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 coastal plants.

OBJECTIVES

Sort and classify plants by characteristics

Research native and non-native species found along the Great Lakes coasts

Create pages for a Great Lakes native coastal plant "field guide"

SUBJECT

Biology, Ecology, Botany

PREREQUISITE

A visit to a coastal habitat where students make observations about specific plants. If students did not visit a habitat, they may choose any Great Lakes 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 (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 Great Lakes 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.

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 Great Lakes native plant species. 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 -- Alien Invasion: Plants on the Move." 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 at the dunes? Why are there multiple classification systems?

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 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 coastal 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 61.

RESOURCES

Please see Resource List for additional information related to Great Lakes 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 _____

7
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. The Great Lakes ecosystem has 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 coastal 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 coastal habitat, such as a wetland, shoreline forest, 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 plans 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

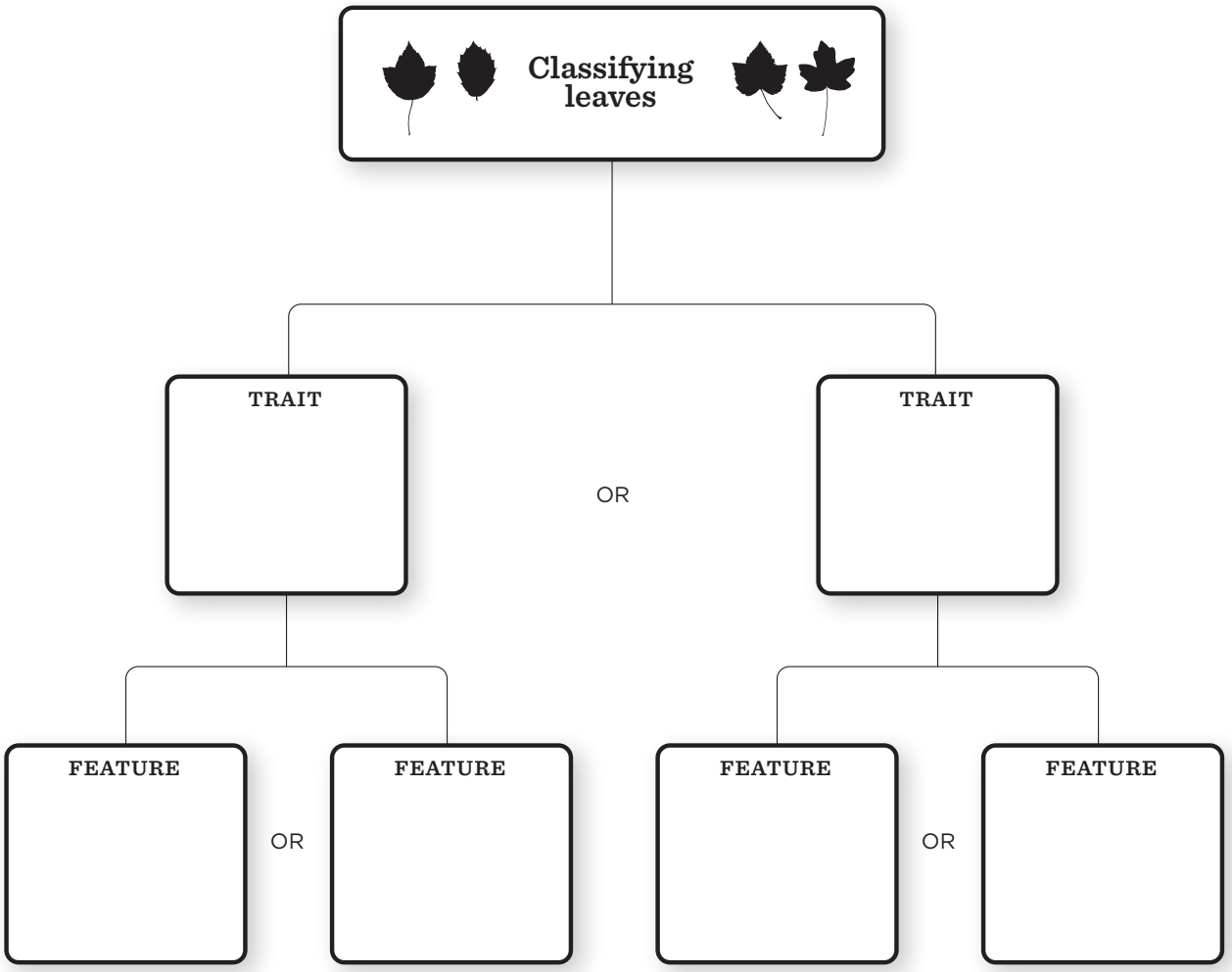
4. Your species:_____ Is it native or invasive? (circle one)

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.



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

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

WRAP-UP QUESTIONS

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 coastal 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