroes/heroines?

What advice would you give to a high school student who expressed an interest in pursuing a career in your field?

Are career opportunities in your field increasing or decreasing and why?

What do you imagine that you will be doing 10 years from today?

Suggestion: While students are waiting to schedule a time to interview a professional, invite a guest speaker to your classroom to discuss his/her profession. Students can ask this person questions from the list above. Another idea would be to connect with the Language Arts teacher or guidance counselor to teach students how to write resumes and cover letters, and how to fill out applications. Students may write these as if they were applying for a job today based on their current employment status and interests, or these can be a prediction of what their resume might look like in the future (after high school, college, etc.). Provide examples of different resumes and formats.

7. Students create profiles for the professional they interviewed, including information on their educational background, previous jobs, related skills, interests, job description, and the answers to the questions above. Use http://marinecareers.net as a model.

WRAP-UP

8. Discussion: What careers are of interest to students? What careers were not researched but are of interest to students? Which of these careers are Calumet-based? Are there ways that someone in the field could give back to the local community?

9. Students can share their profiles, or the teacher can compile them in a book or on a Web site.

10. Students answer the questions on their student pages: Where would you study or train after high school for the job that you have researched? What would you major in, while in college and/or graduate school? What profession would you be a part of? How would you impact your field and/or the Calumet Region?

EXTENSION

A. Students explore their own career interests using a career interest inventory (some schools have a suggested career interest inventory, or teachers may select one from the resource list at the back of the book).

B. Students create profiles for themselves. These can be for the present, or 5, 10, 15 or more years in the future. Where would they have studied or trained after high school? What jobs would they have had in the past? What profession would they be a part of? How would they have impacted their field or the Calumet Region?

ASSESSMENT

See rubric on page 113.

RESOURCES

Chicago Environmental Professionals

See Resource List for additional information related to careers, conservation and restoration efforts and more.

Erika Allen, Chicago and National Outreach Manager
Growing Power
erika@growingpower.org
773/376.8882
www.growingpower.org

Nicole Barker, Executive Director
Save the Dunes
444 Barker Road, Michigan City, IN 46360
nicole@savedunes.org
219/879-3937, ext. 22
www.savethedunes.org

Sue Bennett, Chief of Interpretation
National Park Service, Indiana Dunes National Lakeshore
1100 N. Mineral Springs Rd., Porter, IN 46304
Sue_bennett@nps.gov
219/395-1622
www.nps.gov/indu

Samantha Bingham, Environmental Policy Analyst
Chicago Department of Transportation
30 N. La Salle, Suite 1100, Chicago, IL 60602
Samantha.bingham@cityofchicago.org
312/744-8096

Patricia Bon, Community Gardener
NeighborSpace
patriciabon@gmail.com
312/894-9311
http://neighbor-space.org

Jim Carpenter, Director
Sand Ridge Nature Center
15890 Paxton Avenue, South Holland, IL 60473
james.carpenter@cookcountyil.gov
708/868-0606
http://fpdcc.com/nature-centers/sand-ridge-nature-center/

Zach Clayton, Environmental Engineer
City of Chicago, Bureau of Environmental, Health & Safety Management (EHS)
30 N. LaSalle St, Suite 300, Chicago, IL 60602
Zachary.Clayton@cityofchicago.org
312/744-3161

Benjamin Cox, President and CEO
Friends of the Forest Preserves
542 S Dearborn St, Ste 400 Chicago, IL 60605
benjamin@fotfp.org
312/356-9990
www.fotfp.org

Mollie Dowling, Director
OAI Chicago Southland
180 N Wabash Ave Chicago, IL 60601
mdowling@oaiinc.org
Harvey: 708/339.8173
Chicago: 312/528.3555
www.oaiinc.org

Alex Enarson, Assistant Manager
ReBuilding Exchange
2160 North Ashland Avenue, Chicago, IL 60614
aenarson@gmail.com
773/252-2234
www.rebuildingexchange.org

Catherine Game, Alliance Relations Coordinator
Chicago Wilderness
8 S. Michigan Ave, Ste 900, Chicago, IL 60603
catherine.game@chicagowilderness.org
312/580-2135
www.chicagowilderness.org

Dave Graham, Environmental Engineer
City of Chicago, Bureau of Environmental, Health & Safety Management (EHS)
30 N. LaSalle St., Suite 300, Chicago, IL 60602
Dave.graham@cityofchicago.org
312/744-3639

Mejay Gula, Architect
Rebuild Foundation
mejay.gula@gmail.com
312/752-5263
Skype - mej.gula
http://rebuild-foundation.org

James Hill, Director of Operations (Midwest Region)
Kinder Morgan Liquid Terminal, Northern Area
12200 S. Stony Island Ave, Chicago, IL, 60633
James_hill@kindermorgan.com
708/496-2857

Rafael Hurtado
Little Village Environmental Justice Organization (LVEJO)
2856 S. Millard Ave, Chicago, IL 60623
hurtado_rafa@yahoo.com
773/762-6991
http://lvejo.org

Elsa Jacobson, Region Director
GreenFestival
elsa_jacobson@hotmail.com
773/255-5858
www.greenfestivals.org/chicago

Andy Johnson, Program Manager
Greencorps Chicago
445 N. Sacramento Blvd., Chicago, IL 60612
Andy.johnson@cityofchicago.org
312/746-9775
www.facebook.com/pages/Greencorps-Chicago/254395609920

Edde Jones, Program Director
Greencorps Chicago
445 N. Sacramento Blvd., Chicago, IL 60612
eddejones@cityofchicago.org
312/746-9773
www.facebook.com/pages/Greencorps-Chicago/254395609920

Kristopher Krouse, Executive Director
Shirley Heinze Land Trust
444 Barker Road, Michigan City, IN 46360
land@heinzetrust.org
219/879-4725
www.heinzetrust.org

Katie Larson, Education Coordinator
Alliance for the Great Lakes
17 N. State St, Ste 1390, Chicago, IL 60602
klarson@greatlakes.org
312/445-9726
www.greatlakes.org

Amanda Medress, Corporate Social Responsibility & Sustainability
Edelman
200 E. Randolph St #63, Chicago, IL 60601
Amanda.medress@edelman.com
310/741-9993

Kaye Oberhausen, Associate Director of Development
Openlands
25 E Washington St, Ste 1650, Chicago, IL 60602
koberhausen@openlands.org
312/863-6263
www.openlands.org

Emmanuel Pratt, Director
Chicago State University Aquaponics Center
9501 S. King Drive, Chicago, IL 60628
epratt@csu.edu
773/437-3952
www.csu.edu/biologicalsciences/aquaponics.htm

Elizabeth Redmond, Founder and President
POWERleap
1327 Jones Drive #110, Ann Arbor, MI 48105
elizabeth.redmond@gmail.com
734/646-2853
http://powerleap.net/

Peggy Salazar, Executive Director
Southeast Environmental Task Force
13300 S. Baltimore Ave., Chicago, IL 60633
peggy_setf@sbcglobal.net
773/646-0436
http://setaskforce.blogspot.com

Julie Samuels, Community Garden Organizer
Openlands
25 E Washington St, Ste 1650, Chicago, IL 60602
jsamuels@openlands.org
312/863-6256
www.openlands.org

Mary Eileen Sullivan, Director of Volunteers
Friends of the Parks
17 North State Street, Chicago, IL 60602
sullivanme@fotp.org
312/857-2757 ext. 13
www.fotp.org

Zach Taylor, Program Manager
Greencorps Chicago
445 N. Sacramento Blvd., Chicago, IL 60612
Zachary.taylor@cityofchicago.org
312/287-3566
www.facebook.com/pages/Greencorps-Chicago/254395609920

Carolyn Thomas, Director
God's Gang
godsgang1@ameritech.net
gg60628@aol.com
http://godsgang1.org/

Sean Wiedel, Assistant Commissioner
Chicago Department of Transportation
30 N. LaSalle St, 11th Floor, Chicago, IL 60602
sean.wiedel@cityofchicago.org
312/744-8182

Ryan Wilson, Stormwater Program Manager
Center for Neighborhood Technology
2125 W North Ave. Chicago, IL 60622
rwilson@cnt.org
773/328-7014
www.cnt.org

Kate Yoshida
Office of Sustainability, University of Illinois at Chicago
1140 S. Paulina St. Rm. 117, MC 996
Chicago, IL 60612-7217
kateyoshida@sbcglobal.net
773/561-7143
www.uic.edu/sustainability/about/staff.html

NAME

11
LESSON
STUDENT PAGE

Environmental Careers

VOCABULARY

career
cover letter
job
profession
resume

BACKGROUND

Choosing a career is an involved process that is based on a number of factors, including individual interests, skills, work-related values and personality. People may have many jobs throughout their lives, as they search for a long-term career. It is important to discover the long-standing and lasting values that make you who you are, and what interest and inspires you.

Choosing a career is all about you. You first need to discover who you are as an individual and a future professional in the working world. A self-assessment or career inventory can be helpful as a reflection tool. The result from using this tool will be a list of possible careers based on your interests and values. Obviously you can't do everything on your list, nor will you want to. You will need to do some research to narrow down your focus. Once you have selected a few careers of interest, you should begin to gather more information about these careers. Search to find a job description, outlook for the future of the field (will you be able to find a job?), and required training and education.

INTRODUCTORY QUESTIONS

1. What jobs are of interest to you in the near future? Why?

2. Have you researched careers during school, or on your own? If so, what career(s) might be of interest to you in the future? Why?

CAREER INTEREST INVENTORY

If you haven't already completed a career interest inventory, your teacher can provide you with a link to one. Career interest inventories ask you about your interests, your likes and dislikes and the skills you have to help identify possible careers of interest.

3. What are three possible careers of interest as identified by the inventory?

_____

_____

_____

4. How could someone with this career have a positive impact on the environment? on the Calumet Region? on the Great Lakes?

_____

_____

_____

_____

_____

CAREER EXPLORATION

Choose one of these careers to research. You will interview someone in the field.

Aquaculture Biologist
Aquarium Curator
Aquatic Biologist
Aquatic/Environmental Chemist
Arborist
Biologist
Botanist
Climate Change Specialist
Coastal Engineer
Coastal Project Manager
Coastal Resources Specialist
Conservation Law Enforcement Officer
Environmental Educator
Environmental Engineer
Environmental Lawyer
Executive Director
Field Specialist
Fisheries Biologist
Forest Ranger
Geologist
GIS Analyst
Information Technology (IT) Specialist
Invasive Species Technician
Inventor
Horticulturalist
Hydrologist
Landscape Architect
Landscaper
Maritime Archaeologist
Naturalist
Natural Resource Manager
Outreach Coordinator
Park Ranger
Physical Limnologist
Planner
Policy Advocate
Principal Investigator
Professor
Recreational Guide and Instructor
Research Scientist
Science Writer
Sustainable Farmer
U.S. Coast Guard
Underwater Filmmaker
Urban Gardener
Urban Planner
Volunteer Coordinator
Water/Wastewater Plant Operator
Water Quality Specialist
Watershed Manager
Wetland Specialist

And many more…

Career: _____

Research questions (at least 10):

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

ENVIRONMENTAL CAREERS PROFILE

Career: _____

Where does this professional work? _____

Degree(s) required: _____

(photo)

INTERVIEW QUESTIONS AND ANSWERS

WRAP-UP

5. Where would you study or train after high school for the job that you have researched? What major would you choose in college?

6. What profession would you be a part of?

7. How would this profession impact your local community, Chicago, and the Calumet Region?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
SELF-ASSESSMENT: Student lists jobs that they are interested in and what career-paths they could lead to. Student takes (or has taken in past) a career interest inventory and reveals the careers of interest identified by the inventory and how they could relate to the environmental and the Calumet Region.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
CAREER EXPLORATION: Student identifies an issue and/or location of interest and a career complimenting them. Student identifies a professional within that career to interview and makes a list of at least 10 questions to ask.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
INTERVIEW/PROFILING: Student schedules time to interview a professional. Of the questions previously prepared, student creates a profile for the professional interviewed, including educational background, previous jobs, related skills, interests, and job description.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP UP: Student shares profile and answer the questions in the student pages relating what they have learned to their future plans.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Environmental Leadership Day

Students explore environmental careers and solve real-world problems focused on the environment.

OBJECTIVES

Understand environmental college and career paths by hearing from environmental professionals

Ask questions related to environmental professions and issues

Use critical thinking and communication to solve environmental problems

SUBJECT
Careers, Language Arts, Science

PREREQUISITE
Environmental Careers

VOCABULARY
career
job
profession
sustainability

MATERIALS
worksheet
posterboards
markers

TIME/DURATION
6 hours

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

The Calumet is My Back Yard (CIMBY) annual workshop on environmental leadership brings together environmental professionals currently working in the Chicago region with students from CIMBY's participating high schools. Students see what a career in the environmental field might be like. Working with small groups of students, professionals speak about their career paths and then involve students in a problem-solving discussion about a particular environmental challenge that the professional faces in the course of his/her work.

GENERAL AGENDA

8:00am	Buses depart from schools
9:00-10:00am	Introduction and Icebreaker
10:00-11:00am	1st Career roundtable
11:00-12:00pm	2nd Career roundtable
12:00-1:00pm	Problem-solving with Environmental Professionals and Lunch
1:00-1:30pm	Reporting Out
1:30-2:00pm	CIMBY and FELI Summer Internships
2:00-2:15pm	Closing and Evaluation
2:15pm	Buses return to schools

PROCEDURE

INTRODUCTION AND ENVIRONMENTAL LEADERS ICEBREAKER

1. Randomly distribute multiple copies of each Environmental Leader description to students as they arrive.
2. Instruct students to find others with the same Environmental Leader description and form a circle.
3. Students circulate and introduce themselves, including name, school, grade, and how they are a leader in their community.
4. As a group, students then talk about the environmental leader and what he or she accomplished.
5. Students should choose one word that they would use to describe this person as a leader. Students will write that word on the posterboard.
6. Looking at the posterboards and descriptive words, students have a brief discussion of leadership traits and what it takes to be a leader.

Kimberly Wasserman (1978 –) has lived in the Little Village neighborhood of Chicago most of her life, but like most area kids, she did not know what dangers lurked in the twin plumes billowing from the neighborhood's coal-fired power plants. A 2010 report linked airborne particulate matter from the Fisk and Crawford power plants with 42 deaths, 66 heart attacks, and 720 asthma attacks a year. As Executive Director for the Little Village Environmental Justice Organization (LVEJO), Kimberly formed the Chicago Clean Power Coalition in 2010 to organize community members and decision makers to close the plants. Kimberly and LVEJO achieved success when the plants were officially closed in 2012.

Al Gore (1948 –) served as the 45th Vice President of the United States (1993–2001), under President Bill Clinton. Gore is currently an author and environmental activist. He is the founder and current chair of the Alliance for Climate Protection, the cofounder and chair of Generation Investment Management, the co-founder and chair of Current TV, a member of the Board of Directors of Apple Inc., and a senior adviser to Google. Gore has received a number of awards including the Nobel Peace Prize (joint award with the Intergovernmental Panel on Climate Change) and a Grammy Award for Best Spoken Word Album for his book An Inconvenient Truth. Gore was also the subject of the Academy Award-winning documentary An Inconvenient Truth in 2006.

Van Jones (1968 –) is an American environmental advocate, civil rights activist, and attorney. Jones is a co-founder of four non-profit organizations. In 1996, he founded the Ella Baker Center for Human Rights, a California non-governmental organization (NGO) working for alternatives to violence. In 2005, he co-founded Color of Change, an advocacy group for African Americans. In 2007, he founded Green for All, a national NGO dedicated to "building an inclusive green economy strong enough to lift people out of poverty." In 2011, he founded Rebuild the Dream, a national advocacy organization working towards a fairer economy. His first book, The Green Collar Economy, was released in 2008, which is when he was also named one of Time magazine's "Heroes of the Environment."

Bill McKibben (1960 –) is an American environmentalist, author, and journalist who has written extensively on the impact of global warming. Time magazine described him as "the world's best green journalist." In 2009, he led the organization of 350.org, which organized what Foreign Policy magazine called "the largest ever global coordinated rally of any kind," with 5,200 simultaneous demonstrations in 181 countries. In 2011 and 2012 he led the massive environmental fight against the proposed Keystone XL pipeline project and spent three days in jail in Washington D.C. as leader of one of the largest civil disobedience actions in America for decades. Two weeks later he was inducted into the literature section of the American Academy of Arts and Sciences.

Wangari Maathai (1940 – 2011) was a Kenyan environmental and political activist. She was educated in the United States at Mount St. Scholastica and the University of Pittsburgh, as well as the University of Nairobi in Kenya. In the 1970s, Maathai founded the Green Belt Movement, an environmental non-governmental organization focused on the planting of trees, environmental conservation, and women's rights. In 1986, she was awarded the Right Livelihood Award, and in 2004, she became the first African woman to receive the Nobel Peace Prize for "her contribution to sustainable development, democracy and peace." Maathai was an elected member of Parliament and served as assistant minister for Environment and Natural Resources in the government of President Mwai Kibaki.

Aldo Leopold (1887 – 1948) was an American author, scientist, ecologist, forester, and environmentalist. He was a professor at the University of Wisconsin and is best known for his book A Sand County Almanac (1949), which sold more than two million copies and is considered a must-read classic by environmentalists. Leopold was influential in the development of modern environmental ethics and in the movement for wilderness conservation. His ethics of nature and wildlife preservation had a profound impact on the environmental movement. He emphasized biodiversity and ecology and was a founder of the science of wildlife management. Leopold has been called the father of wildlife management for his work designating wilderness areas with the U.S. Forestry Service.

Rachel Carson (1907 – 1964) was a marine biologist and conservationist whose book Silent Spring and other writings are credited with advancing the global environmental movement. Carson began her career as an aquatic biologist in the U.S. Bureau of Fisheries, and became a full-time nature writer in the 1950s. Late in the 1950s Carson turned her attention to environmental problems she believed were caused by synthetic pesticides. The result was Silent Spring (1962), which brought environmental concerns to an unprecedented share of the American people. Although Silent Spring was met with fierce opposition by chemical companies, it spurred a reversal in national pesticide policy, which led to a nationwide ban on DDT and other pesticides, and it inspired a grassroots environmental movement that led to the creation of the U.S. Environmental Protection Agency.

Chico Mendes (1944 – 1988) was a Brazilian rubber tapper, trade union leader and environmentalist. He fought to preserve the Amazon rainforest, and advocated for the human rights of Brazilian peasants and indigenous peoples. He was assassinated by cattle ranchers in December 1988. He's remembered today for his unparalleled fight against logging and advocacy for sustainable, traditional practices. The Chico Mendes Institute for Conservation of Biodiversity (Instituto Chico Mendes de Conservação da Biodiversidade), a body under the jurisdiction of the Brazilian Ministry of the Environment, is named in his honor.

George Washington Carver (1865 – 1943) researched industrial applications from farm products — a concept that was called "chemurgy" and adopted by conservative agrarians in the late 1920s. Carver is significant in the environmental context because the idea of creating renewable and industrial scale resources from agricultural products was just emerging at a time when the oil, chemical and automotive industries said such systems did not exist or could not work. His ideas, and those of fellow scientists, pointed the way towards the development of biologically compatible paths to sustainable development.

Ken Saro-Wiwa (1941 – 1995) The popular Nigerian author and journalist was executed in 1995 following a mock trial by the Nigerian dictatorship in response to a human rights and environmental campaign. Shell Oil company had a role in both the execution and the environmental damage in the Ogoni homeland, at the mouth of the Niger River. What angered Sawo-Wiwa and others is that the oil industry was able to lift billions of barrels of oil out of Nigeria and yet completely avoid responsibility for environmental cleanup when devastating oil spills, gas flares, pipeline explosions and chemical dumping ruined the land and made simple agriculture impossible for the Ogoni people. His last words were: "Lord, take my soul, but the struggle continues."

Majora Carter (1966 –) is a young economist consultant, public radio host, and environmental justice advocate. Combining urban planning and environmental activism, Majora Carter founded Sustainable South Bronx in 2001 to, as she put it, 'green the ghetto.' Her group raises money and awareness for the area where she grew up, which has been hit hard by some of New York City's worst poverty and—not coincidentally— environmental hazards. Carter earned a MacArthur Genius Grant for her work with the group in 2005.

John Muir (1838 – 1913) America's most influential conservationist, Muir published 300 articles and 10 major books that recounted his travels and explained his naturalist philosophy. John Muir was an activist who worked to save Yosemite Valley, Sequoia National Park and other wilderness areas. In 1892, Muir and friends established the Sierra Club to, as he said, "do something for wildness and make the mountains glad." The Sierra Club is now one of the most important conservation organizations in the United States.

Jane Goodall (1934 –) is a British primatologist, ethologist, anthropologist, and UN Messenger of Peace. Considered to be the world's foremost expert on chimpanzees, Goodall is best known for her 45-year study of social and family interactions of wild chimpanzees in Gombe Stream National Park, Tanzania. [3] She is the founder of the Jane Goodall Institute and has worked extensively on conservation and animal welfare issues. Goodall is a devoted vegetarian and advocates the diet for ethical, environmental, and health reasons. In The Inner World of Farm Animals, Goodall writes that farm animals are "far more aware and intelligent than we ever imagined and, despite having been bred as domestic slaves, they are individual beings in their own right. As such, they deserve our respect."

John Snow (1813 – 1858)— During the cholera epidemics of the late 1840s and early 1850s, physician John Snow realized that cholera is transmitted through contaminated water. Cholera was one of the most widespread and deadly diseases of the 19th century, killing estimated tens of millions of people. Snow was popularly known at the time as the doctor who "broke" the Broad street pump handle because he was tired of waiting for reform. In fact, he convinced the local board of health to shut the pump down after presenting his evidence, and the high profile incident added to calls for sanitary reform.

Michelle Obama (1964 –) Obama's predecessors, Hillary Clinton and Laura Bush supported the organic movement by instructing the White House kitchens to buy organic food, and Obama extended their efforts toward healthy eating by planting the White House Kitchen Garden, an organic garden, the first White House vegetable garden since Eleanor Roosevelt, and installing bee hives, on the South Lawn of the White House. The garden supplied organic produce and honey to the First Family and for state dinners and other official gatherings. In January 2010, Obama undertook the "Let's Move!" initiative to end childhood obesity. Her 2012 book American Grown: The Story of the White House Kitchen Garden and Gardens Across America is based on her experiences with the garden and promotes healthy eating.

Robert Bullard (1946 –) The 'father of environmental justice' sees no distinction between the fight against racism and the fight for environmentalism. Robert Bullard has argued since 1979 that poor minorities have to bear the brunt of the world's environmental problems. In 1979 Bullard's wife, attorney Linda McKeever Bullard, represented Margaret Bean and other African American Houston residents in their struggle against a plan that would locate a municipal landfill next to their homes. The lawsuit, Bean v. Southwestern Waste Management, Inc., was the first of its kind that charged environmental discrimination. Bullard conducted a study that documented the location of waste disposal facilities in Houston and was the first comprehensive account of ecoracism in the U.S. Bullard found that African American neighborhoods were often chosen for toxic waste sites. This discovery prompted Bullard to begin a long academic and activist campaign against environmental racism.

Juan Martinez (1987 –) When he was growing up in South Central Los Angeles, Juan Martinez had an encounter with nature that changed his life. After failing a science class his teacher said he could pass if he joined his school's Eco Club for three months after school. That led to a two-week trip to Wyoming: "Ten years later, I still can't find words to describe the first moment I saw those mountains rising up from the valley," Martinez recalls. "Watching bison, seeing a sky full of stars, and hiking through that scenery was overwhelming." Through tremendous hard work he realigned his life, and after graduating college turned down tempting offers to take jobs that would place him in the wild world he loves so much. Instead he's worked as a national spokesman for getting kids into the outdoors, especially kids from poor communities. He's spoken at conferences at the White House, worked with the Sierra Club and runs the Natural Leaders Network of the Children & Nature Network. He was named a National Geographic Emerging Explorer in 2011.

1ST CAREER ROUNDTABLE

6. Each professional provides a 10 to 15-minute description of what he/she does; his/her profession and organization; high school, college, and career experiences; tips for success; and environmental role.

2ND CAREER ROUNDTABLE

7. Repeat 1st Roundtable with a new group of students.

PROBLEM SOLVING CHALLENGE

8. Guest professional provides background information then explains the environmental challenge.

9. Students work in small groups to understand the problem-solving scenario. Then they fill out the problem-solving worksheet and develop ideas for solving the challenge.

10. Discusion: Bring students together to discuss the problems. Allow students to collaborate with each other and ask for feedback. What is the problem or challenge, and how does it affect them? What potential actions could they take to solve this problem?

11. Students work together to plan a presentation to give to all students. A spokesperson is chosen, major points outlined, and a script developed.

WRAP UP

REPORTING OUT

12. School groups and professionals come back together, and each group explains their challenge and presents their solutions.

EXTENSION

A. Students interview other environmental leaders and find out what they do.
   i. Identify professions, issues, and action strategies for environmental change.
   ii. Prepare questions for, schedule, and conduct an interview

B. Students report back to class with their interview written out in essay format.

ASSESSMENT

See rubric on page 119.

RESOURCES

See Resource List for additional resources on Organizations and Careers.

NAME: _____

12
LESSON
STUDENT PAGE

Environmental Leadership Day

VOCABULARY

career
job
profession
sustainability

BACKGROUND

Today you will be connecting to environmental professionals and hearing about careers in the environmental field. You will learn about real-world problems that these professionals face and the impact these problems have on the Calumet Region. During this session, a professional will tell you about a particular challenge that he/she faces in the course of his/her work. Working in small groups, engage in a discussion to answer the questions below, and come up with a solution to this eco-problem.

INTRODUCTORY QUESTIONS

1. What is the environmental problem or challenge?

2. What is the cause of the problem?

3. What resources would you need to solve this problem?

PROBLEM SOLVING CHALLENGE

4. List two or three potential actions you could take to solve the problem. Think about the pros and cons of each action.

5. What steps are involved in taking the action or actions you listed above? What obstacles might stand in your way?

6. On a separate sheet of paper or on a posterboard, outline your plan of action to present to all students.

WRAP UP

7. What challenges did you learn about in the Calumet region? How do they affect you as an individual living in the region?

8. What leadership traits did you identify today? Think about the Environmental Leader description, the environmental professional you worked with and the traits you feel you have. List 5 traits. Put an asterisk next to the traits you have or would like to develop.

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DISCUSSION: Student contributes his/her input and thoughts on the accomplishments of the assigned environmental leader. Student chooses a word that respectfully and accurately describes the environmental leader.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
GROUP WORK: Student contributes ideas for the Problem Solving Challenge and fills out the problem-solving worksheet completely with his/her group. Student gives feedback in the group discussion.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student cooperates in the group presentation in clearly explaining his/her group's environmental challenge and presenting the proposed solution	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Explore and Restore

Students research Calumet restoration issues and identify organizations and individuals working to alleviate them.

OBJECTIVES

Research organizations and individuals who have positively impacted the Calumet Region and the Great Lakes

Identify current restoration efforts by local organizations

SUBJECT
Social studies, History, Current events

PREREQUISITE
None

VOCABULARY
career
conservation
industrialization
mill
portage
preservation
profession
remediation
restoration
sedimentation
succession
vicinity

MATERIALS
computers with internet access

TIME/DURATION
90 minutes

SETTING
Indoors
Computer Lab

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

Habitats within the Calumet Region were significantly altered following the arrival of European settlers, especially during the last 150 years. Nearly all of the existing forests have been cleared at least once and the forest and the prairie soils suited to agriculture have been plowed or intensively grazed. This, together with the construction of dams and urbanization, has created vast changes in the plant and animal populations. Streams have been changed not only by direct physical disturbances, but by sedimentation and changes in runoff rates due to changing land use, and by increases in temperature caused by the removal of shading vegetation. Although the Great Lakes are large, they are finite and their resources are limited, and the Calumet Region is directly impacted by these resources.

In this lesson, students will read about the history of Calumet, research environmental issues and those who have worked and continue to work to alleviate them. In addition, students will be introduced to organizations working to improve the Calumet Region and to keep the Great Lakes, specifically Lake Michigan, great.

PROCEDURE

1. Discussion: As a class, review Calumet Social and Cultural History and other background information to prepare for a discussion about the importance and the fragility of the Great Lakes, Lake Michigan, and the diverse habitats within the Calumet Region.

2. Divide the class into small groups of students, or individual students may opt to work independently. In small groups (or individually), students will select an issue facing the Calumet Region and/or the Great Lakes. They will then research this issue, such as non-native species, the disappearance of wetlands, or another issue identified during the research process.

a. To aid with research, allow the students to reference the vocabulary list, background information, web addresses for a few resources, the list of "Caretakers of the Great Lakes" and give them access to additional print or online resources as identified by the teacher (see resource list).

b. Using the list of individual "Caretakers of the Great Lakes" from this activity, students will explore how humans have significantly and historically impacted Great Lakes environmental issues. During their research, students should also identify the careers of these individuals.

3. Each student completes the graphic organizer with the information that they acquired during their research.

4. Students share their graphic organizer with another student, a small group or the entire class to summarize the knowledge they have gained and to receive feedback or additional ideas for how to more thoroughly complete their graphic organizer.

5. As a class, compile a list of all of the issues facing the Calumet Region, and/or the Great Lakes. This can be done on the board or using a projector.

6. Discussion: How long has the Calumet Region faced each of these issues? What initially caused these issues? Which organizations are working to address these issues and restore Calumet and Great Lake habitats? How could individuals in the listed professions work to address these issues? How can individuals or citizens help to alleviate these issues?

WRAP-UP

7. Students then answer questions on their student pages: What are the major issues facing Calumet currently? What organizations are working to alleviate those problems and restore Calumet habitats? How can individuals help to alleviate those problems through their professional work or through volunteerism? What additional restoration projects would benefit the Calumet Region? What local restoration efforts could benefit your community and the Calumet Region as a whole?

EXTENSION

A. Each student researches one career from the list in order to identify the qualifications needed to do that job. Students visit web sites of the Great Lakes Restoration Initiative (GLRI) and the Great Lakes Information Network (GLIN) to identify organizations working to preserve, conserve, and/or restore habitats throughout the Great Lakes Basin. Students should find at least two organizations working on each of the GLRI focus issues. Students research the goal or the mission of these organizations and at what level the organizations operate (i.e. federal, state, city, private).

ASSESSMENT

See rubric on page 128.

RESOURCES

See Resource List for additional information related to organizations, careers and more.

NAME

13
LESSON
STUDENT PAGE

Explore and Restore

VOCABULARY

career
conservation
industrialization
mill
portage
preservation
profession
remediation
restoration
sedimentation
succession
vicinity

BACKGROUND

Habitats within the Calumet Region have been significantly altered since the arrival of European settlers, especially during the past 150 years. Nearly all of the existing forests have been cleared at least once, and the forest and prairie soils suited to agriculture have been plowed or intensively grazed. This, together with the construction of dams, urbanization, and industrialization, has created vast changes in the plant and animal populations. Streams have been changed not only by direct physical disturbances, but by sedimentation and changes in runoff rates due to changing land use, and by increases in temperature caused by the removal of shading vegetation.

As many forms of pollution have been controlled and reduced, the importance of habitat is being recognized as critical to the health of the Calumet Region and the Great Lakes. As the physical, chemical and biological interactions of ecosystems are better understood, it has become apparent that no one component can be viewed in isolation. To protect any living component, its habitat and place within the system must be protected. Throughout this lesson, you will research Calumet and other Great Lakes restoration issues and identify organizations and individuals working to alleviate them.

CALUMET SOCIAL AND CULTURAL HISTORY

Native Americans

The Calumet Region was originally a frontier region where hunting, trapping, and fishing were the main activities. Native Americans, and subsequently Europeans and Americans, engaged in these pursuits initially as a means of survival and later as a form of recreation. Before Europeans ever came to the area, Native Americans traveled through the Calumet Region using countless trails that ran along the Lake Michigan shoreline and along the many beach ridges that existed. Area trails included branches of the Sauk Trail and Vincennes Trace. One branch of the Sauk Trail followed Gostlin Street in Hammond and Brainard Avenue in Hegewisch, then turned north at Carondolet Avenue. This trail was later known as the Chittendon Trail and also as Indian Ridge.

It is believed that a Native American village was once located near the Chittendon Trail in the vicinity of 116th and Torrence Avenue. Another major trail followed the Lake Michigan shoreline and crossed the Calumet River at the place where the 92nd Street Bridge crosses the river today. By the time the first Europeans came to the area, the Native American Trails were well known and well-defined, and explorers, hunters and traders used them. These trails were the predecessors of streets, railroad right of ways, highways and expressways. Most diagonal streets in Chicago that run contrary to the street grid system are former Native American trails. Indianapolis Boulevard and the Chicago Skyway, South Chicago Avenue, and Brainard Avenue are all local examples. Native Americans also traveled by canoe on local rivers and used portages in the region. They settled the region in villages of various sizes and in temporary campsites associated with seasonal migrations. There were a few villages, a large one at 79th and the shore of Lake Michigan and another near 134th Street and Wolf Lake, as well as smaller, often temporary, villages scattered throughout the area.

Industrial Development

The story of Chicago's Calumet Region is the story of steel. At one point, the region was one of the largest steel producers in the world. Heavy industry, especially steel mills, came to the area after the Civil War, drawn by natural features compatible with their business. There was cheap land and plenty of it - land that would be used for factories,

bulk storage, and disposal. Freshwater was present - water for cooling necessary in the manufacturing process and water for transportation. Railroads had already crossed the area and linked the area to other regions of the country. There was an available supply of labor and space for housing workers. The region was far enough from Chicago to minimize the negative features of heavy industry on the city and yet close enough to take advantage of the markets of the Chicago metropolitan region.

- 1869 - The Calumet and Chicago Canal and Dock Company was founded by James H. Bowen and other investors.
- 1873 - South Chicago was made a port of entry.
- 1875 - Opening of the Joseph H. Brown Iron and Steel Company rolling mill (later Wisconsin Steel) at 109th and the Calumet River.
- 1880 - North Chicago Rolling Mill (later United State Steel) opened a steel mill at the mouth of the Calumet River.
- 1883 - Grand Crossing Tack Company (later Republic Steel) founded at 79th and South Chicago Avenue moved to the East Side in 1902.
- 1883 - A. Hegewisch opened U. S. Rolling Stock Company in Hegewisch to build railroad cars.
- 1905 - By Product Coke Corporation (later Interlake Steel, then Acme Steel) opened a coke plant on Torrence Ave in South Deering.

Neighborhood Development

South Chicago

The thriving economy of area steel mills brought large numbers of residents into the area. The oldest of the Southeast Side communities was South Chicago. Although it dates its beginnings to 1836, the real development of South Chicago did not occur until heavy industry came to the region after the Civil War. South Chicago was the main "port of entry" for the region. As people moved into the community seeking the jobs offered by local industry, housing was constructed to meet the demand. Most of the surrounding area in South Chicago was developed during the growth years of United States Steel South Works.

South Deering

South Deering dates its origins from 1845 but the history of the community is tied to that of the mill built along the Calumet River near 109th Street in 1875. Both the mill and the community were initially known as Brown's Mill. Later the community came to be called Irondale although this was never the official name of the community. In 1882 the name of the post office was changed to Cummings. Other industries came to the area and built near the river or along Torrence Avenue. Among them were General Mills, Chicago Steel and Wire Company, and By Products Coke Corporation. Some of the richest wetland areas in Chicago are located in South Deering.

East Side

The East Side began in 1851 and derives its name from the fact that it is located on the east side of the Calumet River. The East Side came into being in 1851 when a Potawatomi woman named Togah sold a section of land near present day Calumet Park to George W. Ewing. One of the early names used for the area was the "Island' because of its location between Lake Michigan, the Calumet River and Wolf Lake on the south. Like the other communities on the Southeast Side, it did not develop in earnest until industrialization began after the Civil War.

Hegewisch

Hegewisch is the youngest of the four Southeast Side communities. A. Hegewisch, the head of U. S. Rolling Stock Company, founded it in 1883. Hegewisch wanted to develop a town loosely patterned on the nearby town of Pullman. The plan was to build a factory to construct railroad cars and to sell land for houses in the vicinity of the plant. Hegewisch was also geographically isolated from the other three Southeast Side communities by Hyde Lake and wetland areas. Prior to this transportation link, the community had stronger ties to Hammond, Indiana than to Chicago.

Cultural Diversity

The Calumet Region grew as newcomers were drawn to the area by the numerous jobs available in heavy industry and the jobs necessary to support the growing population of the area. The immigration patterns in the area mirrored those of the country as a whole. The Northern and Western European English, Welsh, and Scotch were followed by Irish, Germans, and Swedes. They in turn were followed by Southern and Eastern Europeans in the latter part of the nineteenth and early part of the twentieth centuries. Polish, Lithuanians, Slovenians, Slovaks, Croatians, Serbians, Italians, Greeks, Hungarians, Eastern European Jews and others became Southeast Siders. During and after World War I, with the decline in European immigration and the immigration quotas of the 1920's, African Americans and Mexicans began to enter the area. In recent years, Puerto Ricans, Arabs, Haitians, Ethiopians, and others have joined these groups.

Mexicans are the fastest growing group in the area at present. Nowhere are these immigration patterns more obvious than in the formation of neighborhood churches and ethnic organizations and institutions.

As the various groups arrived, they brought their culture, customs, and churches. Each succeeding group added to the rich mosaic of multi-ethnic diversity that existed in the area. The groups did not always get along with one another but they learned to live and work together making this one of the most interesting and diverse communities in Chicago. The churches of the Southeast Side tell the story of ethnic succession which occurred in the community. The churches show where the groups settled in the community and the changes that have occurred in the community as it has changed.

- 1857 - St. Patrick's Catholic parish, Southeast Chicago's first church, was founded for Irish Catholics of the region.
- 1874 - German Lutherans organized the first church on the East Side, Bethlehem Lutheran Church.
- 1875 - First Church Evangelical Association, a group of German and Swedish Methodists, organized a congregation, the East Side's second church.
- 1882 - Polish Catholic steelworkers established the first Polish congregation in the area, Immaculate Conception. Eventually four Polish Catholic parishes (Immaculate Conception, Saint Michael the Archangel, Saint Mary Magdalene, and Saint Bronislava) were founded to served the large Polish community of South Chicago.
- 1902 - Agudath Achim-Bikur Cholim Synagogue opens to serve East European Jewish shopkeepers and steelworkers in the South Chicago community. Now the home of an Ethiopian Jewish congregation, it is the oldest continuously operating synagogue in the city.
- 1905 - Polish Catholic parish of Saint Florian opens in Hegewisch.
- 1917 - Ten members of the New Hope Missionary Baptist Church founded Pilgrim Baptist Church, one of the oldest African-American churches in the area.
- 1923 - Our Lady of Guadalupe, the oldest Mexican parish in Chicago, was founded in South Chicago.

The oldest Mexican Independence Day Parade in the city of Chicago has been held in South Chicago since the late 1930's. This annual event continues to be held and is a social highlight of the year for the community. In addition to the above churches and religions, there are many other churches and social and ethnic organizations in the Calumet Region.

Changing Economy / Environmental Concerns

Although the Calumet Region typifies an American success story, there were numerous problems that had to be faced by local residents. In recent years, there were problems with racial and ethnic change in the communities. Many area industries have closed putting thousands of area residents out of work.

- 1980 - Wisconsin Steel closes putting 3500 employees out of work.
- 1990 - Unsuccessful attempt to build the Lake Calumet Airport.
- 1992 - United States Steel closes the South Works plant. At one time the factory employed close to 20,000 workers.
- 1995 - General Mills closes its South Deering plant.
- 2003 - LTV (formerly Republic Steel) and Acme Steel (formerly Interlake Steel) go out of business, closing area facilities.

The region has faced concerns with the damage heavy industry has had on the environment, and a grass roots environmental movement helped fight the spread of landfills and industrial pollution.

Great Lakes Restoration Initiative

In 2010, President Obama made restoring the Great Lakes a national priority when he allocated $475 million to the nation's largest fresh surface water ecosystem. The allocation made history as the largest, most serious commitment to Great Lakes restoration in a U.S. presidential budget. The initiative seeks to stop invasive species from entering the lakes, clean up beaches, remove toxic pollution and restore fish and wildlife habitat.

Focus areas for Great Lakes Restoration Initiative (GLRI) projects include:

- Habitat and Wildlife Protection and Restoration
- Invasive Species
- Nearshore Health and Nonpoint Source Pollution
- Toxic Substances and Areas of Concern
- Accountability, Monitoring, Evaluation, Communication and Partnerships

Visit http://www.glerl.noaa.gov/pubs/brochures/aoc_glri-11.pdf to learn more about the organizations that are currently involved in GLRI projects.

The Future

What does the future hold for the Great Lakes and Calumet Regions? Will industry redevelop the area that still retains many of the natural resources that made it so attractive to developers more than a century ago? Will economic development occur and revitalize the economy of the area? If development occurs, will it be friendly to the environment and to the ecosystem of the area? Will the area return to its historical role as a popular hunting and fishing destination? Will the area become a nature preserve where environmental restoration returns the ecology of the region to a more natural setting?

There is a need for economic development and jobs but not at the expense of the environment. The region has the largest quantity of vacant land in the City of Chicago. It also has some of the best natural and wetland areas, although many are in need of remediation. Some signs are positive. Solo Cup purchased part of the vacant U. S. Steel property for expansion. Ford Motor Company has begun construction for a supplier park near its plant. Portions of former Wisconsin Steel property are available for sale. The National Park Service has proposed creating a Calumet National Heritage Area that would include the area. The City of Chicago has developed a Calumet Region Land Use Plan that sets aside certain areas for industrial use and others for recreational uses as public space. The city also has plans to build an Environmental Education Center in the area.

The dynamic between development and natural preservation continues today, as in the past. The main themes of the Calumet story continue to evolve. The natural and cultural diversity, the continued economic potential of the region, and the renewed interest in this area, along with an enlightened view of the environment, create an opportunity to use the lessons of the past to build a better future for the Calumet Region.

You can learn much more about Calumet and its social and cultural history at http://archive.fieldmuseum.org/calumet/. Just like the Calumet Region, the Great Lakes have undergone many changes over time. Below you will find a list of people who have had strong impacts on the preservation of the Calumet and Great Lakes region.

CARETAKERS OF THE GREAT LAKES

Some environmental heroes from Calumet and the Great Lakes region are:

Dr. Henry Cowles (1869-1939) - Indiana
Professor and scientist in the Indiana Dunes whose studies included "succession."

Dorothy Buell (1886-1977) - Indiana
An English teacher. After she graduated from college, she became a professional reader of current plays and organized book review groups. She helped form the Save the Dunes Council in 1952 and mobilized citizens to push for the creation of the Indiana Dunes National Lakeshore.

Lee Botts (born in 1928) - Indiana
Environmentalist and founder of the Lake Michigan Federation (now the Alliance for the Great Lakes) and the Indiana Dunes Environmental Learning Center.

Marian Byrnes (1925-2010) - Illinois
Educator and environmentalist, preserved natural ecosystems and land in the Calumet area.

Rachel Carson (1907-1964) - Pennsylvania
Environmental writer, author of Silent Spring.

Sigurd Olsen (1899-1992) - Minnesota
Environmental activist and writer, author of Singing Wilderness.

Aldo Leopold (1887-1948) - Wisconsin
Environmental writer and science professor, author of A Sand County Almanac.

Josephine Mandamin (born in 1942) - Thunder Bay, Ontario
Anishinabe elder and environmentalist, founder of Mother Earth Water Walk.

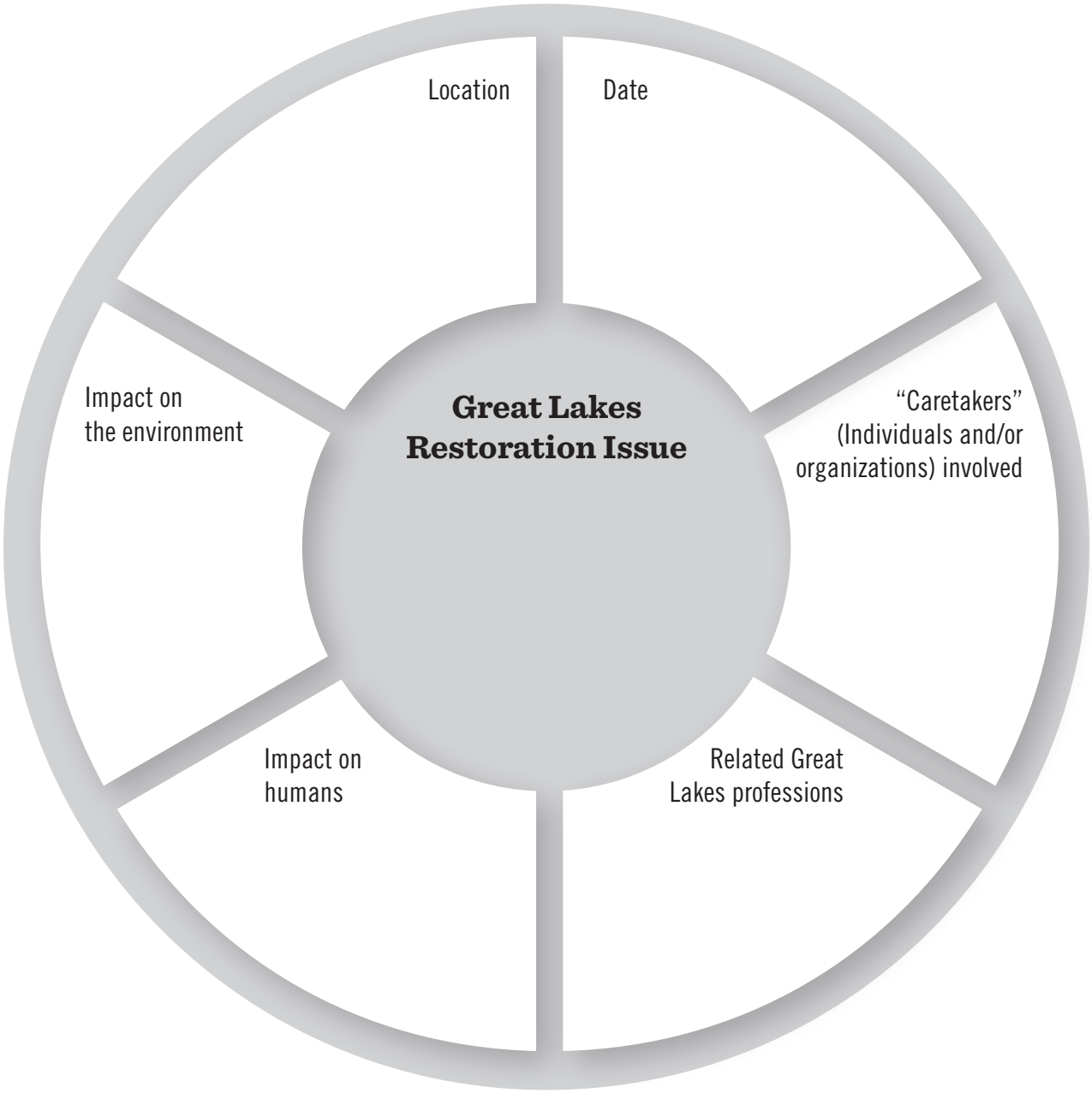
Gaylord Nelson (1916-2005) - Wisconsin
Former U.S. senator, founder of Earth Day, sponsored federal legislation establishing the Apostle Islands National Lakeshore in Lake Superior.

Lorrie Otto (1919-2010) Wisconsin
Naturalist and Milwaukee native who pioneered natural landscaping in the 1970s, spearheaded the successful movement to ban DDT, and founded The Wild Ones.

Sam Speck (born in 1937) - Ohio
Commissioner on the International Joint Commission, former director of Ohio's Department of Natural Resources, helped develop the Great Lakes-St. Lawrence River Basin Water Resources Compact and Agreement.

Gene Stratton-Porter (1863-1924) - Indiana
Environmental writer and photographer.

CALUMET AND GREAT LAKES RESTORATION AND CAREER EXPLORATION:
With your group, conduct research to complete this graphic organizer for one Calumet or Great Lakes restoration issue.



OTHER GREAT LAKES RESTORATION AND ADVOCACY WORK:
A list of organizations engaged in Great Lakes restoration and advocacy work can be found at: http://www.great-lakes.net/links/envt/.

Making connections between restoration issues and professions:
Draw two columns. Write a list of five professions in the left column. Then, write a list of five of the issues facing the Calumet Region today in the right column. Draw lines to connect each of these professions to an issue that could be addressed by someone within that profession.

PROFESSIONS	CALUMET and/or GREAT LAKES ISSUES

WRAP-UP

1. What are some of the major issues currently facing the Calumet Region and the Great Lakes?

_____

_____

_____

_____

2. What organizations are working to alleviate these problems and restore Calumet habitats and the Great Lakes region?

_____

_____

_____

_____

_____

3. How can individuals help to alleviate these problems through professional work or through volunteerism?

_____

_____

_____

_____

_____

4. What additional restoration projects would benefit the Calumet Region and/or the Great Lakes?

5. What local restoration efforts could benefit your community and the Calumet Region as a whole?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DISCUSSION: Student participates in class discussion about the importance and fragility of the Calumet Region and the Great Lakes including the issues that the region faces and what types of organizations are involved in working to address these issues.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
RESEARCH: Student references vocabulary list, background information, web resources, Calumet History, and the "Caretakers of the Great Lakes" list to gain information about restoration work. Students locate and summarize information including: location, date, "caretakers" involved, related profession, impacts on humans and the environment. Student completes the graphic organizer with the information they acquired during their research.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
CAREER CONNECTIONS: Student shares the information they found with their peers. During class discussion, student participates in organizing a list of professions associated with the Calumet Region and the Great Lakes and connects them to appropriate issues that the region faces.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student recognizes the issues that the Calumet Region and the Great Lakes face and the professions and organizations that work towards the goal of restoring these habitats. Student suggests any efforts that could be made in their community that would benefit natural habitats.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Notes

Toxics to Treasures Tour

Students explore natural and industrial sites in the Calumet Region.

OBJECTIVES

Expore the geography of the Calumet Region and its industrial and natural history

Recognize the positive and negative human impacts to the region and the environment

Use critical thinking and communication to develop solutions for environmental problems

SUBJECT
Language Arts, Ecology, Science, History

PREREQUISITE
Explore and Restore

VOCABULARY
advocate
commerce
habitat
locks
moderator
parcel
pollution
restoration
runoff
stakeholder

MATERIALS
None

TIME/DURATION
5 hours

SETTING
Outdoors
Indoors

BACKGROUND

The Toxics to Treasures Tour begins at the Southeast Environmental Task Force. From there, buses will proceed on a tour throughout the Calumet Region, with stops at a number of ecologically and historically significant locations. Students then participate in a mock public meeting, Calumet Mysteries, using information they gathered on the tour.

During this expert-led, interactive bus tour, students will:

1) Visit and gain in-depth knowledge of significant industrial and natural sites and learn to recognize their positive and negative impacts on the region's environment.

2) Analyze development potential for currently vacant and underused areas.

3) Collaboratively develop and present to their peers a vision for environmentally friendly, locally-relevant improvements to these areas (e.g., building nature trails and wildlife viewing platforms on top of closed landfills).

GENERAL AGENDA

9:00am	Buses depart from schools
9:45 - 10:15am	Introduction at Southeast Environmental Task Force
10:15 - 11:15am	Tour of Wolf Lake
11:15 - 11:45am	Ford Supplier Park, Indian Creek, Calumet River
11:45 - 12:00pm	Stop at O'Brien Locks
12:00 - 12:30pm	Tour around Lake Calumet
12:30 - 1:45pm	Intro to Calumet Mysteries (see pages 135-141) and snacks
2:00pm	Buses return to schools

PROCEDURE

1. Students take buses to Southeast Environmental Task Force to pick up tour leaders.

2. Students receive an introduction at Southeast Environmental Task Force (SETF) including an explanation of SETF, advocacy for environmental issues in Calumet, and how the work of SETF supports the community. Students receive agendas, maps, clipboards, and snacks.

3. Students tour Wolf Lake. Students explore: the view of industry across the lake in Indiana, the contrast between nature and industry, bird hunting season, the Nike Missile site, and the Millennium Reserve Initiative.

4. Students visit Ford Supplier Park, Indian Creek, and the Calumet River. Explain to students that the Indian Creek originally flowed from Wolf Lake to the Calumet River, but was blocked with debris and poor water quality. Ford sponsored the Indian Creek Restoration Project, which removed obstructions, restored flow, and replanted the creekbank with native plants. Have students look north up the Calumet River at the industry sites.

5. Students stop at O'Brien Locks.

6. Students tour around Lake Calumet. Students explore: Kinder Morgan Prairie, Indian Ridge Marsh, landfills, Big Marsh, the Calumet Incinerator, the Wisconsin Steel/Asphalt Storage Facility, Harborside International Golf Course (an example of environmentally friendly brownfield development), Lake Calumet, Western Shore, and Pullman.

WRAP-UP

REFLECTION ACTIVITY/SNACKS

7. Introduction to Calumet Mysteries (Lesson 15, page 135-141): Students divide into groups by school to discuss and sketch out ideas for developing vacant or underused areas on large maps.

8. Student collaboratively develops and presents with their school to their peers a vision for environmentally friendly, locally-relevant improvements to these areas (e.g., building nature trails and wildlife viewing platforms on top of closed landfills).

EXTENSION

A. Students independently research a current Calumet issue and write an argumentative essay based on their stance on the issue. The essay is backed by solid evidence and reasoning.

B. Students contact a senator or representative on the issue and express their views from their essay. A list of senators and their addresses can be found at the U.S. Senate's homepage (http://www.senate.gov/general/contact_information/senators_cfm.cfm).

ASSESSMENT

See rubric on page 133.

RESOURCES

See Resource List for additional information related to watersheds.

NAME

14
LESSON
STUDENT PAGE

Toxics to Treasures Tour

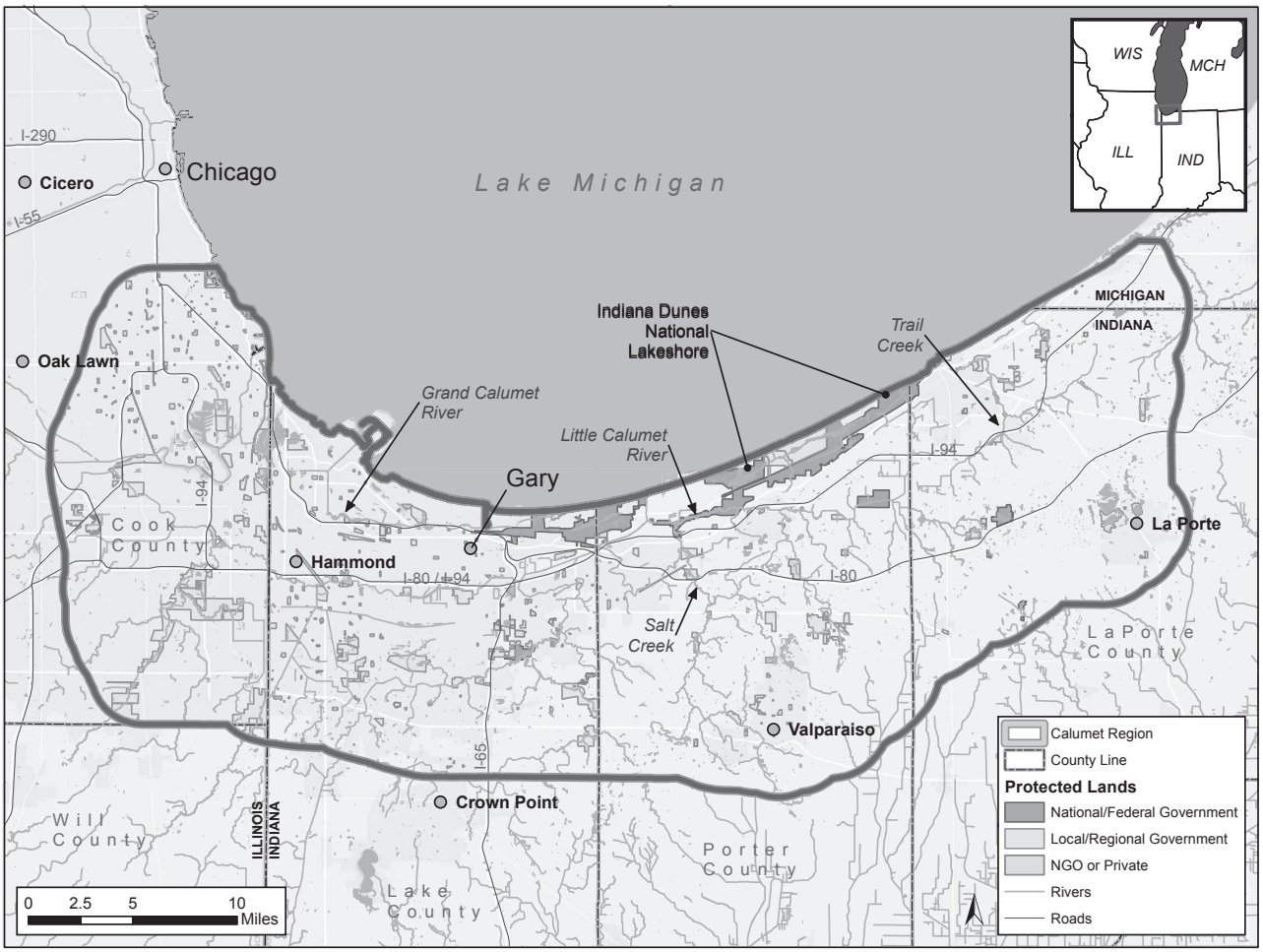
VOCABULARY

advocate
commerce
habitat
locks
moderator
parcel
pollution
restoration
runoff
stakeholder

BACKGROUND

Today you will be going on a tour throughout the Calumet Region, with stops at a number of ecologically and historically significant locations. The Calumet Region is home to more than a dozen significant industrial and natural sites, all of which have positive and potentially negative impacts on the region's environment. While you listen to your tour guide, think about the implications that each of the sites has on you, your home, your family and your community. What vision do you have for the Calumet Region? How would you make it a healthier, more environmentally friendly place to live?

The Calumet Region



WRAP-UP

1. What current issues is Calumet facing?

2. What current issues are the communities within Calumet facing?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DISCUSSION: Student actively discusses his/her developmental ideas within the group. Student's ideas demonstrate knowledge of the visited sites and the ability to recognize the impacts on the region's environment.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student collaboratively develops with his/her group and presents to his/her peers a vision for environmentally friendly, locally-relevant improvements to these areas.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Notes

Calumet Mysteries

Students analyze a problem scenario and host a mock stakeholder meeting to investigate Calumet management issues.

OBJECTIVES

Identify and role-play the participants in an open space stakeholder meeting

Weigh risks and benefits of city planning decisions

Defend one view on an environmental issue related to Calumet open space

SUBJECT
Ecology, Biology, Chemistry, Urban Planning, Debate, Land Management

PREREQUISITE
Explore and Restore, Toxics to Treasures Tour

VOCABULARY
advocate
commerce
debate
habitat
moderator
parcel
pollution
public meeting
restoration
stakeholder

MATERIALS
scenarios
chart paper
library access
internet access

TIME/DURATION
60 minutes

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

Public meetings are held in local or relatively large communities to debate or discuss issues, including land management and watershed planning. Students will discuss a scenario, and debate the issue as it relates to Calumet restoration and habitat management. They will also take on different roles and look at different perspectives as they debate and research Calumet issues, discussing the pros and cons of the issue.

Debates can range from having detailed and formal structures, like Lincoln-Douglas Debates, which are presented by some debate teams (see resource list for more information). Debates can also be simple and informal, such as when students are paired to research and discuss the pros and cons of an issue. As they identify, research, and argue about complex ideas, students will hone their skills in critical thinking, organization, persuasion, public speaking, research and teamwork.

PROCEDURE

PART ONE: LARGE AND SMALL GROUP DISCUSSIONS

1. During the Toxics to Treasures Tour, speakers will introduce topics related to Calumet land use, restoration and habitat management. Ask students to consider what current issues Calumet is facing. What current issues are the communities within Calumet facing?
2. Discuss what makes a good debate. Have students brainstorm a list of ideas for ways to make the debate successful. *The list might include: listening to each other, talking loudly enough for others to hear, being polite, choosing a moderator to facilitate, etc.*
3. Students will be assigned a Stakeholder Group. Copies of each stakeholder group description can be printed ahead of time and distributed to students on the same team. One teacher will be assigned the role of moderator. The moderator calls the class to order.

4. Introduce the Calumet Mysteries worksheet to the students. Ask students to read the worksheet and their assigned Stakeholder Group role. Then students will work in teams to create solid arguments for the roles provided to them.

5. Students should review their own roles, as well as the roles of others within the community. Students will fill in answers to the questions and create a written summary of the statements that they would like to contribute to the debate. In addition, students should write a summary of their personal beliefs on the issue.

PART TWO: (MOCK) PUBLIC MEETING

6. Each Stakeholder Group will have two minutes to make an initial statement. Once this is complete, each will have two minutes to make counter-arguments.

7. Introduce the moderator. The moderator (the educator, or another student) calls the class to order. One or two students can also be assigned as observers, so that they can keep notes for the moderator or for the group.

8. The group should attempt to come to some sort of consensus, or the moderator can make the final decision.

9. Observers should report on their observations. Discuss as a class: What was positive about the public meeting? How could it have been more effective?

WRAP-UP

10. Students use their observations of the public meeting and their written summaries to answer the journal questions and discuss them as a class.

EXTENSION

A. Students conduct independent research on a Calumet issue using the library, Internet and/or teacher's resources.

B. Students write an essay summarizing the Calumet Case Study that was debated in class. The essay should explain their stance on the issue. The opinions should be backed up by facts found through independent research and/or from the background information that was provided.

C. Have students research other current issues facing the Calumet Region and host a public meeting as they did with the scenario from the student pages.

D. Students write a letter to their senator or representative expressing their views on Calumet land use and protection. A list of senators and their addresses can be found at the U.S. Senate's homepage (http://www.senate.gov/general/contact_information/senators_cfm.cfm).

ASSESSMENT

See rubric on page 141.

RESOURCES

See Resource List for additional information related to resources and organizations, watersheds and more.

PRINT MULTIPLE COPIES OF THIS SHEET. CUT AND DISTRIBUTE INDIVIDUAL STAKEHOLDER GROUP DESCRIPTIONS TO TEAMS OF STUDENTS.

ENVIRONMENTAL ADVOCATES

You see this as an opportunity to create a natural wetland area. The parcel sits next to a forest preserve, so it makes perfect sense to extend the preserve to include this parcel. Beneath the waste and contamination left by the steel company is the potential for a richly bio-diverse natural wetland ecosystem that is rare in the area. You also see this project as a springboard for similar projects you'd like to do throughout the area on similar vacant industrial sites.

HOUSING DEVELOPER

You are interested in building affordable housing on the site. New affordable housing hasn't been built in the area for almost a decade. With housing prices increasing rapidly, you feel that affordable housing is the most important issue for the community. You have been looking for a site to build new housing for the last few years. This site's proximity to the forest preserve, jobs at the chemical plant, and stores across the street make it perfect for a housing development.

CHAMBER OF COMMERCE

You would like to see new retail stores built on this site. In the last few years, businesses have left the community, leaving a huge need for jobs. You are interested in bringing businesses and jobs to the area, not parks. Since there are already some shops across the street trying to stay in business, you see this as a good location to build something new.

CHEMICAL PLANT

You run a large chemical plant that sits next to the parcel. You would like to purchase the land yourself and keep it vacant, or at least stall this process as long as possible to prevent another business, or the Forest Preserve, from taking over. You like the fact that the parcel of land has been abandoned because it provides a buffer between your factory and areas where people go. You are constantly worried about your chemicals spilling and harming the public.

DEPARTMENT OF TRANSPORTATION

You would like to build a new bus barn for the southeast side on the site. The existing bus barn is in horrible shape. It has a leaky roof and is not big enough to hold all the buses. This makes it harder to keep the buses in good shape. Every year there are more and more bus breakdowns because of the inadequate bus barn. You feel that it is in the interest of the whole city to build the bus barn.

MAYOR

You would like to build a new Chicago Park District building for the southeast side on the site. You want to make this building the most environmentally-friendly building in the city. The building would help area residents make their homes and businesses more environmentally friendly. The City of Chicago recently finished a similar project on the north side called the Chicago Center for Green Technology that has been a huge success.

NAME

15
LESSON
STUDENT PAGE

Calumet Mysteries

VOCABULARY

advocate
commerce
debate
habitat
moderator
parcel
pollution
public meeting
restoration
stakeholder

BACKGROUND

Read the Calumet Case Study below and Stakeholder Group information. Use what you learned from the Toxics to Treasures Tour, and by taking on the role of the Stakeholder Group assigned to you, to participate in a mock public meeting to discuss and debate these topics.

CALUMET CASE STUDY

A 100-acre parcel of land in Calumet lays vacant. It was once the site of a company that crushed steel and sold it to area manufacturers. The company went bankrupt fifteen years ago, and left significant amounts of waste behind. The 100-acre parcel sits between a chemical plant and a forest preserve. Across the street are a few stores that were once used frequently, but now are struggling to stay in business. City officials (a moderator and/or an independent panel of high school students) have been empowered to decide what to do with the parcel. After hearing proposals from different groups, they will make a decision.

STAKEHOLDER GROUPS

Environmental Advocates

You see this as an opportunity to create a natural wetland area. The parcel sits next to a forest preserve, so it makes perfect sense to extend the preserve to include this parcel. Beneath the waste and contamination left by the steel company is the potential for a richly bio-diverse natural wetland ecosystem that is rare in the area. You also see this project as a springboard for similar projects you'd like to do throughout the area on similar vacant industrial sites.

Housing Developer

You are interested in building affordable housing on the site. New affordable housing hasn't been built in the area for almost a decade. With housing prices increasing rapidly, you feel that affordable housing is the most important issue for the community. You have been looking for a site to build new housing for the last few years. This site's proximity to the forest preserve, jobs at the chemical plant, and stores across the street make it perfect for a housing development.

Chamber of Commerce

You would like to see new retail stores built on this site. In the last few years, businesses have left the community, leaving a huge need for jobs. You are interested in bringing businesses and jobs to the area, not parks. Since there are already some shops across the street trying to stay in business, you see this as a good location to build something new.

Chemical Plant

You run a large chemical plant that sits next to the parcel. You would like to purchase the land yourself and keep it vacant, or at least stall this process as long as possible to prevent another business, or the Forest Rreserve, from taking over. You like the fact that the parcel of land has been abandoned because it provides a buffer between your factory and areas where people go. You are constantly worried about your chemicals spilling and harming the public.

Department of Transportation

You would like to build a new bus barn for the southeast side on the site. The existing bus barn is in horrible shape. It has a leaky roof and is not big enough to hold all the buses. This makes it harder to keep the buses in good shape. Every year there are more and more bus breakdowns because of the inadequate bus barn. You feel that it is in the interest of the whole city to build the bus barn.

Mayor

You would like to build a new Chicago Park District building for the southeast side on the site. You want to make this building the most environmentally-friendly building in the city. The building would help area residents make their homes and businesses more environmentally friendly. The City of Chicago recently finished a similar project on the north side called the Chicago Center for Green Technology that has been a huge success.

INTRODUCTORY QUESTIONS

1. Write three sentences summarizing the background information related to the Calumet Case Study. Think about what was discussed on the Toxics to Treasures Tour and what you know about the Calumet Region.

2. My stakeholder group in the public meeting is: _____

3. Brainstorm a list of issues or opinions that are relevant to your stakeholder group.

4. Write three to six sentences summarizing how you and your group will contribute to the public meeting on behalf of your stakeholder group.

5. Write two to three sentences summarizing your personal beliefs on the issue. Explain if they are similar to, or different from, those your stakeholder group will voice in the public meeting.

6. Write your opening statement here: (You will have two minutes to present this statement).

PUBLIC MEETING

7. Make notes here during the public meeting for your counter-argument: (You will have two minutes to present this).

WRAP-UP

8. How has your initial stance on the issue changed or not changed as a result of the public meeting?

9. What makes this a difficult issue to debate?

10. Which group do you believe had the strongest argument? Explain why you feel it was strong.

11. What made this public meeting work well?

12. What aspects of the public meeting could be improved?

13. Why is it important to learn about and listen to all sides of an issue?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
BACKGROUND: Student reads the background information of the scenario that the class will debate. Student uses additional resources to brainstorm and writes a summary that will describe his/her stakeholder's opinions in the debate. Student writes another summary describing their personal belief on the issue and if it is the same or different than his/her stakeholder group. Student prepares an opening statement for the debate.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ROLE PLAY: Student is well prepared for the debate and actively participates in character. Student uses background information that has been researched with validating points. Student speaks loud and clear, listens to others while they speak their opinions, and is polite. Student takes notes during the debate to use for counter-argument and follow-up questions in student pages.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ESSAY: Student conducts further research on the Calumet issue that was debated. Student writes an essay explaining the student's stance on the issue with at least three documented resources. Spelling and grammatical errors are minimal.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Create-a-Watershed

Students orient themselves to the Great Lakes region using maps and learn about watershed management and water pollution.

OBJECTIVES

- Identify the Great Lakes watershed on a map
- Describe a watershed
- Locate a local watershed(s) on a map
- Research point and nonpoint source pollution in the local watershed

SUBJECT
Geography, Chemistry, Ecology, Geology

PREREQUISITE
A Sense of Place

VOCABULARY
acid mine drainage
algal bloom
aquifer
groundwater
hydrologic cycle
infiltration
impervious surface
land cover
nonpoint source pollution
point source pollution
pH
sediments
stakeholder
surface runoff
transpiration
tributary

MATERIALS
computers with internet access and Google Earth installed, or one computer with a projector.

For each group of four students:
- two spray bottles
- five toothpicks with flags
- food coloring, cocoa powder (optional: chocolate chips or candies)
- 9" by 13" glass baking dish (or clear plastic container of a similar size)
- pencils
- sand
- maps: world map, Great Lakes watershed map (one for each student plus one for the classroom), local watershed map (one for each student)

TIME/DURATION
90-120 minutes

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

A watershed is an area of land drained by a body of water. For example, all of the water that falls in the Great Lakes Basin eventually drains into one of the Great Lakes. All land is a part of a watershed. Watersheds are nested within each other. The Great Lakes Basin is the land that makes up the Great Lakes watershed. Within the Basin, each lake has its own watershed (see map). Within the lake, watersheds are smaller watersheds of land that drain into rivers.

However, as watersheds become more developed and have an increased number of impervious surfaces (rooftops, parking lots, and roads), more water is blocked from soaking into the ground. As stormwater runs across the land, it picks up and transports pollutants to our lakes, rivers and streams. These pollutants can degrade biotic communities, prevent recreational uses and contaminate water supplies. *See student pages for additional background information.*

PROCEDURE

1. Students read the background information and respond to the questions on the student pages.

2. Ask students to describe three large landforms that determine where water ends up in North America. Remind them that water always flows downhill, which is why topography is important. *1. The Rocky Mountains (water flows to the Pacific); 2. The Appalachians (water flows into the Atlantic), and in between the Appalachians and the Rockies, the water flows into the Gulf of Mexico; 3. The Great Lakes (water flows into the north Atlantic).* This is a simplistic explanation, but it will spark a discussion about watersheds.

PART ONE: CAUSE AND EFFECT -- *THE INTERCONNECTEDNESS OF A WATERSHED*

3. Use the "Cause and Effect Cards" that are part of this activity. Hand out "effects" to half of the class, so that several students are assigned each effect. Give the other half of the class the "causes" of these problems. Each student should find a partner in order to match the causes and effects. Give each student two copies of the cause or the effect, so that they can give one copy to their partner. Each student should have a complete set. Cause cards are numbered 1-7 and effect cards lettered A-G. Cards match-up accordingly: 1F, 2C, 3B, 4E, 5A, 6G, and 7D.

4. Make several groups so that each cause-effect or watershed problem is represented in each group. Have each student group put these problems in order of most to least important if these issues were to arise in their community's watershed. Which cause-effect watershed problems would affect you and your family? The school?

5. As a class, discuss the various causes and effects. Have groups report out their most important and least important cause-effect relationships and describe why they place more or less importance on different issues.

PART TWO: LAB ACTIVITY -- *A MODEL WATERSHED*

6. At lab tables or in small groups, have students fill a glass baking dish with sand (a similarly shaped, transparent plastic container can also be used). Allow students to form a "landscape." The landscape should include a lot of variety, with hills, ridges, plains and/or depressions.

7. Students draw a sketch of their watershed model. This should include the key elements of a map, as learned in "A Sense of Place" (title, key/legend, cardinal directions or north arrow, scale and labels).

8. Explain to the student that the food coloring will represent pollution.

9. Students are to place five drops of food coloring or cake dye in the following locations:

a. At three places buried in the sand (in the groundwater)

b. At three places on the sand (on the surface or ground level)

10. Choose three places in the landscape to spray water, simulating rain. Mark them with toothpicks with flags. Caution the students not to use the spray bottle until they are directed to do so. Ask students to guess where the water will go when sprinkled on the landscape. Have them point out the toothpick or draw arrows in the sand to mark the water flow. At each of the marked locations, students will use spray bottles to distribute water, or will gently pour water, over the landscape. They should watch carefully to see where the water goes. Did it follow their flags or arrows? Why did the water flow the way it did? (*Water will flow down hills and collect in the basins. If you choose to use sand, some of the water will sink in. This mimics water flow in the natural world. Gravity is the force affecting this flow.*)

    Have students point out the bodies of water and the rivers that formed. Explain that an area drained by a body of water is called a watershed. Have students find the watershed for the larger bodies of water in their landscape. Ask them if they notice anything about the water poured over the tops of their hills or ridges. *Water poured over the top of a point will probably flow in both directions, into different watersheds.* These points mark the boundaries between watersheds. Consider using cocoa powder instead of colored water or food that will melt or that has colors that will run (chocolate chips, or other candy) to place in the landscape and simulate pollution (have students think of what pollution they want to represent in their watersheds) and animal waste in the ecosystem. You can also make marks with dots of another color to indicate pesticides and insecticides. Re-spray the landscape and have the students observe and discuss what happens. *Remind students that water flows downhill and eventually ends up in the sea. You can see where water goes by using topography.*

PART THREE: POLLUTION WITHIN A WATERSHED -- *POINT AND NONPOINT*

11. On student page, tell students to draw a picture of the watershed model that they created in small groups. Using their watershed model as a visual example, ask students to brainstorm real-life pollution sources. They should answer the questions individually.

12. In small groups or as a whole class, students discuss what problems communities might face in identifying pollution sources. What makes it more difficult to identify nonpoint source pollution in a watershed?

WRAP-UP

13. Ask students to think of watersheds in the natural landscape. What body of water is nearby? What land do they think is a part of its watershed? Are they standing in a watershed now? *(Every place is in a watershed!)* Tell students that they will look at maps to find their watersheds. If desired, have students sketch the landscape that they've created.

14. How does pollution in your watershed impact the people living in your watershed? How does it impact the ecosystem and the species living within this watershed?

15. If you were to discover a pollution source or other problem within your watershed, what would you do as a community? If you were to organize a meeting to discuss this issue, what stakeholders would you invite? How would you structure the discussion to reach a solution to this problem?

EXTENSION

A. You may do this research in advance or with the class. Go to: http://cfpub.epa.gov/surf/locate/index.cfm or another website from the resource list to locate your watershed and find out information about it.

i. To find out more about your watershed, click on: *Environmental Websites Involving This Watershed*. Scroll through the list of web sites and look for a general site about your watershed. Click on the link. The screen will say: *You are now exiting the EPA web server*. Click on the blue link. If you do not find a general web site about your watershed, try http://www.great-lakes.net.

B. Have students mark their watershed on a Great Lakes map with a highlighter. These maps are not very detailed, so you may wish to use them in conjunction with more detailed maps of your area. Comparing the two maps, have students find their watershed on the more detailed map. This will give them a better orientation. They can look for their school and homes on the map, as well.

ASSESSMENT

See rubric on page 152.

RESOURCES

See Resource List for additional information related to watersheds and more.

CAUSE-AND-EFFECT: POLLUTION IN OUR WATERSHED

CAUSE - 1

As power plants produce electrical energy, the pressure and temperature within and surrounding their generators increase. Power plants are often developed near a body of water, such as a river or lake. To reduce the heat and pressure, water is used for cooling purposes. This water is taken in from a nearby body of water, such as a river or lake. After the water is used, it is discharged into the lake. Excess heat is discharged and thermal, or heat, pollution often results.

CAUSE - 3

Areas dense in agricultural activities often see increased amounts of nutrients, phosphorus and nitrogen, in the local watershed. This is because some farmers use mass amounts of fertilizer containing phosphorus and nitrogen and during precipitation events, like storms, this fertilizer runs off into local streams and lakes.

CAUSE - 2

Groundwater and surface water can be considered a single resource, because they are connected. Although gasoline on the surface of pavements, such as driveways, parking lots and roads appears to just sit there, this gasoline can be washed away with the rain into permeable surfaces, or into our stormwater drains or local waterways. This is an example of nonpoint source pollution. On the other hand, a leak from an underground gasoline tank would be considered point source pollution. Underground storage tanks (USTs) are prone to corrosion and leaks. If a UST leaks, the petroleum or hazardous substances stored in the UST may contaminate nearby groundwater. Groundwater pollution is a huge concern because the many communities' use groundwater as a drinking water resource. It is difficult, time intensive, and costly to clean contaminants from groundwater.

CAUSE - 4

Acid mine drainage is a huge concern in many places near mining operations. Acidic run-off with a low pH arises when iron or aluminum minerals and water become exposed to oxygen. A low pH level means that little to no life can persist. Because of this, acid mine drainage is a large threat to ecosystem health.

CAUSE - 5

The coastal city in which you live has a combined sewer system, which carries both sanitary sewage and stormwater to a treatment plant. In the event of a heavy rainstorm, the combined system may exceed its holding capacity due to an increased amount of stormwater entering the system, and, as a result, this combined sewage is discharged directly into nearby waters. This is referred to as a combined sewer overflow, or CSO, and can results in sewage discharge with E. coli levels up to 250,000 CFU/ 100 mL.

CAUSE - 7

Monitoring data shows high levels of phosphorus near the lake's shoreline. Phosphorus pollution is associated with the growth of algae, which proliferates during warm weather then washes ashore and decays, sending up foul-smelling odors in the hot summer sun that deter swimmers and others from using the beach. The algae can also harbor potential human pathogens such as Salmonella. Additionally, a changing climate is occurring as a result of natural and human induced processes. Burning of fossil fuels and changes in land use (i.e. deforestation) has accelerated climate change beyond an expected natural rate of change. Climate change has resulted in areas of heavy rain and localized flooding, extreme drought and increasing temperatures. Increasing temperatures and changes in weather patterns have caused some plants, including algae, to bloom earlier in the year.

CAUSE - 6

One of the most common ways pharmaceutical compounds enter our watersheds are through our wastewater. Humans and animals alike are given medications, however, their bodies do not fully metabolize or absorb them. The excess drugs are excreted as waste. Another possible cause would be from unused prescription medications that are flushed down the toilet or some other drain by humans. These drugs then enter our wastewater. If effluent isn't treated, these traces of pharmaceuticals may be discharged into our watersheds. Not all wastewater treatment plants can remove these chemicals from the water. The long term effects of pharmaceutical pollution are not known, but there are ways to dispose of pharmaceuticals in a safe way. Pharmacies, nursing homes, hospitals and residents are prompted to bring their unused medications to a "take-back" or safe disposal location.

EFFECT - A

Today, a few of your nearby Great Lakes beaches were closed due to high levels of E. coli in the water. While E. coli is commonly found in low levels most everywhere in the environment, it can cause illness in humans. Humans and most warm-blooded animals carry it in their systems, and excrete it in their fecal matter. The U.S. Environmental Protection Agency recommends that there be no more than 235 CFU ("Colony Forming Units" or cells) per 100 mL in recreational waters. At one of these beaches, you notice a large pipe upstream from where you usually swim at this beach. What may have caused these increased levels of E. coli in the water?

EFFECT - B

The Illinois Department of Natural Resources (IDNR) has identified an algal bloom in a local lake. Algal blooms occur when excessive nutrients from fertilizers allow bacteria and algae to grow beyond the natural level and deplete the oxygen that fish and other wildlife in the ecosystem need to survive. Where do you think extra fertilizer is coming from to destroy the native ecosystem of this lake?

EFFECT - D

It's early spring, but the sun is shining and there is algae growing on the surface of the lake. Lately, the lake has an increase in algae, including some large algal blooms. What could be causing these algal blooms?

EFFECT - C

The United States Geological Survey (USGS) has been assessing the groundwater near underground storage tanks (USTs) filled with petroleum that are located near a gas station in your community. Why do you think the USGS has been carefully monitoring the USTs?

EFFECT - E

Yesterday, the pH level of a river was measured and it was extremely low, or acidic. The color of the stream was also a bright orange. Geoscientists are exploring where this acidity could have originated from, because the river isn't directly connected to any industry. This river is one of the few remaining functioning rivers in this mining town and the health of the river is crucial to the functioning of the community. Where do you suppose the abnormal acidity is originating from?

EFFECT - F

The Environmental Protection Agency (EPA) has recently discovered increased temperatures in a river populated with several power plants. Where do you think this heat pollution is coming from?

EFFECT - G

Trace amounts of pharmaceutical chemicals were found in the local drinking water supply. Scientists are concerned about the health effects of drinking these low-level concentrations over an extended period of time. The public is notified immediately if certain regulated contaminants are found in the drinking water supply, however there are no requirements to notify if pharmaceuticals are detected. How do you think these pharmaceutical chemicals are getting into our watersheds?

NAME

16
LESSON
STUDENT PAGE

Create-a-Watershed

VOCABULARY

acid mine drainage
algal bloom
aquifer
groundwater
hydrologic cycle
impervious surface
infiltration
land cover
nonpoint source pollution
point source pollution
pH
sediment
stakeholder
surface runoff
transpiration
tributary

BACKGROUND

A watershed is the area of land drained by a body of water. For example, all of the water that falls into the Great Lakes Basin eventually drains into one of the Great Lakes. All of this land is part of a watershed. Watersheds are nested within each other. The United States could be divided into Atlantic and Pacific watersheds, then into smaller watersheds of rivers and lakes and then into even smaller watersheds of the tributaries of rivers. The Great Lakes Basin is the land that makes up the Great Lakes watershed. Within the basin, each lake has its own watershed (see map). Within the lake, watersheds are smaller watersheds of land that drain into rivers. Within the Great Lakes system, water flows from Lake Superior and Lake Michigan to Lake Huron, through Lake St. Clair into Lake Erie, over Niagara Falls and into Lake Ontario before flowing through the St. Lawrence River into the ocean. Rivers and streams transport nutrients, dissolved gases, salts and minerals, sediments and pollutants from watersheds into the Great Lakes.

When precipitation falls on the land, most of it infiltrates the soil, evaporates, is taken up and transpired by plants, or runs across the surface of the land into our waters as surface runoff. Under natural conditions, a relatively small amount of water leaves as surface runoff, while the majority of the water soaks into the ground or is taken up by plants. Soil and plants absorb the water and provide the natural filtration of pollutants. Some water that infiltrates the soil remains near the surface, where it gradually moves downhill, through the soil, and eventually into a nearby stream or water body. Some of the water may infiltrate much deeper, into the aquifers. Water can travel long distances or remain in storage for long periods before returning to the surface. The amount of water that will soak in over time depends on the land cover and soil characteristics and the slope of the lane. In many communities and along many shorelines, more impervious surfaces (rooftops, parking lots, and roads) are being developed within watersheds, and thus more water is blocked from soaking into the ground. Water then remains on the surface and becomes stormwater. Stormwater, either discharging from the end of a pipe or entering a body of water after flowing over the land, is a key threat to water quality. Stormwater may carry a variety of substances as it makes its way to the water: grit, oils and litter from city streets and parking lots; waste from domestic and wild animals; nutrients such as phosphorous from lawns, gardens and farms; yard waste; and sediment and bacteria. All of these substances can harm water quality.

Nonpoint source (or NPS) pollution comes from many different, diffuse sources and is extremely difficult to regulate and control, which makes it a hazard facing the Great Lakes today. NPS pollution is mainly caused by runoff, when rain and snowmelt move over the land, picking up pollutants along the way and eventually dumping the pollutants into rivers and lakes. Some common NPS pollutants include fertilizers and pesticides from agricultural lands and homeowners; oil, grease and salt from highways; sediment from construction sites and eroding shorelines; and animal and human waste.

In contrast, point source pollution is when pollutants enter a waterway though a specific entry point, such as a drainpipe draining directly into a river or lake. Industrial water discharges and sewage treatment plants are the main culprits of this type of pollution. Point source pollutants can include many different organic and inorganic substances, including human waste and toxic metals. Point source pollution can be traced to a specific discharge point and owner; therefore, it has been the easiest source of pollution to control and regulate, although it continues to be a problem.

Atmospheric pollution (or air deposition), which comes from the sky, is another form of nonpoint source pollution. As water moves through the hydrologic cycle, it falls as rain or snow and then evaporates into the air from land and surface

water. Pollutants emitted into the air, such as through smoke stacks, follow this same path, and can be carried through the atmosphere and deposited into waterways hundreds of miles away from their sources. Acid rain is a well-known form of atmospheric pollution. The major sources of atmospheric pollution include coal-burning energy plants and waste incinerators. The combustion of fossil fuels and waste (such as that from hospitals) produces large amounts of mercury, which travel into the air. Mercury is a toxic chemical that is fatal to humans and animals in large quantities. Phosphorus and polychlorinated biphenyls (PCBs) are also transported to waterways via air deposition.

Because water does not follow our municipal and political boundaries, communities must work together to address nonpoint source pollution and the impacts of land use decisions on our water resources. Watershed management is an effective way to cross traditional boundaries and bring people in different regions together to effectively manage land, increase public understanding and awareness about water quality issues, and promote better stewardship of private and public lands. Watershed management integrates scientific and social considerations to take a holistic approach to protecting and improving a water body. By the end of this lesson, you will understand the issues facing watersheds and you will identify techniques for remediating these issues.

INTRODUCTORY QUESTIONS

1. What are three main features that determine how water flows in North America? (Hint: Think big.)

2. What are two examples of point source pollution? What are two examples of nonpoint source pollution?

LAB PROCEDURE/QUESTIONS

PART 1: CAUSE AND EFFECT -- POINT AND NONPOINT SOURCE POLLUTION

3. Which cause and effect watershed problems would affect you and your family? The school?

4. What were the most important cause-effect relationships? What were the least important cause-effect relationships? Describe why you placed more or less importance on different issues.

PART 2: LAB ACTIVITY -- A MODEL WATERSHED

5. Form a "landscape" in a glass baking dish using sand. Your landscape should have a lot of variety, such as hills, ridges, plains and depressions.

6. Place five drops of food coloring or cake dye (pollution) in the following locations:
   a. At three places buried in the sand (in the ground water)
   b. At three places at the surface (ground level)

7. Choose three places on the landscape to spray water, simulating rain. Mark them with toothpicks with flags.

8. Either point the toothpick flag or draw arrows in the sand to mark where you think the water will flow.

9. Now, spray water on these surfaces, and observe where the water flows.

PART 3: POLLUTION WITHIN A WATERSHED -- POINT AND NONPOINT SOURCES

10. Sketch a simple map of your watershed model. Include the five key elements of a map: title, key/legend, cardinal directions or north arrow, scale and labels.

11. Draw arrows to show where the water drains.

12. Identify sources of pollution and delineate between point and nonpoint source pollution. Label pollution sources as either **P** (point source pollution) or **N** (nonpoint source pollution).

13. What makes it difficult to identify, monitor and address nonpoint source pollution in a watershed?

WRAP-UP

14. Describe how water flows in a watershed.

15. What are the problems associated with point and nonpoint source pollution?

16. What are impervious surfaces and what is their connection to pollution sources in a watershed?

17. Based on your understanding of watersheds, where would the best location be if you were building a house in this watershed? Where would you build a school or park? Why?

18. What can you do to decrease pollution problems in your watershed?

19. If you were to discover a pollution source or other problem within your watershed, what would you as a community do?

20. If you were to organize a meeting, what stakeholders (people who are interested and/or involved in the topic being discussed) would you invite?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
BACKGROUND/QUESTIONS: Student reads background information about watersheds, nonpoint source pollution, and point source pollution and answers introductory questions in the student pages.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WATERSHED ISSUES: Student identifies cause and effect relationships between issues within a watershed and the effects they have on the watershed. Students work together to discuss these issues and determine how important they are to the community's watershed. Student shares his/her views with the rest of the class.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
MODELING: Student works with a group to construct a model of a landscape consisting of hills, depressions, ridges and plains. Student applies food dye (pollution) at different locations (above and below the ground), and predicts where the water will flow by marking with toothpicks or flags. Student simulates precipitation by using a spray bottle of water in three areas of the model, observing how the water flows through the watershed.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
MAPPING: Student sketches a map of the watershed model. All five key elements of the map are included (title, key, cardinal directions or north arrow, scale and labels), arrows are used to show the water flow direction, and point and nonpoint sources of pollution are labeled. Student uses model and map to answer the wrap-up questions to discuss with the class.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Spring Stewardship

Students pull invasive garlic mustard and collect water samples for chemical and macroinvertebrate testing.

OBJECTIVES

Participate in a service-learning field experience at the local adopted natural area

Plan and carry out an investigation of water samples from a local water source

Analyze and interpret water quality tests

SUBJECT
Biology, Chemistry, Ecology

PREREQUISITE
Create-a-Watershed
Wet Your Waders CD-rom (see Resources on p.150)

VOCABULARY
dip-netting
drainage
ecotype
macroinvertebrate
sedimentation

MATERIALS
waterproof shoes
long pants
old clothes
gloves
nets
water testing kits

TIME/DURATION
3 hours

SETTING
Outdoors

BACKGROUND

As an essential part of scientific studies, collecting data can be an interesting and worthwhile endeavor for students. This activity allows students to practice collecting data related to ecosystem health.

During the spring stewardship experience, students will restore the local habitat by removing invasive species (in most cases, pulling garlic mustard) and determining the health of a nearby water feature. Students will test the chemistry of a water sample and conduct a biological inventory of macroinvertebrates.

Chemical testing will look at the following indicators:

pH: refers to the acidity of the water. Lower number means more acidic, higher number means more basic. Values in the range of 6.5 to 8.5 are normal.

Dissolved Oxygen (DO): a measure of oxygen content in the water. Oxygen is critical for the survival of fish and other wildlife in the water. Decreases in DO stress the ecosystem. There may be natural fluctuations in the DO level due to seasonal variations in temperature; however, pollution can also impact the DO of the water. Bacteria, algae, and other organic matter consume oxygen, causing DO levels to drop. DO levels below 5 mg/L will cause ecosystem stress; 1-2 mg/L will result in fish kills.

***E. coli*/Fecal Coliform/Enterococcus Bacteria**: These bacteria are used as indicators to determine if fecal matter is present in the water and to evaluate if a body of water supports safe recreational use. Beach monitoring typically involves testing for *E. coli* and sometimes fecal coliform to determine if the water is safe for swimming. Enterococci is another bacteria that is used as an indicator. Enterococci is traditionally used to monitor marine bathing water, but it is also suitable to use as an indicator for freshwater. The U.S. EPA recommends the posting of beach advisories if a measurement of E. coli exceeds 235 cfu/100 mL. If enterococci levels are above 61 cfu/100mL, this could also lead to a beach advisory. Elevated bacteria levels can be due to a few full diapers on the beach, bird droppings, or sewage discharges after a heavy rainfall.

Phosphate and Nitrate (or Phosphorus and Nitrogen): concentration of nutrients such as phosphorus and nitrogen influence the growth rates of organisms in the water. If there is an excessive amount of nutrients, particularly phosphorus, algal blooms can appear. Algae is slimy and smells bad. Some types of algae can release toxins, as well. Algal blooms result in decreased DO content. Excessive nutrients can come from sewage treatment plants or agricultural (fertilizer or animal waste) runoff. The U.S. EPA recommends that the total amount of phosphorus should not exceed 0.05 mg/L in a stream at a point where it enters a lake or

reservoir, or 0.025 mg/L within the lake or reservoir. The recommended levels of nitrogen and nitrogen compounds (nitrate, nitrite, ammonia) are site specific and depend on the type of habitat.

GENERAL AGENDA

10 minutes Welcome and overview, including goals for the day and safety brief
65 minutes 1st Station Rotation Activity

Group 1: Stewardship Station Rotation Activity

5 minutes	Safety brief and demonstration
5 minutes	Before photograph
40 minutes	Stewardship activities - Invasive species control (in spring, focus on pulling garlic mustard; do not remove invasive brush in sensitive areas where new vegetation could be trampled and soil could be compacted) - Seed collecting and dispersal, if available - Litter removal
15 minutes	Wrap-up - Measure and estimate area of work done - Record blooming, migrating species observed - 'After' photo

Group 2: Exploration and Monitoring Station Rotation Activity

5 minutes	Explanation and demonstration of water monitoring
25 minutes	Dip-netting and water sampling, macroinvertebrate search
10 minutes	Share observations and results
15 minutes	Walk to photo monitoring location and exploration of site
10 minutes	Listening reflection

10 minutes Break
65 minutes Groups rotate to other activity
25 minutes Clean up, wrap-up and reflection

PROCEDURE

STEWARDSHIP ACTIVITIES

1. Photograph the work area at the beginning of the stewardship activities time.

2. Perform invasive species control activities (in spring, focus on pulling garlic mustard; do not remove invasive brush in sensitive areas where new vegetation could be trampled and soil could be compacted)

3. If available, perform seed collecting and dispersal in a designated area.

4. Complete litter removal in the same designated area.

5. Measure/estimate work completed: (e.g. 100 meters2 of brush removed, number of garbage bags of trash collected, gallons of seed collected/dispersed, pounds of garlic mustard pulled).

6. Record blooming, migrating species observed.

7. Take a photo of the work area after the stewardship activities are completed.

MONITORING ACTIVITIES

8. Water quality testing in groups of 5, students gather samples and specimens for tests: dip-netting, photographing and identifying types of aquatic macroinvertebrates, water depths, drainage patters.

9. Identify species or record observations for future verification. Species can be added to site inventory.

10. Test for DO, pH, phosphates, nitrates, fecal coliform, temperature, and turbidity.

11. Look for evidence of pollution and sedimentation with images of common pollution effects in water.

12. Monitor general site characteristics: landmarks, large trees, ecotype boundaries.

PHOTO POINT

13. If located within walking distance of work area and water testing area, group locates the site's permanent photo points and takes photos.

WRAP-UP

SPRING SOUNDS LISTENING REFLECTION EXERCISE

14. Students find individual spots to enjoy 5 minutes of solitude in nature. Students can listen for calling frogs, migrating birds and more.

EXTENSION

A. Have the students participate in the Alliance for the Great Lakes' ongoing Adopt-a-Beach™ program: http://www.greatlakesadopt.org or participate in the International Coastal Cleanup, which occurs on the third Saturday of every September: www oceanconservancy.org.

ASSESSMENT

See rubric on page 163.

RESOURCES

See Compact Discs in the Resource List for additional information, including Wet Your Waders - an interactive field trip to a stream near you

See Resource List for additional information related to wetlands and more.

NAME: _____

17
LESSON
STUDENT PAGE

Spring Stewardship

BACKGROUND

Today you are collecting data related to ecosystem health. You will take part in stewardship, exploration and monitoring activities where you will pull invasive garlic mustard and collect water samples for chemical and macroinvertebrate testing.

VOCABULARY

dip-netting
drainage
ecotype
macroinvertebrate
sedimentation

CIMBY WORKDAY DATA SHEET

School: _____

Site: _____ Date: _____

Start time of workday: _____ Number of students at workday: _____

End time: _____ Number of adult leaders: _____

Please RECORD the type and amount of work accomplished.

1. WEATHER CONDITIONS TODAY (CIRCLE)

Precipitation	Sky Conditions	Wind	Air Temperature (oF):
None Light Moderate Heavy	Clear Partly Cloudy Overcast	Calm Light breeze Windy	

2. AMOUNT OF WORK ACCOMPLISHED TODAY

Please measure the approximate area (m^2) in which you worked as a group:

1st Rotation	_____ m^2
2nd rotation, did you work in a different area than the 1st rotation?	yes no (circle one)
If yes, please measure this new area	_____ m^2

3. TYPE OF WORK ACCOMPLISHED TODAY
Invasive Plant Control

Cut Brush
a. If you cut brush, which species? Check all that apply.

	Common buckthorn (*Rhamnus cathartica*)
	Japanese honeysuckle (*Lonicera japonica*)
	White Ash (*Fraxinus americana*) or Green Ash (*Fraxinus pennsylvanica*)
	Japanese barberry (*Berberis thunbergii*)
	Gray dogwood (*Cornus racemosa*)
	Wild black cherry (*Prunus serotina*)
	Others:

b. Were they verified by CIMBY staff? yes no

Pulled Weeds
a. If you pulled weeds, which species?

	Garlic mustard (*Alliaria petiolata*)
	Yellow sweet clover (*Melilotus officinalis*)
	Others:

b. Pounds or number of bags of invasive species pulled: _____ (lbs) or _____ (# of bags)

Scouted & Flagged

a. If you scouted and flagged, please describe specific action: _____

Trash Pick-up

Did you collect trash today? yes no

If yes, what type of trash?	
How many total bags of trash were collected?	

Seed Collection And Dispersal

Did you collect seeds? yes no

If yes, what species?	
How many gallons?	
Did you spread seeds?	yes no
If yes, what species?	
How many gallons?	

4. Other tasks accomplished:

a. _____

b. _____

c. _____

5. Animal species observed:

	Species verified by steward or CIMBY staff?	Other observations: *(such as number or species observed; what do you think this animal was doing?)*
a.	yes no	
b.	yes no	
c.	yes no	

6. Plants blooming:

	Species verified by steward or CIMBY staff?	Other observations: *(such as number of plants in population)*
a.	yes no	
b.	yes no	
c.	yes no	

7. Other notes or observations: _____

_____

_____

_____

_____

_____

_____

8. Checklist

Before you turn in this data sheet to CIMBY staff, please make sure that you have:

- ❑ Taken a "before" photo of the work area
- ❑ Taken an "after" photo of the work area
- ❑ Taken a photo of your student group
- ❑ Measured the area in which you worked

CIMBY WATER MONITORING DATASHEET

School: _____

Site: _____ Date: _____

Type of Water Body (stream, pond, etc.): _____

Monitor's Names: _____

_____

Step 1: Land Use Survey. Use all senses to observe land around the water body you're monitoring. Record everything that might impact the watershed – stormwater runoff, erosion, pollution from neighboring industry, recreational use, etc. Record assets and positive features too.

Land Uses in the Watershed	Yes	No	Think about potential problems or threats to water quality. Is there a problem here? Why?
Residential Areas			
Is it high density housing (apartments)?			
Is it low density housing (single family homes)?			
Do storm sewers drain into ponds or streams?			
Do storm sewers drain into a city sewer system?			
Is there dumping of trash?			
Could lawn treatment chemicals wash from residents' yards into ponds/streams?			
Could pet waste be washing into ponds/streams?			
Are neighbors helping take care of the watershed via stewardship cleanup days, etc.? (A positive impact!)			
Other residential uses?			
Schools			
Litter?			
Erosion and polluted stormwater runoff from bus and car traffic?			
Is the land covered by impermeable pavement?			
Is the land covered by grass?			
Are teachers/students helping take care of the watershed with a school garden, native plantings, or cleanup days? (Another positive impact!)			
Other school uses?			
Commercial/Industrial Areas			
Are there businesses or industries nearby? (e.g., powerplant, steel mill, municipal sewage processing, auto pound, train/truck transportation of goods, etc.)			
Are there garbage landfills nearby?			
Is there a lot of truck traffic?			
Is there dust in the air from coal, limestone, dirt, etc. that could settle in the water?			
Is there factory smoke that could contain toxins that will settle into nearby water bodies?			

Land Uses in the Watershed	Yes	No	Think about potential problems or threats to water quality. Is there a problem here? Why?
Construction Areas			
Is there new construction of buildings nearby?			
New roadways?			
Is the construction site managing dust and erosion when stormwater hits bare soil?			
Is there trash from the construction process?			
Public Use Areas			
Are there public use areas nearby? e.g., park, golf course, airport, bus/train station, marina/shipping port, fishing, sports, and other active recreation, etc.			
Would maintenance of these areas affect the watershed?			
Is there runoff of lawn chemicals from a golf course? Are mowers cutting the grass?			
Are there trails? Do they get a lot of use? from foot traffic and/or ATV traffic? Are they in good shape or do they erode a lot when storms come?			

Step 2: Record any effects from recent weather events or man-made disasters. (e.g., a big storm came through yesterday and caused flooding which stirred up mud from the pond or stream bottom; or, a nearby chemical plant accidentally released several tons of toxic chemicals into the river.)

Describe known (or suspected) weather event or disaster	Date of event	The effect it appears to be having on water bodies?	What could it mean for the health of the watershed?	How might this be avoided in the future?

Step 3: Water Chemistry Survey. Use test kits to assess chemicals in samples of water. Follow directions from test kits VERY CAREFULLY! Then write your results under "What We Found" and check corresponding box under "Quality".

		Quality				
Type of Test	What We Found	4 Excellent	3 Good	2 Fair	1 Poor	Field Notes
Dissolved Oxygen	1. Write temperature of water: _____ degrees Celsius 2. Write color of sample: _____ 3. Which ppm level does it match? (circle) 0 ppm 4 ppm 8 ppm 4. Percent saturation (use chart): _____%	91-110%	71-90%	51-70%	<50%	
Nitrate	1. Write color of sample: _____ 2. Which ppm level does it match? (circle) 0 ppm 5 ppm 20 ppm 40 ppm		0 ppm	5 ppm	20, 40 ppm	
pH	1. Write color of sample: _____ 2. Which pH number does it match? (circle) 4 5 6 7 8 9 10 11	7	6, 8		4, 5, 9, 10, 11	
Phosphate	1. Write color of sample: _____ 2. Which ppm level does it match? (circle) 1 ppm 2 ppm 4 ppm	1 ppm	2 ppm	4 ppm		
Temperature, Turbidity	1. Write temperature of water: _____ degrees Celsius 2. Circle matching secchi disk: 0 JTU 20 JTU 40 JTU 60 JTU 80 JTU 100 JTU	0 JTU	>0 to 40 JTU	>41 to 100 JTU	>100 JTU	

Step 4: Bentho Macroinvertebrate Survey. Follow the steps outlined in the top row of the chart, then enter the Pollution Tolerance Index at the bottom of the chart.

Step 4A Write an "X" next to each species found in the water sample.	Step 4B Add up the number of species in each group in Column A that is marked with an "X".	Step 4C Multiply the number in Column B by the appropriate index value in Column C.	Step 4D Enter results from Column C.
Column A	**Column B (# of species)**	**Column C**	**Column D**
Group 1 _____ Mayflies _____ Stoneflies _____ Dobsonflies _____ Caddisflies		X 4 =	
Group 2 _____ Dragonflies _____ Damselflies _____ Beetles _____ Crane Flies _____ Planarians _____ Sowbugs _____ Scuds		X 3 =	
Group 3 _____ Midges _____ Black Flies _____ Leeches		X 2 =	
Group 4 _____ Earthworms _____ Snails		X 1 =	
Step 4E Add all numbers in Column D and write the total next to Pollution Tolerance Index.		Pollution Tolerance Index: _____ (Use this number to determine water quality level in the chart below.)	

Step 5: Water Quality Rankings. Based on the Pollution Tolerance Index from Step 4, check the matching box.

Water Quality Rankings Based on Benthic Macroinvertebrates (Check matching box)	4 Excellent	3 Good	2 Fair	1 Poor
Pollution Tolerance Index (from box above): _____	16 and above	12-15	8-11	7 or less

9. CIMBY PHOTO POINT MONITORING

Camera location: _____

Area: _____ Date: _____

Number of photo points: _____ Observer: _____

Comments: _____ Slope: _____

_____ Aspect: _____

_____ Slope position: _____

Photo point A

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

_____

_____

_____

Photo point B

Compass bearing: _____

Distance: _____

Site description: _____

_____

_____

_____

_____

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_____

WRAP-UP

10. What do the results of the water monitoring activity tell you about the health of this habitat?

_____

_____

_____

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_____

_____

_____

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
STEWARDSHIP: Student follows all appropriate CIMBY Stewardship Station Instructions for his/her assigned role as: photographer, recorder, or brush pile supervisor. Student accurately fills out all work accomplished for his/her role on the CIMBY Workday Data Sheet.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WATER MONITORING: Student works with group to gather samples and specimens for appropriate tests. Student records all data and observations and completely fills out group water monitoring datasheet.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
PHOTO POINT MONITORING: Student records all information on the Photo Points sheet with appropriate site marking and documentation. Student uses GPS to mark points, and takes photos in specified directions.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student participates in Spring Sounds Listening Reflection exercise and demonstrates attentiveness and listening.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Habitat Analysis

Students analyze data from a coastal habitat scenario, compare data to findings from actual data, and then determine steps to improve the health of the local ecosystem.

OBJECTIVES

Analyze data to reach conclusions

Develop action plans for addressing restoration issues

SUBJECT
Ecology, Geology, Environmental Science, Hydrology, Chemistry

PREREQUISITE
Wet Your Waders CD-rom (See resources on p.161)

VOCABULARY
colony forming unit (cfu)
concentration
macrophyte
ravine
stream
stream flow
turbidity

MATERIALS
data charts
pencils

TIME/DURATION
90 minutes

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

Although collecting data can be an interesting and worthwhile endeavor for students, the real interest and potential for critical thinking is in understanding what the data means. This activity allows students to practice analyzing and synthesizing data related to ecosystem health. Teachers can use data collected during the Spring Stewardship activity or seek out other citizen science data collection projects in their local community. This activity can serve as a way to get students to interpret data and understand how to look for trends and possible cause-and-effect relationships.

pH: refers to the acidity of the water. Lower number means more acidic, higher number means more basic. Values in the range of 6.5 to 8.5 are normal.

Dissolved Oxygen (DO): a measure of oxygen content in the water. Oxygen is critical for the survival of fish and other wildlife in the water. Decreases in DO stress the ecosystem. There may be natural fluctuations in the DO level due to seasonal variations in temperature; however, pollution can also impact the DO of the water. Bacteria, algae, and other organic matter consume oxygen, causing DO levels to drop. DO levels below 5 mg/L will cause ecosystem stress; 1-2 mg/L will result in fish kills.

E. coli/Fecal Coliform/Enterococcus Bacteria: These bacteria are used as indicators to determine if fecal matter is present in the water and to evaluate if a body of water supports safe recreational use. Beach monitoring typically involves testing for E. coli and sometimes fecal coliform to determine if the water is safe for swimming. Enterococci is another bacteria that is used as an indicator. Enterococci is traditionally used to monitor marine bathing water, but it is also suitable to use as an indicator for freshwater. The U.S. EPA recommends the posting of beach advisories if a measurement of E. coli exceeds 235 cfu/100 mL. If enterococci levels are above 61 cfu/100mL, this could also lead to a beach advisory. Elevated bacteria levels can be due to a few full diapers on the beach, bird droppings, or sewage discharges after a heavy rainfall.

Phosphate and Nitrate (or Phosphorus and Nitrogen): concentration of nutrients such as phosphorus and nitrogen influence the growth rates of organisms in the water. If there is an excessive amount of nutrients, particularly phosphorus, algal blooms can appear. Algae is slimy and smells bad. Some types of algae can release toxins, as well. Algal blooms result in decreased DO content. Excessive nutrients can come from sewage treatment plants or agricultural (fertilizer

or animal waste) runoff. The U.S. EPA recommends that the total amount of phosphorus should not exceed 0.05 mg/L in a stream at a point where it enters a lake or reservoir, or 0.025 mg/L within the lake or reservoir. The recommended levels of nitrogen and nitrogen compounds (nitrate, nitrite, ammonia) are site specific and depend on the type of habitat.

PROCEDURE

Divide the class into two groups: tributary and beach.

TRIBUTARY GROUP

1. Give the students the following scenario: A local high school has adopted a nearby river that flows into a Great Lake. This river is a tributary. The students made four visits throughout the fall and spring, looking at the shoreline and the surrounding area, the types and quantity of aquatic species, the quality of the water and the presence of pollution. They are ready to analyze their data and create an action plan to create positive change at this ravine site.

2. Give the students the data in the journal pages. Data on water quality and macroinvertebrate populations was collected during each visit, on separate charts. Have them compare the visits based on the data and use the journal questions to make note of their observations. As a class, discuss the data. *This may include noticing problems with increased water temperature, decreased populations or increased pollution following precipitation events.*

3. Introduce the idea of taking action to help the tributary. Divide students into smaller groups and have each group pick one problem on which they will focus their attention. *Problems might include litter along the shoreline or in the water, lack of educational signage, storm water runoff from a parking lot. What type of project can students create that will address these issues?*

4. Have students develop an action project to address the issue, including a presentation of results to each other in the "roles" of city officials.

BEACH GROUP

5. Give students the following scenario: A local high school has adopted a nearby beach. Students have made four visits throughout the fall and spring looking at the shoreline and surrounding area, the type and amount of litter, and the presence of E. coli bacteria. They are ready to analyze their data and create an action plan to create positive change at their beach.

6. Give students the data in the journal pages. Data on litter condition and water quality was collected each time, on separate charts. Have them compare the visits based on the data and use the journal questions to make note of their observations. As a class, discuss the data. *This may include noticing problems with overflowing trash cans, consistent seagull waste, and a possible sewage overflow on the second visit.*

7. Introduce the idea of taking action to help the beach. Divide students into smaller groups and have each group pick one problem on which they will focus their attention. *Problems might include overflowing trash cans, consistent seagull waste, possible sewage overflows, lack of educational signage, stormwater runoff from the paved parking lot.* What type of project can students create that will address these issues?

8. Have students develop an action project to address the issue, including a presentation of results to each other in the "roles" of city officials.

WRAP-UP

9. Have each group take turns presenting their action project while the other group role-plays the group hearing the results.

10. After both groups have presented, use the rubrics from the student pages to evaluate the presentations. Did the students prefer presenting or hearing the presentation? What did the other group do well? What could they do better? If your classroom were to really arrange a meeting, what other things should be considered?

EXTENSION

A. Students take results from their habitat analysis and create an action plan to help a Calumet habitat.

B. Use this activity as a model for presenting actual data to community decision-makers.

C. Have the students participate in the Alliance for the Great Lakes' ongoing Adopt-a-Beach™ program: http://www.greatlakesadopt.org or participate in the International Coastal Cleanup, which occurs on the third Saturday of every September: www.oceanconservancy.org.

ASSESSMENT

See rubric on page 172.

RESOURCES

See Compact Discs in the Resource List for additional information, including Wet Your Waders - an interactive field trip to a stream near you

See Resource List for additional information related to conservation and restoration, native and invasive species and more.

NAME _____

18
LESSON
STUDENT PAGE

Habitat Analysis

VOCABULARY

colony forming unit (cfu)
concentration
macrophyte
ravine
stream
stream flow
turbidity

BACKGROUND

Collecting data can be an interesting and worthwhile endeavor. However, the real interest and potential for critical thinking is in understanding what the data means. This activity can serve as a way to interpret data and understand how to look for trends and possible cause-and-effect relationships. This activity uses sample data (general conditions, from two different habitats, a river and a beach. Review this data, looking for trends. Following this lesson you will be able to analyze and synthesize data relating to habitat health.

INTRODUCTORY QUESTIONS

1. What bodies of water are in or near your community?

_____

_____

2. What factors determine the health of an ecosystem?

_____

_____

_____

3. How can data and observations help determine the health?

_____

_____

_____

DATA SET #1 (TRIBUTARY)

A local high school has adopted a nearby river that flows into a Great Lake. This river is a tributary. The students made four visits throughout the fall and spring, looking at the shoreline and the surrounding area, the types and quantity of aquatic species, the quality of the water and the presence of pollution. They are ready to analyze their data and create an action plan to create positive change at this ravine site.

Description of the stream: *The Little Calumet River is a 24 mile long tributary of the East Arm Little Calumet River that begins south of Valparaiso, Indiana and flows north until it joins the East Arm Little Calumet River just before it exits to Lake Michigan.*

GENERAL CONDITIONS

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Air temperature (degrees Celsius)	28	25	21	22
Recent precipitation event (date)	none	9/25	9/27	10/01
Recent precipitation event (description)	n/a	Mild rainstorm	Light rain	Heavy rainstorm
Current sky conditions	Sunny	Cloudy	Cloudy, Windy	Partly cloudy

WATER QUALITY MONITORING

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Depth of stream (centimeters)	60.2	64.4	62.8	63.1
Stream flow	Mild	Moderate	Moderate	Rapid
pH	6.3	6.4	7.1	7.5
Dissolved oxygen content (mg/L)	14.0	12.7	13.4	13.1
E. coli (cfu/100 mL)	0	100	0	0
Fecal coliform (cfu/100 mL)	300	200	100	400
Phosphate (mg/L)	78	71	79	75
Nitrate (ppm) (mg/L)	54	51	54	53
Water temperature (degrees Celsius)	24	20	21	24
Odor	Odorless	Foul	Odorless	Odorless
Turbidity	Slightly cloudy	Cloudy	Opaque	Slightly cloudy

MACROINVERTEBRATE (AQUATIC INSECT) POPULATION MONITORING

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Caddisfly	600/2000	685/2000	659/2000	670/2000
Damselfly	203/2000	198/2000	271/2000	350/2000
Stonefly	145/2000	167/2000	206/2000	109/2000
Scuds	179/2000	225/2000	203/2000	235/2000
Clams and mussels	366/2000	105/2000	200/2000	130/2000
Gilled snails	290/2000	200/2000	190/2000	162/2000
Riffle beetles	147/2000	178/2000	165/2000	136/2000
Crayfish	120/2000	225/2000	60/2000	130/2000
Mayfly	18/2000	17/2000	6/2000	78/2000
Other:	None	None	None	None
Other:	None	None	None	None

STREAM HABITAT TYPE MONITORING

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Woody debris or snags	4/20	3/20	4/20	3/20
Vegetated banks	3/20	3/20	3/20	5/20
Sand and fine sediment	6/20	4/20	5/20	4/20
Cobble (hard substrate)	3/20	4/20	4/20	3/20
Aquatic plants (macrophytes)	4/20	6/20	4/20	5/20

DATA SET #2 (BEACH)

Scenario: A local high school has adopted a nearby beach. Students have made four visits throughout the fall and spring looking at the shoreline and surrounding area, the type and amount of litter, and the presence of E. coli bacteria. They are ready to analyze their data and create an action plan to create positive change at their beach.

Habitat Description: Rainbow Beach is located in South Chicago adjacent to the southwest portion of Lake Michigan and offers 0.60-mile of shoreline. This beach is often closed due to issues with water quality, but efforts are being made to improve this habitat.

GENERAL CONDITIONS

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Air Temperature (degrees Celsius)	28	20	18	22
Recent precipitation event (date)	9/20	none	4/21	5/12
Recent precipitation event (description)	Severe rain	n/a	Rain	Severe rainstorm
Current sky conditions	Cloudy	Partly sunny	Sunny	Cloudy

WATER QUALITY MONITORING

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Current wave height (feet)	2.3	2.6	2.7	3.1
Intensity of the waves	Calm	Calm	Somewhat intense	Intense
pH	7.6	7.9	7.3	7.8
Dissolved Oxygen Content (mg/L)	14.1	15.2	14.7	14.9
E. coli - water (cfu/100 mL)	100	0	50	400
Fecal Coliform (cfu/100 mL)	700	75	300	1500
Enterococcus (cfu/100 mL)	50	14.9	20	90
E. coli - sand (cfu/100 mL)	9	10	7	6
Water temperature (degrees Celsius)	23	17	16	17
Odor	Foul	No odor	No odor	Rotten egg smell
Turbidity	Cloudy	Pretty clear	Slightly cloudy	Opaque

POTENTIAL POLLUTION SOURCE: Combined sewer outfall pipe

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Flow rate	Medium	n/a	Low	Medium
Water color	Brown	n/a	Light brown	Brown
Characteristics	Smelly	n/a	n/a	n/a
E. coli - water (cfu/100 mL)	1900	n/a	600	800
Fecal coliform (cfu/100 mL)	5000	n/a	1000	1500
Enterococcus (cfu/100 mL)	1000	0	200	120
E. coli - sand (cfu/100 mL)	10	4	7	9
Algae in the water near the shore (amount)	Low	Moderate	Moderate	Moderate
Algae in the water near the shore (type)	Black Brush	Staghorn	Greenspot	Greenspot
Algae in the water near the shore (color)	Black	Green	Green	Green
Algae on the beach (amount)	Low	Low	Low	Moderate

WILDLIFE ON THE BEACH POPULATION MONITORING

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Geese (living)	47	22	19	36
Gulls (living)	28	32	26	22
Dogs (living)	1	5	7	4
Other:	n/a	n/a	n/a	n/a
Common loon (dead)	2	0	1	0
Herring gull (dead)	0	3	2	1
Ring-billed gull (dead)	1	0	0	0
Double-crested Cormorant (dead)	0	0	0	0
Horned grebe (dead)	0	1	0	0
Fish (dead)	2	3	2	1
Other:	n/a	n/a	n/a	n/a

LITTER MONITORING

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Litter condition	Fair	Moderate	Moderate	Moderate
Trash cans (quantity)	8	8	8	8
Animal waste (source)	Dog	Seagull	Seagull/dog	Dog
Restrooms	Fair	Fair	Fair	Fair
Cigarette filters	45	32	28	36
Food wrappers and containers	22	31	36	42
Caps and lids	33	39	40	37
Straws and stirrers	21	20	29	26
Plastic beverage containers	35	38	39	22
Balloons	0	3	1	0
Other:	n/a	n/a	n/a	n/a
Other:	n/a	n/a	n/a	n/a

HABITAT ANALYSIS

4. Describe your observations as you analyze the data. What trends do you notice? Are there correlations among the data? Identify any possible issues at these habitats.

ACTION PROJECT

5. In small groups, identify one problem that you would like to investigate. Describe that issue here:

6. What are the possible causes of this issue?

7. What actions can you take to address this issue?

8. On a separate page or on a computer, develop an action plan for your site. Then, create a presentation to describe your action plan. You can outline your action plan in the space below:

WRAP-UP

9. Enter information from your Spring Stewardship CIMBY Water Monitoring Datasheet below.

WATER QUALITY MONITORING

Measurement	Result	Is this good or bad? Why?
pH		
Dissolved oxygen content (mg/L)		
Phosphate (mg/L)		
Nitrate (ppm) (mg/L)		
Water temperature (degrees Celsius)		
Turbidity		

10. MACROINVERTEBRATE (AQUATIC INSECT) POPULATION MONITORING

Macroinvertebrate	Number	What could this indicate?
Mayflies		
Stoneflies		
Dobsonflies		
Caddisflies		
Dragonflies		
Damselflies		
Beetles		
Crane Flies		
Planarians		
Sowbugs		
Scuds		
Midges		
Black Flies		
Leeches		
Earthworms		
Snails		
Others:		

11. How do the measurements from your Spring Stewardship Day compare to those of the Little Calumet River and Rainbow Beach? What could this mean?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DATA ANALYSIS: Student thoroughly reads the journal pages that include all data from habitat site visits. Student notes his/her observations of the data and summarizes their findings (i.e. potential reasons for increases or decreases in quantity of bacteria in a water sample).	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ACTION PROJECT: Student works in a group to investigate one problem associated with the habitat. Student develops an action plan to address the problem. Student role plays a city official or community stakeholder. Groups highlight what the problem is, where it is coming from and who is involved. As a class, students identify possible solutions to the problem. Student evaluates others and discusses what should be considered if a meeting were really to be arranged.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Notes

Calumet Action Plan

Students plan and implement a service-learning action project related to Calumet habitat restoration.

OBJECTIVES

Identify at least one Calumet habitat restoration issue or watershed issue

Develop a restoration plan for alleviating the restoration issue

SUBJECT
Biology, Ecology, Chemistry, Environmental Science, Environmental Law, Public Policy

PREREQUISITE
Restore and Explore Habitat Research

VOCABULARY
best management practices (BMPs)
incentive
indicator
regulation

MATERIALS
pencils

TIME/DURATION
Long-term project

SETTING
Indoors and outdoors (independent projects will be completed throughout the community)

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

There are four ways in which habitats are protected: regulations, landowner protections (e.g. park districts, organizations like The Nature Conservancy, etc.), economic incentives and public education. Certain habitats are federally protected under the Clean Water Act, the U.S. Fish and Wildlife Services' Habitat Conservation Program and other management programs. State and local governments may also have their own regulations. Public education about the value of natural habitats is a preventative protection measure. The theory behind environmental education is that if people understand and value their habitats, they are more likely to work to preserve, conserve and restore these diverse ecosystems.

Based on the information that students have gathered in previous lessons, they will work as a class to identify an issue in their local watershed, or within another habitat in the Calumet Region. Students will then work independently to prioritize these problems and then identify possible solutions to one of these issues. These solutions should focus on best management practices (BMPs) for conserving, restoring and preserving natural habitats. Students will then develop an action plan and then, if possible, implement this plan. These action projects will connect the classroom curriculum with a final service project. Service-learning engages students in projects that serve the community while building social, civic, and academic skills. These experiences build an understanding of a community, enrich learning and help youth develop personally, socially and academically. Great Lakes in My World: Calumet offers three opportunities for service-learning - Fall Stewardship, Winter Stewardship, and Spring Stewardship. This lesson is an opportunity for students to curate their own service-learning project. Service-learning action projects incorporate such steps as: research, investigation, analysis, action, reflection and celebration. Finally, students will develop a portfolio or presentation that analyzes the success and effects of their action project. *See student page for additional information.*

PROCEDURE

1. Introduction: Students read background information and answer introductory questions: What are five ways that humans are currently harming the environment? What are five easy ways for humans to preserve the environment? What are three examples of how the Clean Water Act has had an impact?

ACTION PROJECT

STEP 1: RESEARCH
Before students can develop and implement an action project, they must have an understanding of the Calument Region and Great Lakes ecosystems. Prior lessons from this curriculum (see the "prerequisites" listed) provide students with the background knowledge needed to begin this lesson. If students have not completed these lesson plans, they should use other means to engage in information gathering through direct observation, data collection and analysis, or research (Internet searches, library resources, interviews, etc.). Research specifically on the Clean Water Act would be beneficial to the student in preparation for an action project. You may also invite guest speakers to discuss local past, current or future restoration projects.

STEP 2: INVESTIGATION
As a class, create a list of restoration issues within the school's adopted Calumet natural area, the local watershed, or within another habitat in the Great Lakes watershed. These can include point source and nonpoint source (NPS) water pollution, invasive species (aquatic or terrestrial), or another habitat restoration need.

STEP 3: ANALYSIS
Prioritize problems/issues. Students will analyze them by examining them from different perspectives. How do/would these issues impact the environment, human health, recreation and the economy?

STEP 4: ACTION
Each student then selects one problem to address. They should ask themselves, "What are possible solutions to this problem? What do I want to see happen to improve this issue? What process would help to achieve a solution?" Each student will then develop a list of possible solutions to the problem that they selected.

Students will then develop a plan for addressing their issue. Their plan can be a:

i. watershed plan
ii. pollution management plan
iii. land management (or land use) plan
iv. community development plan
v. coastal management plan
vi. educational campaign
vii. another service learning plan

Each of these plans must include the following components:

a. Observation of the area
b. Description of the problem
c. Map of the area (what does the area look like now, and what do you plan to change?)
d. Indicators (how will we measure success?)

See resource list for websites giving examples of these restoration plans.

Additional suggestions: Teachers meet with their students regularly to discuss the progress of each step of the action project. Students share their plans with their classmates as a peer review process. Students should communicate with the experts of the problem or geographic area they choose. Any responses from the experts should be included in the project plan.

WRAP-UP

STEP 5: REFLECTION
Discuss the following questions and have students respond to them on the student pages: How can you educate others on how to conserve natural resources and protect nature? What are some negative reactions to protecting the environment? What eco-friendly choices have you made in your life? How has your work on this project changed your values and understanding of the Calumet Region and Great Lakes ecosystems?

STEP 6: CELEBRATION
If desired, take steps to share the educational projects or the habitat management or restoration plans. This may mean passing out flyers, making presentations, hanging up signs, or working with a television or radio crew. Students will share their projects at the CIMBY Science Summit.

EXTENSION

A. Communicate actions and results to the school, district or local community via a Web page, public service announcement (PSA), media outlet or other communication tool. Attend a town meeting to present a project that could benefit the community. Students should include photos, data and quotes from others in the community.

ASSESSMENT

See rubric on page 179.

RESOURCES

See Resource List for additional information related to organizations, Department of Natural Resources and more.

NAME

19
LESSON
STUDENT PAGE

Calumet Action Plan

VOCABULARY

best management practices (BMPs)
incentive
indicator
regulation

BACKGROUND

There are four ways in which habitats are protected: regulations, landowner protections (e.g. park districts, organizations like The Nature Conservancy, etc.), economic incentives and public education. Certain habitats are federally protected under the Clean Water Act, the U.S. Fish and Wildlife Services' Habitat Conservation Program and other land and coastal management programs. State and local governments may also have their own regulations.

CLEAN WATER ACT

Clean water is a very valuable natural resource and is relied on for drinking, recreation, manufacturing, energy development, agriculture, commercial fishing, tourism, and many other purposes that are essential to public health and the economy. By the mid-1900s, the water quality of the Great Lakes declined due to certain ways humans were using the lakes. In order to address this, legislation such as the Clean Water Act (1972) and the Great Lakes Water Quality Agreement (1972) were passed and continue to be upheld. The Clean Water Act set a new national goal "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters", with interim goals that all waters be fishable and swimmable where possible. Since 1972, the Clean Water Act has protected our health and environment by reducing the pollution in streams, lakes, rivers, wetlands and other waterways.

CURRENT ISSUES

Untreated Sewage Overflows

Each year over 24 billion gallons of combined untreated sewage and storm water are dumped into the Great Lakes. High concentrations of bacteria and viruses present in the overflows of untreated sewage pose a significant health risk and result in beach advisories across the region. Other pollutants from urban and agricultural run-off also end up in the waterways. Causes of municipal sewage overflows consist of outdated infrastructures, heavy rainfall in which excess storm water and raw sewage are diverted directly to coastal waterways, and several wastewater treatment plants. According to the U.S. EPA, the principal pollutants found in combined sewer overflows (CSOs) are: microbial pathogens, oxygen-depleting substances, total suspended solids, toxic materials, nutrients, floatables and trash. Sewage overflows result in water quality impairments, human contact with pathogens, and long term exposure and accumulations of pollutants in aquatic systems.

Invasive Species

The jumping, jumbo-sized Asian carp is the most notorious invasive species to travel up the Mississippi River and knock on Lake Michigan's door - a gateway to the Great Lakes and the world's largest surface freshwater system. Experiences in Illinois and other places where the carp have a foothold show us the threat is real. Once established in the Great Lakes, the fast-growing carp could gobble up the food that sustains native fish, devastating the region's $7 billion fishing industry and forever changing how boaters, anglers and tourists enjoy the lakes. The Asian carp's arrival has prompted serious questions about how to protect the lakes against these and other invaders.

Public education about the value of natural habitats is a preventative protection measure. The theory behind environmental education is that if people understand and value their habitats, they are more likely to work to preserve, conserve and restore these diverse ecosystems. You will develop ideas for a plan for a Calumet restoration project or another Calumet-related action plan.

INTRODUCTORY QUESTIONS

1. What are five ways that humans are currently working to conserve and restore the natural environment?

2. What are five ways that humans are currently harming the natural environment?

3. What are two actions you can take to protect the environment?

4. What are three examples of how the Clean Water Act has had an impact on humans and the environment?

ACTION PROJECT

5. List various restoration issues within your adopted CIMBY natural area, your local watershed, or within another habitat in the Calumet Region.

6. How do these issues impact the environment, human health, recreation, and the economy?

7. Identify one problem to address.

8. What are possible solutions to this problem? What needs to happen in order to improve this issue? What process would help achieve a solution?

9. Using a computer or a separate sheet of paper, develop an action plan for addressing your issue. You can begin to outline the action plan in the space below. Your plan must include the following components:
   a. Observation of the area
   b. Description of the problem
   c. Map of the area (what does the area look like now, and what do you plan to change?)
   d. Indicators (how will you measure success?)

WRAP-UP

10. How can you educate others about how to conserve natural resources and protect nature?

11. What are some negative reactions to protecting the environment?

12. What eco-friendly choices have you made in your life?

13. How has your work on this project changed your values and your understanding of the Calumet Region and Great Lakes ecosystems?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
RESEARCH: Student investigates environmental issues related to their adopted CIMBY site, their watershed and/or Calumet habitat. Student uses available resources (internet searches, library, interviews, etc.) to conduct research. Student uses the introductory questions as a basis for where to start their research.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
INVESTIGATION: Student participates in class discussion creating a list of restoration issues affecting their local watershed. Student uses the initial research they performed individually to engage in ideas.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ANALYSIS: Student prioritizes the list of issues in order of importance; separates them into categories of impact on: the environment (land, water, ecology, etc.), human health, recreation, and/or economy; and determines the feasibility of creating a service project out of one of them.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ACTION: Student chooses an issue to address, developing a list of possible solutions with expected results. A plan of action is written including- observation of the area, description of the problem, map of the area both present and future, and indicators (measures of success).	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
REFLECTION: Students review each other's plans. During assessment, student both receives and gives constructive criticism in a positive way. Student reflects on what they have learned throughout the lesson by answering the questions on the student pages.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

CIMBY Science Summit

Students present their Calumet Action Plans at the culminating all-school CIMBY event.

OBJECTIVES

Present findings from CIMBY experiences through written, oral, visual, videotaped and other displays

Understand impact of CIMBY program on all schools and natural areas

Learn from Field Museum scientists and exhibits to make broader environmental connections

SUBJECT
Ecology, Biology, Environmental Science

PREREQUISITE
Calumet Action Plan

VOCABULARY
biodiversity

MATERIALS
Calumet Action Plan projects
lunch

TIME/DURATION
6 hours

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards and Next Generation Science Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

The Calumet is My Back Yard (CIMBY) Science Summit ties the year's experiences together, allowing students to present information about their service-learning projects related to Calumet restoration in a meaningful way. Each group will create a visually appealing presentation that informs people about at least one local restoration or watershed issue that they have identified, and subsequent action steps students have taken to alleviate the issue. The project should highlight student accomplishments achieved at their site during the school year and information that educates others about their adopted natural area. It should be a meaningful representation of their Calumet Action Plans. This could take the form of a podcast tour of the natural area, the development of a Rapid Color Guide, educational signs, fliers, etc. Students are strongly encourage to use their creativity in designing their presentation. A newsletter template can also be used by students as they gather basic information about their site and project stories.

During the summit, presentation tables will be available for student projects. As groups move to the project presentation session, they will locate their table and teacher. One half of the group will stay with their teacher and presentation table for thirty minutes (approximately half the session time) to inform others about their own issue and project, while the other half of the group moves around the balcony area to view other students' projects and learn from scientists who will be presenting behind-the-scenes collections

GENERAL AGENDA

8:30am	Buses depart from schools
9:00 - 9:30am	Registration
10:15 - 11:15am	Kick-off Presentation Year-in-review, photos, accomplishments and awards Student reflections
11:30 - 12:30pm	Free exploration of exhibits, Restoring Earth and lunch or Student and scientist presentation
12:30 - 12:45pm	Students rotate
12:45 - 1:45pm	Free exploration of exhibits, Restoring Earth and lunch or Student and scientist presentation
1:45 - 2:00pm	Students depart

PROCEDURE

1. Prior to the CIMBY Science Summit: Students develop a presentation and materials for a display table at the CIMBY Science Summit. Students create a visually appealing presentation that informs people about at least one local restoration or watershed issue that they have identified, and subsequent action steps students have taken to alleviate the issue. The project should highlight student accomplishments achieved at their site during the school year and information that educates others about their adopted natural area. It should be a meaningful representation of their Calumet Action Plans. This could take the form of a podcast tour of the natural area, the development of a Rapid Color Guide, educational signs, fliers, etc. Students are strongly encouraged to use creativity in designing their presentation and materials. A newsletter template can also be used by students as they gather basic information about their site and project stories. Students must prepare to discuss and share information with others about their project.

2. During the CIMBY Science Summit: See agenda for more details on the CIMBY Science Summit. Student projects are displayed at presentation tables. In addition, scientists share behind-the-scenes collections to the students. As groups move to the project presentation session, they will locate their table and teacher. One half of the group will stay with their teacher at the presentation table for the first thirty minutes (approximately half the session time) to inform others about their project, while the other half of the group explores the other students' projects and learns from scientists who are presenting behind-the-scenes collections. After approximately a half hour, the groups switch roles.

WRAP-UP

3. CIMBY Student Evaluation: Students respond to the questions on the post-survey to reflect on and share what they have learned.

ASSESSMENT

See rubric on page 183.

RESOURCES

See Visual Media in the Resource List for additional information. In particular, The Field Museum: N.W. Harris Learning Collection.

NAME

20
LESSON
STUDENT PAGE

CIMBY Science Summit

VOCABULARY

biodiversity

STUDENT EVALUATION

EXPERIENCE

1. If you participated in the Mighty Acorns program in elementary school, how many years did you participate?
   - ❑ 0 years
   - ❑ 1 year
   - ❑ 2 years
   - ❑ 3 years or more

2. If you participated in the Earth Force program in middle school, how many years did you participate?
   - ❑ 0 years
   - ❑ 1 year
   - ❑ 2 years
   - ❑ 3 years or more

3. How many years have you participated in the CIMBY program?
   - ❑ 0 years
   - ❑ 1 year
   - ❑ 2 years
   - ❑ 3 years or more

4. How often do you visit a natural area (a lake, a river, the woods, a wetland, a prairie, a marsh, the forest, the beach, the dunes, a pond)?
   - ❑ Never
   - ❑ Once a year
   - ❑ Three or four times a year
   - ❑ Once a month
   - ❑ Once a week

KNOWLEDGE

5. If you can name a natural area close to your home or school (within 10-15 miles), write it below.

_____

_____

6. If you can name one or more plant species native to the Calumet region, write it below.

_____

_____

7. If you can name one or more plant species invasive to the Calumet region, write it below.

_____

_____

8. The word biodiversity is used often in the CIMBY Program. How would you define biodiversity?

_____

_____

9. Name one or more environmental problems in the Calumet region?

_____

_____

10. If you wanted to work in the environmental field, what are some careers you could have? Name up to three possible careers.

a. _____

b. _____

c. _____

ATTITUDE

11. Are you comfortable being in nature?
- ❑ Always
- ❑ Sometimes
- ❑ Never

12. Do you like being out in nature?
- ❑ Often
- ❑ Sometimes
- ❑ Never

13. Do you have an interest in exploring nature?
- ❑ Yes
- ❑ No

14. Do you have an interest in protecting the environment?
- ❑ Yes
- ❑ No

15. Are you interested in pursuing an environmental career?
- ❑ Yes
- ❑ No

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
GROUP PRESENTATION: Student works closely with group to create a visually appealing presentation that informs people about at least one local restoration or watershed issue that they have identified, and subsequent action steps students have taken to alleviate the issue. Project demonstrates student accomplishments at their site during the school year and a meaningful representation of their Calumet Action Plans. Student uses creativity in their presentation.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
WRAP-UP: Student fills out student evaluation completely. Explanations are thorough and demonstrate increased knowledge of the Calumet region.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components

Notes

Great Lakes in My World 9-12: Calumet
Glossary

abiotic: non-living (such as sand, water, sunlight)

acid mine drainage: refers to the outflow of acidic water from (usually abandoned) metal mines or coal mines

advocate: someone who voices his/her support of an idea through speaking or writing

algal blooms: a rapid increase or accumulation in the population of algae in an aquatic system

alternate leaves: leaves rising singly along the stem, not in pairs or whorls

annual: having a life cycle completed in one year or season

aquifer: a geologic formation that contains sufficient permeable material to yield significant quantities of water to springs and wells

areas of concern: seriously contaminated sites in the Great Lakes that impair beneficial uses of the Great Lakes by causing harm to wildlife, habitat, and drinking water hotspots impair beneficial uses of the Great Lakes by causing harm to wildlife, habitat and drinking water

autotroph (producer): an organism that can synthesize its own food by photosynthesis, usually a green plant; can also be chemosynthetic

basal leaves: leaves at the base of the stem

basin: a hollow or depression in the earth's surface, wholly or partly surrounded by higher land

bathymetric map: map that uses contour lines to show the depths of a body of water; measures distance below sea level

bathymetry: features of the depths of lake or ocean floors

beach: the zone extending from the water's edge to the limit of the highest storm waves. This area acts as the first region of a coastal zone, or can be interspersed with coastal wetlands and emergent marshes

best management practices (BMPs): principal techniques or guidelines for preserving biodiversity, water quality and habitats

biennial: growing vegetatively (not flowering) during the first year and flowering, fruiting and dying during the second

biodiversity: the number, variety, and genetic variation of different organisms found within a specified geographic region

biotic: living (such as insects, birds, plants)

bittersweet: a semi-woody herbaceous vine, that is an invasive species along the coast of Lake Michigan

bog: a nutrient-poor peatland characterized by acidic, saturated soil and the prevalence of peat mosses and shrubs

brush: a thicket of shrubs, branches, and leaves

brushpile: a pile of branches, leaves, and shrubs

buckthorn: a shrub or small tree that came to the US in the 1800s which can be invasive in many Illinois habitats

career: an occupation or profession, especially one requiring special training, followed as one's lifework

cartography: the study and practice of making maps

cfu: colony-forming unit (the US EPA's recommended limit of E. Coli is 235 cfu per 100 mL of recreational water, Coliform bacteria limits are around 200 cfu per 100 mL of recreational water)

coastal habitat: a habitat near a body of water such as sand dunes, ravines, gravel beaches, estuaries lagoons and coastal marshes

commensalism: relationship in which one organism benefits and the organism is neither significantly harmed nor helped

commerce: the activity of buying and selling, particularly on a large scale

compound leaf: a leaf divided into leaflets

concentration: abundance of a constituent divided by the total volume of a mixture

conservation: careful utilization of a natural resource in order to prevent depletion or degradation

contour lines: curved lines on a topographic or bathymetric map that connect points between places with the same depth or elevation

cover letter: a document sent with your resume to provide additional information on your skills and experience

decomposer: organisms that break down dead or decaying organisms

dichotomous key: an outline of the distinguishing characteristics of a group of species, used as an identification guide

dip-netting: the act of scooping up fish and other objects with a net

drainage: means of removing surplus water or liquid waste

dune: a sand hill or sand ridge formed by the wind, usually in desert regions or near lakes and oceans.

eco-sculpture: a piece of art that is either natural, made of organic materials or presents environmental issues

ecosystem: a system made up of an ecological community and its environment especially under natural conditions

ecotype: a distinct species of a plant or animal that occupy a particular habitat emergent marshes: type of wetland characterized by shallow water and saturated soils; contains bulrushes, cat-tails, and other emergent species, but also submergent and/or floating vegetation.

fauna: all animal life found in a particular region, period, or spacial environment

fen: sedge- and rush-dominated wetland that occurs on calcareous (limestone or marble) rock beds in coastal embayments.

field guide: handbook used to identify and learn about specific plants or animals

flora: all of the plant life found in a particular region, period, or spacial environment

flux: process in the water cycle by which water moves between reservoirs such as evaporation, infiltration, precipitation, or runoff

food chain: a series of organisms each dependent on the next as a source of food

food web: the whole group of interacting food chains in a living community

forb: an herbaceous flowing plant other than grass

foredune: in a series of coastal dunes, the dune closest to the front

forested shoreline (or boreal forest): a broad band of mixed coniferous and deciduous trees that stretches across northern North America (and also Europe and Asia); its northernmost edge, the taiga, intergrades with the arctic tundra

germination: to develop into a plant or individual, as a seed, spore, or bulb

GIS - Geographic information systems or geospatial information systems: technology that captures, stores and shares geographically referenced data using satellites and a system of computers. Geographic data is any data that has location information attached to it.

GPS - Global Positioning System: system of satellites that determines the latitude and longitude of a receiver on Earth by calculating how long it takes signals to travel from the satellite to the receiver.

gramminoid: plants that have one seed-leaf and are also herbaceous plants; grass

Great Lakes basin: the land where water from the ground, rivers and streams flow into the Great Lakes; includes the Great Lakes and the surrounding lands in the states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin in the United States, and the province of Ontario in Canada; also known as Great Lakes watershed

groundwater: water located beneath the ground in soil and in the fractures of rock formations

habitat: the home or environment of an animal, plant, or other organism

headwaters: the place from which the water in the river or stream originates

herbaceous: a plant that has leaves and stems that die down at the end of the growing season to the soil level

heterotroph (consumer): an organism that cannot synthesize its own food and consumes other organisms in a food chain

hydrologic cycle: the continuous movement fo water on, above, and below the surface of Earth

Hydrologic Unit Codes (HUC's): the numbers that are used in the United States to identify watersheds (i.e. 8, 10, 12)

impervious surfaces: impenetrable, usually artificial, surfaces that do not allow the passing of water from the sky to the ground below, thus are causes of flooding; examples include roads, parking lots, driveways and sidewalks

incentive: something that motivates or encourages one to do something

indicator: a trend or fact, that indicates the state or level of something

industrialization: the development of industry on an extensive scale

infiltration: the process by which water enters the soil or substrate material of the ground

invasive (non-native) species: plant or animal that enters an ecosystem to which it is not native and competes with one or more native species for food, shelter, and/or reproductive opportunities

invasive plant: a plant that enters an ecosystem to which it is not native and competes with one or more native species for food, shelter and/or reproductive opportunities; also referred to as non-native, exotic, non-indigenous, alien or noxious

job: a post of employment; full-time or part-time position

lake: a large body of water surrounded by land

lakeplain prairie (coastal lake plain): low-lying, wet prairie-like area adjacent to or very close to water; prone to seasonal flooding and includes small pockets that remain wet throughout the year

land cover: physical material at the suface of the Earth (i.e. grass, asphalt, trees, bare ground, water, etc.)

littoral: a coastal region; a shore

locks: in Chicago, an enclosed chamber between the lake and the river, with gates at each end for raising or lowering vessels from one level to another by admitting or releasing water

macroinvertebrate: organism without a backbone, large enough to be seen without the use of a microscope

macrophytes: aquatic plants

mammoth: any large extinct elephant of the Pleistocene genus Mammuthus (or Elephas), such as M. primigenius (woolly mammoth), having a hairy coat and long curved tusks

map: a visual representation of an area

mental map: an individual's own perception of their own world

mill: a building equipped with machinery for grinding grain into flour

monitor: to observe or check the quality of something over a period of time

moderator: a person who presides over a debate, event, or study lobes: any of the parts, not entirely separate from each other, into which a flattened plant part, such as a leaf, is divided

mutualism: relationship in which both organisms benefit

native plant: flora and fauna species that occur naturally in a given area or region; also referred to as indigenous species

node: the place on a stem from which a leaf or a branch grows

nomad: a person who continually moves from place to place; wanderer

nonpoint source (NPS) pollution: pollution (usually affecting water) from diffuse sources, such as precipitation, atmospheric deposition or runoff

nonpoint source pollution: pollution which cannot be traced back to a single origin or source such as storm water runoff, water runoff from urban areas and failed septic systems.

opposite leaves: leaves occurring in pairs at a node, with one leaf on either side of the stem

parasitism: relationship in which one organism benefits and the organism is harmed

parcel: a distinct portion of land

pelt: the untanned hide or skin of an animal

percent cover: the proportion of a specific plant species that inhabits a certain area

perennial: present at all times of the year; in reference to a plant, one that lives for more than two years, usually producing flowers, fruits, and seeds annually

permeable: capable of being passed through or permeated, especially by liquids or gases

pH: is a measure of the acidity or basicity of a solution; lower pH means more acidic and higher pH means more basic

photopoint: a type of monitoring that consists of photography of a particular area of interest over a period of time

physical maps: a type of map that shows countries of the world, major cities, and bodies of water highlighting landforms such as mountains, deserts, and plains

point source pollution: air, water, thermal, noise, or light pollution that can be traced back to a single origin or source such as a sewage treatment plant discharge

political map: a type of map that displays borders defining countries, states, or territories

pollution: a poisonous or harmful substance present in the environment which causes a negative impact

population: the number of individuals in a particular habitat

portage: the carrying of a boat or its cargo between two navigable waters

ppb: parts per billion

ppm: parts per million

prairie: a grassland containing a variety of herbaceous plants

preservation: protection and management of a natural resource, habitat or ecosystem in order to prevent damage or destruction

primary consumer: the organism that eats the producer

primary producer: organisms that synthesize organic materials from inorganic materials

profession: a vocation requiring specialized knowledge through intensive academic preparation

quadrat: a small area of habitat, typically of one square meter, selected at random to act as samples for assessing the local distribution of plants or animals

quaternary consumer: an organism that eats tertiary consumers

rapid color guide: a site-specific sheet of plant photographs used to assist with plant identification in the field

ravine: a narrow valley created by running water, such as a stream or river; often located adjacent to a beach or cliff

remediation: the action of reversing or stopping environmental damage

reservoir: body of water in the water cycle such as stream, lake, river, glacier, or ocean

restoration: renewing degraded, damaged, or destroyed ecosystems and habitats

résumé: a brief written account of personal, educational, and professional qualifications and experience

riparian: relating to or inhabiting the banks of a natural course of water

river: a natural stream of water of fairly large size flowing in a definite course or channel or series of diverging and converging channels

runoff: the water flow that occurs when soil is infiltrated to full capacity and excess water from rain, meltwater, or other sources flows over the land

sand dunes: giant, shifting mounds of sand that form whenever there is enough sand, a consistent onshore wind of at least eight miles an hour, and a place for the sand to accumulate

savanna: a grassland ecosystem characterized by trees being sufficiently small or widely spaced so that the canopy does not close

secondary consumer: the organism that eats or derives nutrients from the first-order consumer

sedimentation: the tendency for a particle in suspension to settle out of the fluid in which they are entrained and come to rest against a barrier

sediments: naturally occurring material that is broken down by the processes of weathering and erosion and is transported by the action of fluids

stakeholder: a person, group, or organization member or system that can be affected by an organization's actions

stewardship: the responsibility of overseeing and protecting something through restoration work

stream flow: Average Width(ft.) x Average Depth(ft.) x Stream Velocity(ft/sec)

stream: a body of water with a current, confined within a bed and stream banks; often flows into or out of a larger body of water, such as a lake

succession: the sum of changes in the composition of a community that occur during its development towards a stable climax community

surface water: water collecting on the ground or in a stream, river, lake, wetland, or ocean

sustainability: the quality of not being harmful to the environment or depleting natural resources, and thereby supporting long-term ecological balance

swale: a low place in a tract of land, usually moister and often having ranker vegetation than the adjacent higher land

swamp: a type of wetland characterized by woody vegetation (shrubs or trees) that are partially covered by water; a wetland is considered a swamp if it has about thirty percent tree cover with seventy percent open, slow-moving or stagnant water

symbiosis: relationship or ongoing interactions between two or more organisms in an ecosystem; can be classified as mutualistically, commensally or parasitically symbiotic

tertiary consumer: animal that feeds on secondary consumers in a food chain, usually top predators in an ecosystem or food chain

thermal pollution: pollution or change in the temperature of water that degrades water quality

topographic map: map that uses contour lines to show changes in elevation of a land feature; measures distance above sea level

topography: physical features of a landscape, with special attention paid to changes in elevation

transect: a straight line or narrow section through an object or natural feature or across the earth's surface, along which observations are made or measurements taken

transpiration: loss of water vapor from parts of plants (similar to sweating)

tributary: a stream or river that flows into a main stem river or lake

turbidity or Total Suspended Sediments (TSS): is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye

veins: made up of the xylem and phyloem of a leaf located in the spongy layer of the mesophyll

vicinity: the area near or surrounding a particular place

voyageur: a person who is an expert woodsman, boatman, and guide in remote regions, especially one employed by fur companies to transport supplies to and from their distant stations

watershed: the region or area drained by a river, stream, or other body of water; drainage area

wetlands: lands on which water covers the soil or is present seasonally or permanently; considered the most biologically diverse of all ecosystems and includes marshes, bogs, swamps, fens, bogs and swales.

whorls: the attachment of petals, sepals, leaves, or branches at a single point

woodland: land covered by numerous trees and other woody plants

woody plant: a plant that produces wood as its structural tissue; woody plants are usually trees or shrubs

Great Lakes in My World 9-12 Resource List

Books (alphabetical by title)

Borne of the Wind: An Introduction to the Ecology of Michigan's Sand Dunes, Dennis Albert
Discovering Great Lakes Dunes, Elizabeth Brockwell-Tillman and Earl Wolf
The Dynamic Great Lakes, Barbara Spring
Encyclopedia of Mammals, David Macdonald
Evolution of the Great Lakes Water Quality Agreement, Lee Botts and Paul Muldoon
Eye Witness: Pond and River, Steve Parker
Field Guide to Lakes, Jacob Verduin
A Good Catch: Managing Fisheries to Meet the Nation's Demand for Seafood, Taylor Morrison
Great Lakes Atlas, United States Environmental Protection Agency
Great Lakes Dune Ecosystems, Michigan State University Extension
Great Lakes Nature: An Outdoor Year, Mary Blocksma
Great Lakes Water Levels, Communications Centre
Groundwater in the Great Lakes Basin, International Joint Commission
Guide to the Study of Freshwater Biology, Needham and Needham
A Guidebook to Groundwater Resources, Great Lakes Commission
How to Know Immature Insects, H.F. Chu
Illinois Native Peoples, Andrew Santella
The Inland Seas: A Journey Through the Great Lakes, Paul Vasey
Invasion Ecology, Marianne E. Krasny and the Environmental Inquiry Team
The Image of the City, Kevin Lynch
The Living Great Lakes, Jerry Dennis
Maritime Chicago, Theodore Karamanski and Deane Tank Sr.
On the Brink, Dave Dempsey
People of the Lakes, editors of Time-Life Books
Pond and Brook: a Guide to Nature in Freshwater Environments, Michael Caduto
River Road Publication, Inc., *www.riverroadpublications.com*
Sooper Yooper, Mark Newman
Stories From Where We Live: The Great Lakes, Sara St. Antoine
Wild Lake Michigan, John & Ann Mahan

Great Lakes Field Guides

Amphibians and Reptiles of the Great Lakes Region, James H. Harding
Animal Tracks of the Great Lakes, Chris Stall
Chicago Wilderness: An Atlas of Biodiversity
Dune Country: A Hiker's Guide to the Indiana Dunes
A Field Guide to Fish Invaders of the Great Lakes Region, Minnesota Sea Grant

Guide to Common Invertebrates of North America
Guide to Great Lakes Fishes, Gerald R. Smith
Insects of the Great Lakes Region, Gary A. Dunn
Mammals of the Great Lakes Region, Allen Kurta
Scats and Tracks of the Great Lakes Region, James Halfpenny
What's Doin' the Bloomin'? Revised Edition: A Pictorial Guide to Wildflowers of the Upper Great Lakes Regions, Eastern Canada and Northeastern U.S.A, Clayton and Michele Oslund

Additional Field Guides

Audubon Field Guides
Fandex Family Field Guides
Golden Guides
Newcomb's Wildflower Guide, *Lawrence Newcomb*
Peterson Field Guides
Pocket Naturalist Series
Take Along Guides

Magazines

EEK! (online): Wisconsin Department of Natural Resources, *www.dnr.state.wi.us/org/caer/ce/eek*
Chicago Wilderness Magazine: The Calumet Region, **www.chicagowilderness.org/CW_Archives/calumet**
Tracks Magazine, Michigan United Conservation Clubs *www.mucc.org/index.php/tracks*

Web sites

Resources and Organizations

Alliance for the Great Lakes, www.greatlakes.org
Center for Great Lakes Environmental Education, www.greatlakesed.org
COSEE Great Lakes, www.coseegreatlakes.net
Environment Canada: Great Lakes Kids and Our Great Lakes, www.on.ec.gc.ca/greatlakeskids
Environmental Education Association of Illinois, www.eeai.net
Environmental Education in Wisconsin, www.eeinwisconsin.org
Environmental Protection Agency Region 5 Office, www.epa.gov/region5
Freshwater Future, www.glhabitat.org
The Globe Program, www.globe.gov
Grand Valley State University, Annis Water Resources Institute, Education Resources, www.gvsu.edu/wri/education
Great Lakes Atlas, www.epa.gov/glnpo/atlas/index.html
Great Lakes Aquarium, www.glaquarium.org
Great Lakes Directory, www.greatlakesdirectory.org
The Great Lakes Green Book, www.glu.org/en/campaigns/restoration/green_book
Great Lakes Image Collection, www.epa.gov/glnpo/image
Great Lakes Information Network, www.great-lakes.net
Great Lakes National Programs Office, www.epa.gov/glnpo

Great Lakes Research and Education Center, www.nps.gov/indu/naturescience/glrec.htm
Great Lakes Sea Grant, www.greatlakesseagrant.org/about.html
Great Lakes Science Center, www.greatscience.com
Great Lakes United, www.glu.org
Illinois-Indiana Sea Grant: Education Resources, www.iisgcp.orgeducation/topics_education.html
Indiana Dunes National Lakeshore, www.nps.gov/indu/forteachers
Inland Seas Education Association, www.schoolship.org
International Joint Commission, www.ijc.org
John G. Shedd Aquarium, Shedd Educational Adventures, www.sheddaquarium.org/sea
Lake Superior Youth Symposium, www.wupcenter.mtu.edu/education/lake_superior_symposium
Lakewide Management Plans, www.epa.gov/glnpo/gl2000/lamps
L.A.P.'s, Michigan Department of Natural Resources, www.dnr.state.mi.us/edu
Michigan Department of Environmental Quality, Michigan Environmental Education Curriculum Support, www.michigan.gov/deq/0,1607,7-135-3307_3580_29678---,00.html
Michigan Environmental Council, www.environmentalcouncil.org
Michigan Alliance for Environmental and Outdoor Education, www.michiganenvironmentaled.org
Michigan Sea Grant: Education Resources, www.miseagrant.umich.edu/education/index.html
Michigan United Conservation Clubs: Education Resources, www.mucc.org/index.php/youth-outreach
Minnesota Center for Environmental Education, www.d.umn.edu/ceed
Minnesota Sea Grant: Education Resources, www.seagrant.umn.edu/educators
National Wildlife Federation, www.nwf.org/Kids.aspx
National Wildlife Federation: eNature, www.enature.com/home
National Wildlife Federation: Happenin' Habitats, http://happeninhabitats.pwnet.org/index.php
National Wildlife Federation: Schoolyard Habitats and Resources, www.nwf.org/schoolyard
New York Sea Grant, www.seagrant.sunysb.edu
Ocean Arks International, www.oceanarks.org
Ohio Sea Grant, www.ohioseagrant.osu.edu
Ohio Sea Grant: Great Lakes Literacy, www.greatlakesliteracy.net
Peggy Notebaert Nature Museum: Education Resources, www.naturemuseum.org/education
Pennsylvania Sea Grant: Education Resources, www.seagrant.psu.edu/education/resources.htm
Pier Wisconsin, www.pierwisconsin.org
TEACH Great Lakes, www.great-lakes.net/teach
TEACH Great Lakes, Education Resources, www.great-lakes.net/teach/links
Tlfft Nature Preserve, Buffalo Museum of Science, www.sciencebuff.org
Tom Ridge Environmental Center, www.trecpi.org
Union of Concerned Scientists: Great Lakes Communities and Ecosystems at Risk, www.ucsusa.org/greatlakes
US Fish and Wildlife Service, www.fws.gov
Wisconsin Great Lakes Education Clearinghouse on EE in Wisconsin, www.eeinwisconsin.org/core/item/page.aspx?s=83585.0.0.2209
Wisconsin Maritime Museum, www.wisconsinmaritime.org
Wisconsin Sea Grant: Education Resources, www.seagrant.wisc.edu/education
Wolf Ridge Environmental Learning Center, www.wolf-ridge.org

Departments of Natural Resources by States and Provinces

Illinois Department of Natural Resources, www.dnr.illinois.gov
Indiana Department of Natural Resources, www.in.gov/dnr
Michigan Department of Natural Resources, www.michigan.gov/dnr
Michigan Department of Natural Resources: Wildlife and Habitat, www.michigan.gov/dnr/0,1607,7-153-10370---,00.html
Michigan Department of Natural Resources: Wildlife Educational Resources, www.michigan.gov/dnr/0,1607,7-153-10369-57667--,00.html
Minnesota Department of Natural Resources, www.dnr.state.mn.us
New York State Department of Environmental Conservation, www.dec.ny.gov
Ohio Department of Natural Resources, www.dnr.state.oh.us
Ontario Ministry of Natural Resources, www.mnr.gov.on.ca/en/index.html

Pennsylvania Department of Conservation and Natural Resources, www.dcnr.state.pa.us
Wisconsin Department of Natural Resources, www.dnr.wi.gov

Wetland Sites by States and Provinces

Illinois Wetlands, www.district96.k12.il.us/TG/Wetlands/Wetlands.html
Indiana Wetlands, www.in.gov/wetlands
Michigan Environmental Council, www.environmentalcouncil.org Michigan Natural Habitats: http://web4.msue.msu.edu/mnfi/communities/index.cfm
New York State Wetlands Forum, www.wetlandsforum.org
Ohio Wetlands Foundation, www.ohiowetlands.org
Ontario Wetlands, www.ec.gc.ca/tho-wlo
Wisconsin Wetlands Association, www.wisconsinwetlands.org
Wisconsin Department of Administration, Coastal Management Program, www.doa.state.wi.us/section.asp?linkid=65&locid=9
U.S. Fish and Wildlife Service Wetlands Mapper, www.fws.gov/wetlands/Data/Mapper.html

Additional Wetland Sites

Definition of Wetland: www.water.ncsu.edu/watershedss/info/wetlands/definit.html
Digital Coastal Change Analysis Data: www.csc.noaa.gov/digitalcoast/data/ccapregional/
EPA – Great Lakes ecosystem overview: www.epa.gov/ecopage/wetlands/glc/glctext.html
Great Lakes Coastal Wetlands Consortium: http://glc.org/wetlands/flora-fauna.html
Michigan Sea Grant – Great Lakes Coastal Habitats: www.miseagrant.umich.edu/explore/coastal-habitat/index.html

Sand Dune Sites

Indiana Dunes National Lakeshore, www.nps.gov/indu
Parks in the Great Lakes, www.great-lakes.net/tourism/rec/parks.html
Preserve the Dunes, www.sosdunes.org
Sand Dune Park Geology Tour, www.nature.nps.gov/geology/tour/sanddune.cfm
Sand Dune Ridges and Dunes in the Calumet Region, www.newton.dep.anl.gov/natbltn/700-799/nb709.htm
The Unofficial Sleeping Bear Dunes Home Page, www.leelanau.com/dunes/dunes
Save the Dunes Council, www.savedunes.org
Sleeping Bear Dunes, www2.nature.nps.gov/geology/parks/slbe

Careers

Career Clickers eXpanded www.learnmoreindiana.org
Career Interest Inventory: www.careerperfect.com/content/career-planning-work-preference-inventory/
Forestry career: www.forestrycareers.org/sub_disciplines.php
Great Lakes Careers: www.schoolship.org/careers
Great Lakes, Great Careers: www.miseagrantumich.edu/flow/pdf/U3/FLOW-U3-L5-MICHU-08-403.pdf
Great Lakes Information Network Jobs Listserv: www.great-lakes.net/pipermail/glin-jobs/last30/date.html
Great Lakes Marine Careers: www.marinecareers.net
Survey: www.learnmoreindiana.org/careers/exploring/Pages/IndepthCareerInterestInventory.aspx

Conservation/Restoration

Biodiversity in the Great Lakes Basin: www.epa.gov/ecopage/glbd/issues/intro.html
Chicago Metropolitan Agency for Planning: www.cmap.illinois.gov/
Great Lakes Commission: www.glc.org/
Great Lakes Fishery Commission: www.glfc.org/fishmgmt/
Great Lakes Restoration Projects: www.great-lakes.net/links/envt/
Great Lakes Today: Concerns: www.epa.gov/greatlakes/atlas/glat-ch4.html
GLRI Projects: www.epa.gov/glnpo/glri/2010GLRIProgramsProjects.pdf
Great Lakes Restoration Initiative Action Plan: http://yosemite.epa.gov/sab/sabproduct.nsf/RSSRecentHappeningsBOARD/750D38466C98D0818525771A0068B925?OpenDocument
Highland Park Waterfront Restoration: www.blueraritan.org/Studio/HPReport.pdf
The Kinnickinnic River Corridor: www.groundworkmke.org/pdf/kk.pdf
Lakewide Management Plans: www.epa.gov/greatlakes/lamp/index.html
The Nature Conservancy in Indiana – Ivanhoe Dune and Swale Nature Preserve: www.nature.org/wherewework/northamerica/states/indiana/misc/art32172.html
NOAA, Coastal Zone Management, http://oceanservice.noaa.gov/tools/czm/; http://coastalmanagement.noaa.gov/programs/czm.html
NOAA, Damage Assessment, Remediation, and Restoration Program, www.darrp.noaa.gov/greatlakes/index.html
NOAA, Great Lakes Habitat Restoration, www.habitat.noaa.gov/restoration/programs/greatlakes.html
Northwest Indiana Regional Planning Commission, www.nirpc.org/
Nonpoint Source Pollution, http://oceanservice.noaa.gov/education/kits/pollution/supp_pollution_roadmap.html
Sustain Our Great Lakes, www.sustainourgreatlakes.org
Water Quality Project, www.michigan.gov/documents/deq/ess-nps-fs-harper-beadle_208829_7.pdf

Mapping/GIS/GPS

ArcGIS, www.esri.com/software/arcgis/index.html

Bathymetry and Lakes, http://lakewatch.ifas.ufl.edu/circpdffolder/Morph2ndEdPt2.pdf
Geodata's federal, state, and local geographic data, http://gos2.geodata.gov/wps/portal/gos/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKL9443cnIFSYGYfpb6kehCFgghX4_83FR9b_0A_YLc0IhyR0VFAEZ_VEU!/delta/base64xml/L3dJdyEvUUd3QndNQSEvNElVRS82X0xfSVI GIS Tip Sheet: www.classroomearth.org/GIS_Tips
Great Lakes Ecological Assessment – GIS Maps, www.ncrs.fs.fed.us/gla/maps.htm
The Great Lakes Information Network (GLIN), http://gis.glin.net/
Make a topo map, www.education.com/activity/article/Make_Topographic_Map/
Make a topo map, http://spaceplace.jpl.nasa.gov/en/kids/srtm_make1a.shtml
Maplandia, www.maplandia.com/united-states/illinois/lake-county/great-lakes/
Mapping, www.socialstudiesforkids.com/articles/geography/mapsavvy1.htm
Maps and Graphics, www.amaps.com/mapstoprint/GREATLAKESDOWNLOAD.htm
Maps, Maps, Maps, www.pbs.org/edens/denali/maps.htm
Map symbols, http://egsc.usgs.gov/isb/pubs/booklets/symbols
National Map Viewer, http://viewer.nationalmap.gov/viewer/
National Land Cover Database, http://gisdata.usgs.net/website/MRLC/viewer.htm
Natural Connections green infrastructure maps (14 counties in WI, IL, IN), http://www.greenmapping.org/maps/
Teaching with Google Earth, http://serc.carleton.edu/introgeo/google_earth/index.html
Topographic Maps, http://ngmdb.usgs.gov/Other_Resources/rdb_topo.html
Topographic Maps, http://store.usgs.gov/b2c_usgs/b2c/start/(xcm=r3standardpitrex_prd)/.do
Topographic Maps-Natural Resources Canada, http://maps.nrcan.gc.ca/topo101/index_e.php

Native and Invasive Species

Center for Invasive Plant Management, www.weedcenter.org/education/k-12.html
Dichotomous Key, http://creekconnections.allegheny.edu/Modules/On-LineActivities/Wetlands/ThisPlantKeyIsAllWet.pdf
Dichotomous Key (trees), www.forestry.about.com/library/treekey
Guide to Dichotomous Key (trees), www.dnr.state.wi.us/org/caer/ce/eek/veg/treekey/index.htm
Great Lakes Invasive Species, www.glerl.noaa.gov/res/Programs/glansis/glansis.html
Identifying Trees, www.fw.vt.edu/dendro/dendrology/syllabus/factsheet.cfm?ID=184
Invasive Species, www.great-lakes.net/envt/flora-fauna/invasive/invasive.html
The Lionfish Invasion, http://oceanservice.noaa.gov/education/stories/lionfish/teachers.html
Using a Dichotomous Key, www.cteonline.org/portal/default/Curriculum/Viewer/Curriculum?action=2&cmobjid=203121&view=viewer&refcmobjid=202344
A Walk in the Forest, http://nationalzoo.si.edu/Education/ConservationCentral/walk/walk4.html

Watersheds

Adopt a Watershed, www.epa.gov/owow_keep/adopt/index.html
Locate Your Watershed, http://water.usgs.gov/wsc/map_index.html
Surf Your Watershed, http://cfpub.epa.gov/surf/locate/index.cfm
Watershed Model, www.watershedactivities.com/projects/fall/h2omodel.htmlWatershed Project: http://www.michigan.gov/documents/deq/ess-nps-wmp-battle-creek-river_208908_7.pdf

Miscellaneous

Gardening, www.plantnative.org/how_intro.htm
Making Books, www.makingbooks.com/freeprojects.shtml
National Wildlife Federation's Schoolyard Habitat Program, www.nwf.org/Get-Outside/Outdoor-Activities/Garden-for-Wildlife/Schoolyard-Habitats.aspx
Service Learning, http://servicelearning.cps.k12.il.us/Guidelines.html

Curricula

Drinking Water Activity, http://water.epa.gov/learn/kids/drinkingwater/index.cfm
ESCAPE: Exotic Species Compendium of Activities to Protect the Ecosystem, Illinois/Indiana Sea Grant, www.iisgcp.org/catalog/ed/esc.htm
Exploring the Great Lakes: A Logbook of Adventures, Patricia Westfield and Nan Soper, www.riverroadpublications.com/HTML/StateStudies.html
Fresh and Salt, COSEE Great Lakes, www.coseegreatlakes.net/curriculum
Great Lakes in My World K-8, www.greatlakes.org/GLiMW
Great Minds? Great Lakes!, United States Environmental Protection Agency, Great Lakes National Programs Office, www.epa.gov/glnpo/monitoring/great_minds_great_lakes/
Greatest of the Great Lakes, COSEE Great Lakes, www.coseegreatlakes.net/news/20070402

Lake Rhymes: Folk Songs of the Great Lakes (includes a cd), Lee and Joann Murdock, www.leemurdock.com/lm_html/music/lakerhymes.htm
Learning to Give: A Day at the Beach, www.learningtogive.org/lessons/unit85/overview.html
Michigan Department of Environmental Quality: Michigan Environmental Education Curriculum Support (MEECS), www.michigan.gov/deq/0,1607,7-135-3307_3580_29678---,00.html
Ohio Sea Grant Publications (ES-EAGLS): Land and Water Interactions in the Great Lakes, Great Lakes Climate and Water Movement, Great Lakes Shipping, Life in the Great Lakes, Great Lakes Environmental Issues, http://earthsys.ag.ohio-state.edu/project/pubs/ES_EAGLS.html
Paddle-to-the-Sea: Supplemental Curriculum Activities, http://earthsys.ag.ohio-state.edu/project/pubs/Paddle.html
Pollution Lesson Plan, www.cacaponinstitute.org/pollution_lesson_plan.htm
Pollution Worksheets, www.lessoncorner.com/Science/Environment/Pollution?page=3
Project Flow, Michigan Sea Grant Extension, Michigan State University, www.miseagrant.umich.edu/flow/
The Science Spot, http://sciencespot.net/Pages/classgpslsn.html
Topographical Mapping, www.its.umn.edu/Education/k12outreach/modules/TopographicMapping/ http://stwww.weizmann.ac.il/g-earth/geogroup/whole_articles/a11-whole.pdf
Wetland Activity, http://resources.cas.psu.edu/ipm/lessons/strife.pdf
Wisconsin Center for Education, K-12 Educational Resources, www.uwsp.edu/cnr/wcee/PDF/Bibs/LandUse.PDF
Working With Water: Wisconsin Waterways, Teacher's Guide and Student Materials, Wisconsin Historical Society, Office of School Services, www.wisconsinhistory.org/whspress/books/book.asp?book_id=242

Visual Media

The Great Lakes Research and Education Center: Materials for Loan – Video Collection, call: 219-395-1987, or visit: www.nps.gov/indu/forteachers/materialsforloan_videos.htm
The Field Museum: N.W. Harris Learning Collection - Loan Exhibit Cases and Experience Boxes, email: harris@fieldmuseum.org, or visit: http://harris.fieldmuseum.org/index/default.php

Compact Discs

Biodiversity Around the Great Lakes, US EPA Great Lakes National Programs Office
Exploring the Great Lakes, US EPA Great Lakes National Programs Office
Wet Your Waders - an interactive field trip to a stream near you, LaMotte, North American Benthological Society, Earth Force, Hoosier Riverwatch
Wetlands Educational Curriculum, US EPA

Great Lakes in My World 9-12: Calumet | A 9-12 grade curriculum for Calumet Is My Back Yard (CIMBY), which addresses Common Core State Standards, Next Generation Science Standards, and the Chicago Public Schools Framework for Teaching through science, mathematics, language arts, social science and more activities

CONNECT to the Calumet region by inspiring care and a sense of place.

EXPLORE habitats of the Calumet region while learning about ecology, communities and careers.

INVESTIGATE solutions to issues that affect the Calumet region and the Great Lakes.

RESTORE natural areas through service-learning activities in the field

SYNTHESIZE data and develop plans to improve the Calumet region and the Great Lakes.

181 page curriculum focused on understanding and stewarding Calumet habitats

20 indoor and outdoor activities

1 USB flash drive with supplemental materials

155 words defined in a glossary for students and teachers

62 Student Journal Pages

"The GLiMW 9-12 curriculum is an outstanding resource to help teachers develop ways that connect their students to their local environment in a meaningful way -- and that these lessons will carry beyond their school years, potentially creating advocates and stewards for the most important resource in our area."

Rebecca Corrigan, teacher, Lincoln Park High School, Chicago Public Schools

"This is a terrific collection of lessons that connect, explore, investigate and synthesize all that is so special about the Great Lakes."

Janet Vail, Associate Research Scientist, Annis Water Resources Institute, Grand Valley State University

"Curriculum such as this can help bridge the expanse between a student's education and the role as citizen in their community."

Jon Yoder, national consultant for sustainability education and Secondary Education Coordinator, Northwest Center for Sustainable Resources

"There has never been a more important time for students to be aware of the intricate and inextricable ties residents have to their Great Lakes."

Darci Sanders, Director of Education, Lake Erie Nature & Science Center

"GLiMW 9-12: Calumet gives CIMBY students the opportunity to understand the rich, biodiverse ecosystems just outside of their classroom doors. Teachers connect students to their local community and implement place-based education strategies which help them improve their professional practice in and out of the classroom.

Samantha Mattone, Chicago Public Schools

"This curriculum brings the connectedness of the animals, habitats and people of the Great Lakes into the classroom in imaginative ways that will inspire understanding and action to protect these valuable freshwater resources."

Melissa Williams, Vice President of Learning, Shedd Aquarium

"Great education is rooted in 'place.' The Great Lakes in My World 9-12 curriculum is a perfect tool to connect youth to their communities, develop stewardship skills and introduce environmental careers vital to sustaining our wonderful 'place.'."

Susan Santone, Executive Director, Creative Change Educational Solutions

"The new Great Lakes in My World 9-12 curriculum can be easily integrated into existing secondary social studies and science courses. Through inquiry and hands-on activities, students will explore their local Great Lakes watershed. They will investigate relevant, place-based Great Lakes issues and develop the skills and strategies needed to take an active role in resolving these issues."

Dennis Yockers, Professor of Environmental Education and Natural Resources, Wisconsin Center for Environmental Education, University of Wisconsin – Stevens Point

"This compendium of engaging lessons moves learning from awareness to action. Students gain an appreciation for and understanding of the complexities within the Great Lakes watershed, while building the critical thinking and problem solving skills needed to become responsible community members and advocates for this magnificent ecosystem."

Lyndsey Manzo, Ohio Sea Grant Educator and Science Teacher, Westerville North High School, Westerville, OH

ALLIANCE FOR THE GREAT LAKES
ENSURING A LIVING RESOURCE FOR ALL GENERATIONS

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