Lessons and Activities to Supplement the

Life Along a Prairie River poster

Exploring the ecology of the wide and sandy rivers of the Great Plains

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Information for Educators

Dear Educators,

We hope you will enjoy bringing activities about prairie river ecosystems into your classrooms! This booklet is designed so that you can utilize the entire book or you can pick individual activities. Activities and lesson plans are appropriate for middle school level students, but can be modified for different age groups. We have covered a wide range of ecological topics and have emphasized prairie river ecosystems. We expect these activities will help you to explore ecological topics close to your "backyard."

For ease of incorporating these activities into the classroom, we have included a "Copy Me" graphic at the bottom of pages to indicate which pages could be handed out to students to complete the activities. We have included a glossary of keywords, which you will find underlined throughout the booklet. For your reference, Appendix A lists the national and Oklahoma education standards addressed in each activity.

The activities culminate in a BioBlitz, tying together lessons in the booklet as well as many other science topics and skills. A schoolyard BioBlitz is a great opportunity for students to take their new knowledge out into nature! You can contact our office for support and more information about planning your BioBlitz.

This booklet and poster are on our Web site in PDF format and available for printing straight from the computer for your specific classroom needs. The project Web site also contains additional information about the topics covered in this activity booklet and a list of many other useful and reliable Web sites.

Feel free to send us any comments regarding the poster and this supplemental booklet. Your input will help us in the development of future posters and associated educational materials. Again, we hope you enjoy bringing prairie river ecosystems into your classrooms and talking to your students about the biodiversity all around them!

Thanks for your interest in promoting the natural diversity of prairie rivers!
Priscilla and ***Sarah***

To request the full color, 28 x 22 inch poster that accompanies this guide, call (405) 325-7658 or go to our Web site: www.biosurvey.ou.edu.

Contents

Introduction to Prairie Rivers

Rivers have a vital role in the landscape, although river water makes up only about 0.2% of the Earth's freshwater. Rivers are like highways — with water, animals, and seeds travelling along this road. Energy and nutrients also flow along this corridor. Rivers and their associated wetlands help to absorb and drain rainwater.

The large, sandy-bottomed prairie rivers of the Great Plains are generally under appreciated in spite of their biological diversity and wildlife viewing potential. On a brief walk along one of these captivating rivers, you may observe dozens of herons fishing along the water's edge, turtle tracks criss-crossing in the sand, coyotes skirting the edge of the trees, migrating shore birds wading in isolated puddles and pecking in the mud deposits, leaves of the majestic cottonwood waving in the breeze, and fish spawning in the shallow, turbid water.

Many prairie rivers are "braided" — meaning that the river is divided into several smaller channels that are separated by temporary islands or sandbars. Braided rivers occur in relatively flat regions, such as western and central Oklahoma, with an abundant supply of sediment. Eroding sandbars and sandy river banks contribute to the sediment that is deposited in the river channel creating the islands. Braided and meandering rivers are usually highly mobile with the river channel moving during flood events (see the activity "How does flooding change the landscape?").

Braided and meandering section of the Canadian River south of Lexington, Oklahoma.

Label the Prairie Rivers of Oklahoma and the reservoirs built to capture their water.

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Ecosystems

Do You Live In an Ecosystem?

Everything in our world is connected. To understand the connections in the natural world, we need to study both living and non-living components of our planet. Biotic, or living parts, and abiotic, or non-living parts, function together to form an ecosystem. The biotic components include organisms and the interactions they have with one another. The abiotic factors are things such as temperature, light, soil, and water. Both living and non-living factors work together to form a complex system of energy and resource transfers.

Ecosystems have no particular size. They can be as large as a lake or as small as a puddle. Every centimeter of the planet is part of an ecosystem, and every part works together to make a balanced system. Each species in an ecosystem has a function, or niche, that helps keep the system working smoothly, but that doesn't mean a healthy ecosystem never changes. A healthy ecosystem has high species diversity, which helps the system recover after a disturbance, such as damage caused by humans or by a natural disaster. For example, torrential rains can flood a forest, reducing the population of ground-dwelling birds, but water fowl in the area increase due to added suitable habitat. As the floods recede over time, the balance of ground-dwelling birds to water fowl will shift again. Therefore, the forest needs a diversity of birds to take advantage of the variety of environmental conditions that can occur over time.

Too much disturbance in an ecosystem will cause it to lose diversity. Today, human actions are having negative impacts on natural ecosystems all over the world. The building of roads and homes, recreational activities, and farming reduce the biodiversity of natural ecosystems. Contamination of the abiotic components is sending many ecosystems out of balance, too. As part of the living organisms inhabiting the global ecosystem, humans need to be aware of their role in the ecosystem and how they can minimize their negative impact.

Wading Deeper - River Ecosystems

The river ecosystem can be broken down into three zones: benthic, aquatic, and terrestrial.

The benthic zone consists of the streambed and the organisms that live in, under, or close to it. In the benthic zone, species are usually attached to or buried in the substrate and are accustomed to being submerged in the water. In slow moving rivers, organic material from dead and decaying organisms accumulates on the streambed. This material becomes the food for invertebrates that live in or on the substrate. The primary producers in the benthic zone are not true plants, but instead are green algae. The green, slippery slime in streambeds is most likely microscopic, filamentous algae.

The aquatic zone includes the flowing water in the river and the animals in it. Slow-moving streams have a high diversity of insects and other invertebrates. Many of the insects are in their larval or nymph stage when they live in the water, for example mosquitos and dragonflies. These immature insects are the food for many fish species. Other invertebrates, such as leeches, mussels, and worms, also live in the aquatic zone. Larger animals can also thrive in slow-moving rivers. Frogs, newts, and otters also may live in rivers where they can withstand the current.

The terrestrial or riparian zone consists of land adjacent to the river and the organisms that inhabit the land. This zone can be steep river banks with a narrow strip of vegetation or a wide shallow floodplain that includes wetlands. Both types of habitat along rivers are important to the river ecosystem because riparian vegetation is an important source of the organic matter in the benthic zone. Riparian vegetation can reduce the damage caused by floods by stabilizing the soil and riverbanks. Wetlands function as filters by reducing soil entering the river, trapping nutrients before they wash away, and providing habitat for organisms that utilize the river resources, such as beaver, raccoons, bats, and song birds.

Although the zones can be described separately, there are numerous connections and interactions among the benthic, aquatic, and terrestrial zones of a river.

For more river ecosystem information, visit our Web site for educational links: *www.biosurvey.ou.edu*

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Ecosystems

Activity – Get to Know Your Schoolyard Ecosystem

Materials

- An outdoor area such as your schoolyard, park, or outdoor classroom.
- String
- Magnifying glass
- Thermometer
- Popsicle sticks
- Journal or paper for collecting observations and data
- Small gardening tools

Procedure

First, locate a small patch of land to examine. Choose any place that you find interesting and has at least a few plants.

Using popsicle sticks and string, partition an area for examination.

Record observations about organisms in your ecosystem:

- List the organisms you find. (Don't worry if you don't know the names. Give a descriptive name to your species, such as shiny green beetle or skinny leaved plant.)
- Which species is most abundant?
- What organisms are producers in your ecosystem?
- What organisms are consumers?

Tip -- Don't forget to look underground!

Describe the abiotic components of your ecosystem:

- Record the temperature of the air and soil
- Use your trowel to examine the soil. Describe its texture and moisture.
- Describe the terrain or form of the land. (For example, is it flat, hilly, rocky, or a depression?)
- Which way does it slope? Does that affect the organisms that live there?

Questions for Discussion

1. What are some of the interactions that you see in your ecosystem?
2. Does your ecosystem have a lot of biodiversity?
3. Are there many different species or do just a few dominate?
4. Think of other organisms that could survive in your ecosystem.
5. What enables organisms to live successfully in your ecosystem?
6. What are some organisms that would not survive in your ecosystem? Why could they not survive?

Pulling it all together

Write a paragraph describing your ecosystem using the information you gathered and thinking about how your ecosystem functions.

Activity – Sampling the Biotic Components of a Ecosystem

Materials

- 1x1 meter square with string tied to make a grid of 10x10 cm squares (pvc pipe is a good material to use to make the quadrat)
- 1 yellow, 3 green, 5 blue, and 10 purple pieces of 9x12 inch construction paper (representing different tree species)
- 20 index cards (representing cattail clumps)
- 20-30 objects smaller than index cards, such as large paper clips, binder clips, or checkers (representing fourpoint evening primrose)

Procedure

In an area of at least 4x4 meters (open classroom or gym would be appropriate), place at random the construction paper, index cards, and small objects.

- 1 yellow = Green Ash
- 3 green = Box Elder
- 5 blue = Willow
- 10 purple = Cottonwood
- 20 index cards = Cattail Clumps
- 20-30 objects smaller than index cards = Fourpoint Evening Primrose

Count the number of evening primrose (small objects) and calculate the total area covered by trees (construction paper) and clumps of cattails (index cards).

Have students collect data using both sampling methods described below and record their data. You may want to form several groups so that students have a greater opportunity to perform the data collection.

For the quadrat method, have students randomly place the quadrat within your artificial riparian area. Students should record the number of squares within quadrat that are covered at least 50% by each tree species (construction paper). Students should record the number of squares within quadrat that are covered at least 50% by clumps of cattails (index cards). They should count the number of individual evening primrose (small objects). They should repeat their data collection in two or three randomly chosen places in the study area.

For the point transect method, students should place one end of a tape measure randomly in the study area. The transect should run for 3 m in a randomly chosen direction. Students should record what is directly under the tape measure at every 25 cm.

Students should use the worksheet to determine the total percentage cover of tree, cattail, and evening primrose plant density for each method.

Questions for Discussion

1. Which method did you prefer? Why?
2. Compare sampling results to the true densities that your teacher calculated. Which method better represented the real composition of your artificial ecosystem?
3. What is the downside of taking samples rather than inventorying the whole system?
4. If one method is clearly better in this situation, can you think of reasons to use the other method?
5. Which method was better at representing the "rare" species?

Sampling the Biotic Components of the Ecosystem Worksheet

Quadrat Method

Quadrat Area = _____ Total number of squares in quadrat = _____

Trees	# of squares containing 50% or more tree coverage	% cover of tree species (# of squares containing species divided by total # of squares)
Green Ash		
Box Elder		
Willow		
Cottonwood		
	# of plants in quadrat	Plant density (# of plants divided by total quadrat area)
Cattail Clumps		
Evening Primrose		

Transect Method

Length of transect = _____ Total number of points sampled = _____

Width of measuring tape = _____ Total area sampled (# of points *times* width of tape) = _____

Trees	# of points directly over tree species	% cover of species (# of points of each tree species divided by total # of points)
Green Ash		
Box Elder		
Willow		
Cottonwood		
	# of points directly over plants	Plant density (# of points over plants divided by total area sampled)
Cattail Clumps		
Evening Primrose		

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Are Floods Always Bad?

Flooding is a natural part of every river. Flooding creates the floodplains and wetlands that are vital components of a healthy river ecosystem. Damming rivers and building levees to prevent flooding can destroy wetlands and limit the ecological function of floodplains.

Wetlands are areas that are seasonally or permanently saturated with water and often have standing water. If we protect wetlands, they can be a natural defense against flooding of other areas and homes. Like a sponge, wetlands can soak up extra water during flood times because they are able to hold hundreds of thousands of gallons of water when saturated. Without a wetland to soak up the floodwaters, water may quickly flow across land and flood homes. Wetlands allow the slow release of floodwaters into the river system after the torrent of the flood is over. Wetlands also filter and cleanse water, contain many nutrients, and are habitats for thousands of different species of plants and wildlife. Marshes and swamps are both types of wetlands. Wetlands are home to aquatic species such as water lilies, frogs, and turtles. They are also important feeding areas for many migratory birds. When wetlands are destroyed, it takes away these and many other benefits.

Floodplains are areas near rivers that are occasionally or periodically flooded and have sediment deposited onto them by the flooded rivers. The sediments deposited make floodplains rich in nutrients and can support diverse ecosystems. Floodplains link rivers, wetlands, and lakes and are an important part in keeping all of these ecosystems functioning. In order for floodplains to function properly, they need to flood occasionally. Cutting floodplains off from rivers and lakes by levees can be destructive for the river and the floodplain. Due to the rich soil deposited by floods, floodplains have been used extensively for agriculture. It is important however that they are still managed properly in order to maintain the health and diversity of the floodplain.

Activity – How Does Flooding Change the Landscape?

In 2007, there was record-breaking rainfall in central Oklahoma that caused significant flooding along many of the rivers in Oklahoma. On the next page you see pictures of the same reach of the Canadian River in 2005 and 2008, before and after this season of excessive rainfall. These pictures are an excellent illustration of the environmental change after a flooding event. Examine the pictures and write a paragraph describing the changes you see.

Imagine standing on the river bank during the flood!

Questions for Discussion

1. What happened to the river channel after the floods?
2. Why is there more sand exposed in 2008?
3. Is this a good thing for the wildlife? *(hint - read the section on the least tern)*
4. Would you like to live in the neighborhood in the upper right corner of the picture? Why or why not?
5. Would you like to have a farm on the floodplain? Why or why not?
6. What do you think the river looked like during the floods?

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Activity – How Does Flooding Change the Landscape?

Endangered Species

Do You Have Endangered Species in Your Neighborhood?

To be endangered means that a species is at risk of extinction. A species is considered extinct when there are no more of that species alive on the planet, for example, *Tyrannosaurus* dinosaurs, wooly mammoths, and passenger pigeons are all extinct. Human activity, changes in climate, and habitat loss are some of the causes of recent species extinction.

The Endangered Species Act of 1973 (ESA) was signed on December 28, 1973, and provides for the conservation of species that are endangered or threatened and the conservation of the habitat on which these species depend. In addition to the term endangered, the ESA defined the term threatened to mean a species likely to become an endangered species within the foreseeable future.

Some endangered or threatened species from around the world include:

Arizona hedgehog cactus (Arizona)
Green Sea Turtle (warm tropical oceans)
Jamaican Giant Swallowtail Butterfly (Jamaica)
Mississippi Sandhill Crane (Mississippi)
Tigers (Asia)
Giant Panda (China)
Jaguars (Mexico and SW U.S.)
Killer Whale/Orca (Pacific Ocean)
Red Wolf (SE U.S.)
Kauai Cave Wolf Spider (Hawai'i)

Wading Deeper - Least Tern

Interior least terns (*Sterna antillarum athalassos*) are a subspecies of the least tern that live in the Great Plains and Mississippi Valley. This subspecies was added to the federal list of endangered species in 1985 due to a population decline caused by the loss of breeding habitat in the center of the United States.

Breeding Behavior

Least terns nest on the ground in bare sand, gravel, or shells on dry mudflats, salt plains, or in sand and gravel pits. The natural dynamics of prairie rivers maintain the sandbars that terns prefer for nesting. The water fluctuations that come with flooding and dry periods create sandbars bare of vegetation that are attractive to terns for nest sites. However, many of the best habitats for breeding have been lost or disturbed due to river damming, dredging, and straightening. By regulating the rivers, we have disrupted the flood cycle that scoured vegetation out of the riverbed and shifted the sandbars in the wide river bottom. Regular flooding reduces the invasion of the riverbed by plants. However, floods during the breeding season can wash away tern nests, eggs, and chicks. Too little water in the river also can adversely affect the terns by reducing the fish population, and consequently, the food source for terns. To be successful, terns that breed in Oklahoma rivers need a combination of suitable sandbars, favorable water levels, and sufficient food during the nesting season.

Human Impacts

In addition to the change in the natural river processes, terns are also threatened by increased disturbance by humans. Our rivers have become very popular recreation areas. ATV use in and along the river has increased, which negatively affects the nesting birds. Because terns build their well-camouflaged nests on the ground, they are vulnerable to trampling by people, pets, and livestock. Even if we do not destroy the nest, human activity can keep parent birds away from the eggs and chicks, leaving them vulnerable to overheating or predation by other animals.

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Learn More About Endangered Species in Your Region

Choose an endangered or threatened species that lives in your state or region, research the species using materials in the library or online, and write a report about the species.

Information to include about your species:

- Scientific name
- Habitat
- Why the species is endangered
- What humans are doing to try to protect the species
- How ***you*** can help the species to recover

Don't forget a picture of your species!

Also include information about the Endangered Species Act and when your species was added to the endangered species list.

Your paper should include at least three sources properly cited. Your teacher can help you with proper citation.

You may also prepare a short presentation to educate your classmates about your chosen species.

Endangered and Threatened Species of Oklahoma

Common Name	Species Group
American Alligator	Reptile
American burying beetle	Insect
American peregrine falcon	Bird
Arkansas darter	Fish
Arkansas River shiner	Fish
bald eagle	Bird
black-capped vireo	Bird
gray bat	Mammal
Indiana bat	Mammal
least tern	Bird
leopard darter	Fish
lesser prairie-chicken	Bird
Neosho madtom	Fish
Neosho Mucket	Clam
Ouachita rock pocketbook	Clam
Ozark big-eared bat	Mammal
Ozark cavefish	Fish
piping plover	Bird
red-cockaded woodpecker	Bird
scaleshell mussel	Clam
western prairie fringed orchid	Plant
whooping crane	Bird

Resources:

Information can be found at your school and public libraries. If you have difficulty finding good sources, ask the reference librarian. They are there to help you find the information you need.

Good online sources for information are:

The Endangered Species Program at the U.S. Fish and Wildlife Service	*www.fws.gov/Endangered/wildlife.html*
Oklahoma Department of Wildlife Conservation	*www.wildlifedepartment.com*
Oklahoma Biological Survey	*www.biosurvey.ou.edu*
NatureServe	*www.natureserve.org*
Earth's Endangered Creatures	*www.earthsendangered.com*

For a more comprehensive list of online resources go to the Prairie River Poster page:
www.biosurvey.ou.edu/prairieriver.html

If you use Web sites other than the ones suggested, be sure your information is accurate and your source is reliable.

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Human Impact

How Do Humans Affect Rivers?

Humans have a great impact on ecosystems and biodiversity. Sometimes humans can have a positive impact on ecosystems, but often human actions can have detrimental ecological consequences. Changes in the environment that cause changes in ecosystem function can be described as disturbances.

Here is a list of some things that humans can do that have a negative impact on river ecosystems:

Damming – Obstructing the flow of a river or stream for energy production, to create a lake, or to control the levels of the water. Damming can be a great renewable resource for power, but it may destroy river ecosystems downstream. Damming can also be an effective flood control measure to ensure towns and neighborhoods are safe. Dams can obstruct the path of migratory fish and disrupt the life cycle of many different aquatic organisms.

Channelizing – Modifying a stream or river into a pattern other than what may be its natural meandering. This can have a major effect on floodplains.

Dumping – Discarding materials into a river. Any chemical, such as car oil or antifreeze, poured down a storm drain will flow directly into the river. Many people don't realize this water isn't "cleaned" before it runs right into a natural waterway.

Recreation – Activities done for relaxation or enjoyment. Examples of river recreation are driving ATVs, riding horses, walking a dog, fishing from a boat, or simply having a picnic. All of these activities could have a negative impact to river wildlife if not done carefully.

Littering – Careless disposal of trash and waste.

Domestic Animals - Waste from livestock can be washed into rivers, adding excessive nutrients and illness causing bacteria. Pet waste can also be a problem, but they are more likely to impact the wildlife of the river by chasing or hunting.

Invasive species – When species from far away are introduced into a new area it can have devastating effects. An invasive species is one that spreads into and throughout the habitat and locations of an environment, taking over other species. One alien, invasive species can totally wipe out a native species, change how the ecosystem functions, and reduce biodiversity of the area. For more information see "Aliens Are Taking Over Our Rivers!" section following this one.

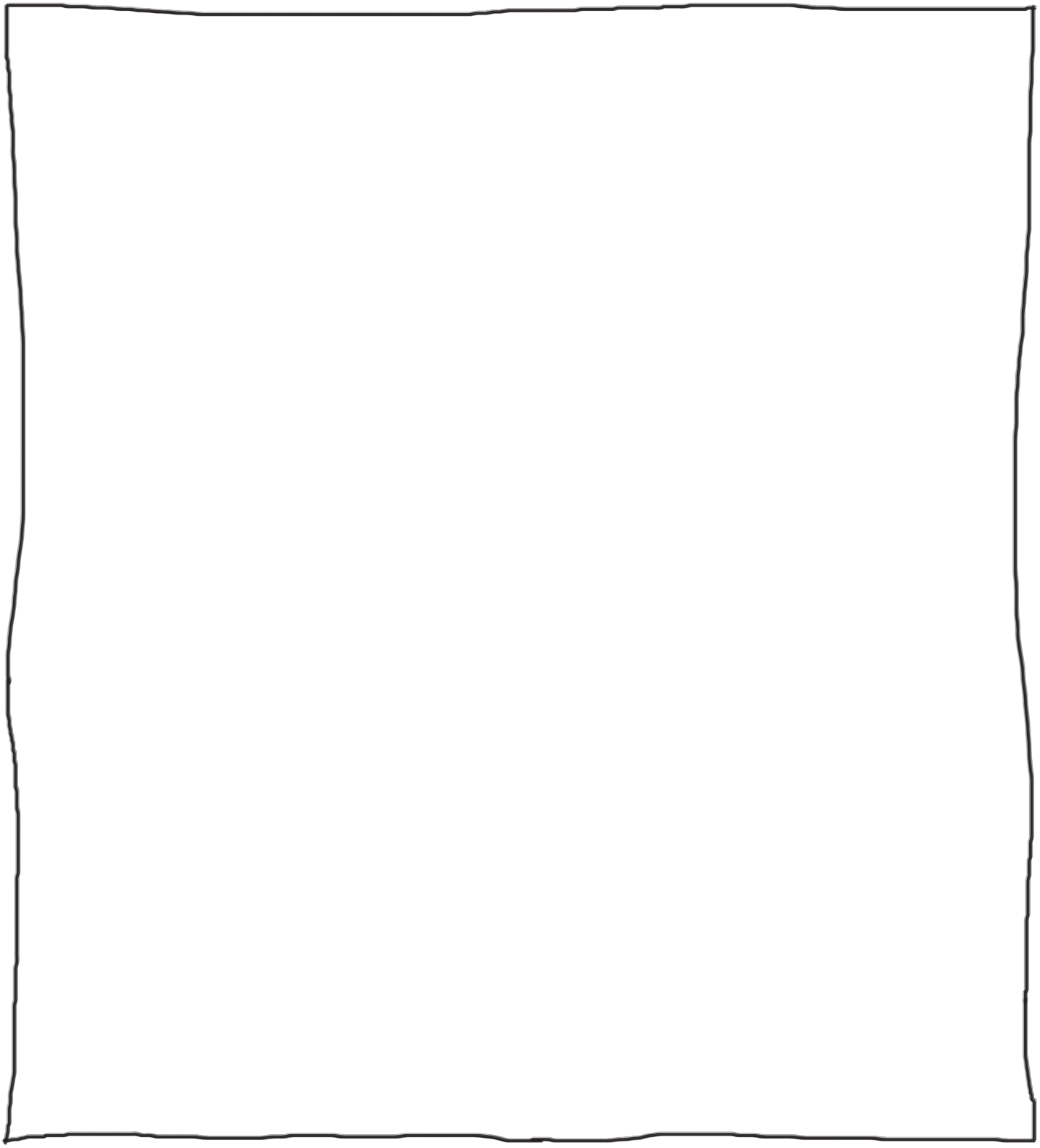
Wading Deeper - Point and Nonpoint Source Pollution

Point source pollution is pollution that happens at a certain location in a body of water. An example of point source pollution is when chemicals are discharged from a chemical plant into a body of water. In contrast, nonpoint source pollution occurs from many scattered sources. An example of nonpoint source pollution would be storm runoff that travels through fields and picks up contaminants that eventually ends up in a river. These contaminants may be fertilizers and pesticides from agriculture or bacteria from pet waste. These pollutants can have a negative impact on water quality in our lakes and rivers.

Nonpoint source pollution has been a problem in the North Canadian River in central Oklahoma. In 2007 a project was started to improve the water quality of the North Canadian River due to levels of fecal bacteria and turbidity (suspended particles in the water making it cloudy) that exceeded Oklahoma water quality levels. These high levels were coming from nonpoint sources such as livestock waste, fertilizers used in agriculture, and faulty septic systems.

Activity - Promote Clean & Healthy Rivers

Design a poster to educate your community on the importance of taking care of our rivers. Use the space below for your creative and original poster promoting clean and healthy prairie rivers. Include things you have learned from other activities found in the Prairie River Ecosystem booklet.



Go the Oklahoma Biological Survey Web site (*www.biosurvey.ou.edu*) to learn how to submit your poster to the Gallery of Clean and Healthy River Posters.

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Invasive Species

Aliens Are Taking Over Our Rivers!

A species usually does not occupy all the areas where it could grow. Boundaries such as mountains, rivers, oceans, and deserts stop the spread of organisms into areas that have suitable habitat. Now with the help of globetrotting humans, those geographic obstacles can be easily hurdled. Species have been jumping over boundaries with human assistance, both deliberate and accidental, and becoming alien entities in a new "world." We find plants from Africa in Hawai'i, birds from Europe in Oklahoma, and fish from China in Wisconsin.

If the habitat is right, alien species can survive and thrive in their new home. The alien species may reproduce and spread rapidly over the landscape if there are few competitors and predators in the new region. When this occurs, we may consider the alien to be invasive. Just because a species is not native doesn't mean that it will become invasive. Invasive species compete for space and resources with other species. Invasive species can take over an area because they are often good at producing many offspring and do not require a special habitat. By spreading and taking over areas in which native species live, invasive species can reduce biodiversity in an area. In fact, invasive species may be one of the biggest factors in the reduction of biodiversity around the whole world!

Not only do alien, invasive species have an environmental impact, but they have an economic effect as well. It is estimated that more than $136 billion is spent each year in the United States to manage invasive species. Finding and getting rid of invasive species before they become a major problem helps to reduce the money spent fixing the problem and the environmental damage done.

Wading Deeper - Tamarisk Along the Prairie Rivers

Many invasive species thrive in and along rivers. The waterway and associated riparian habitat can become a corridor for invasive species dispersal. Tamarisk, or salt cedar, is highly invasive along rivers in the western United States. Tamarisk (*Tamarix* species) was introduced from Europe and Asia to be grown in wind breaks, create shade in treeless areas, stabilize eroding stream beds, and be grown in gardens and yards as an ornamental shrub. Tamarisk prefer moist areas and grow primarily along waterways, even in salty water.

Tamarisk have spread along many rivers in western Oklahoma, including the Salt Fork of the Arkansas River, and taken over areas in the Great Salt Plains in north-central Oklahoma. Not only are they very invasive, growing in dense monocultures, but they also use a lot more water than native plants. This reduces the water available to native species and increases the salt concentration in the soil. Many native species cannot tolerate the drier, saltier soil. Tamarisk has changed the ecosystem by changing the soil chemistry.

The small plants in the foreground of this picture are newly sprouted tamarisks. Patches like this pop up on sandbars after flooding events.

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Invasive Species

Activity - Competition for Space: Alien vs. Native

You have an artificial landscape that is ready for colonization by three plant species. You may imagine that your landscape is an open sandbar recently scoured by flood waters. One plant species able to colonize the landscape is considered invasive in riparian systems, tamarisk. One species is common in the area, but doesn't usually dominate over other species, Maximillian sunflower. The last species is rare to sandbars and generally is only found is small patches, partridge pea. The colonization of the sandbar will be based on the reproductive potential of each species and the environmental conditions on the sandbar.

Take a large poster board and draw on it a grid of approximately 200-300 cells (small groups can use graph paper instead). The grid represents the landscape within which species can spread.

For your three species, you will need 3 sets of 200 markers that can be placed on the grid (such as 3 different kinds of beads, bingo markers, beans, paper cut outs - paper hole punches work well for graph paper grids). Divide your class into three groups and give each group one set of "species" markers.

Each group places one individual on the grid at the beginning. They may chose to locate it anywhere on the grid.

Each group takes a turn rolling the die to obtain a number representing the variation in environmental conditions that affect reproduction of plants - such as rain fall, temperature, birds eating seeds, etc… A roll of 1 indicates less suitable conditions and 6 indicates highly suitable.

After a group rolls the die, that number is multiplied by its reproductive potential and rounded up.

Invasive species has a reproductive potential of 1.3
Common native species has a reproductive potential of 1
Rare species has a reproductive potential of 0.5

The number represents the offspring for each "parent" and that number of markers should be added to the grid adjacent to each "parent" plant. For example, if the invasive group rolls 3, then they multiply 3 x 1 (their first individual on the board) x 1.3 = 3.9 and rounded up = 4. Four invasive markers will be added to the grid. You may use the table to keep track of your data. Each group gets a turn in each round.

In round 2, the invasive group has 5 individuals on the grid. They roll a 4 again and do the following calculation: 4 (environment suitability) x 5 (individuals on grid) x 1.3 (reproductive potential) = 26. Then they add 26 markers adjacent to any of the other invasive markers. When the grid is full, the game is over.

Before the Activity:

Generate at least two hypotheses to test based on what you know about your species, the landscape, and environmental variability. Here are some things that you might consider:

- Which species will spread fastest and why?
- What will happen when species meet?
- How would a barrier affect the colonization of an old field, such as a rock wall or abandoned tractor?
- How will the variation in environment (rolling the die) affect the colonization?

Variations:

How do these variations change the game?

- Place the first individuals in a different location.
- Try adding geographic obstacles that might limit the spread of species.
- At the beginning, put more than one individual of the rare species on the board.

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Invasive Species

Competition for Space Worksheet

		Invasive	Common Native	Rare Native
1	# of reproducing individuals for Round 1	1	1	1
2	Reproductive Potential	1.3	1.0	0.5
3	Environmental suitability (number from die)			
4	# of individuals added to grid (line 1 x line 2 x line 3)			
5	# of reproducing individuals for Round 2 (line 4 + line 1)			
6	Reproductive Potential	1.3	1.0	0.5
7	Environmental suitability (number from die)			
8	# of individuals added to grid (line 5 x line 6 x line 7)			
9	# of reproducing individuals for Round 3 (line 8 + line 5)			
10	Reproductive Potential	1.3	1.0	0.5
11	Environmental suitability (number from die)			
12	# of individuals added to grid (line 9 x line 10 x line 11)			
13	# of reproducing individuals for Round 4 (line 12 + line 9)			
14	Reproductive Potential	1.3	1.0	0.5
15	Environmental suitability (number from die)			
16	# of individuals added to grid (line 13 x line 14 x line 15)			
17	# of reproducing individuals for Round 5 (line 16 + line 13)			
18	Reproductive Potential	1.3	1.0	0.5
19	Environmental suitability (number from die)			
20	# of individuals added to grid (line 17 x line 18 x line 19)			
21	# of reproducing individuals for Round 5 (line 20 + line 17)			
22	Reproductive Potential	1.3	1.0	0.5
23	Environmental suitability (number from die)			
24	# of individuals added to grid (line 21 x line 22 x line 23)			

Questions for Discussion:

1. Which species spread across your artificial landscape most quickly? Why?
2. Invasive species compete with native species for resources and living space. Do your results indicate that your invasive species was a superior competitor for space?
3. Graph the number of individuals on the grid after each round for each species. How do the graphs differ for each species?
4. If you planted a highly invasive species in your backyard, what do you think would happen?
5. Would invasive plants do better in environments that people inhabit or in wild places? Explain your answer.
6. Would you get the same results every time you do the activity? Why or why not?

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Many Birds Are International Travelers

Why do birds migrate?

In order to survive, birds need basic things such as food, water, shelter, and a place to breed. As seasons change, an area that may have been ideally suited to provide all of these necessities may no longer offer what the bird needs. Food and water supply can diminish and plant cover may dwindle. Since some bird habitats may only be suitable for part of a year, many birds have a tool that enables them to continue to survive. This tool is migration. With the power of flight, birds are able to leave areas that no longer meet their needs and travel to new places to maintain food, water, and shelter.

A very important part of migration is stopover sites. These are areas where birds can stop to rest, eat and drink, nest, and find shelter. Without these vital stopover sites, many birds cannot survive migration. Birds may use the same stopover sites year after year for nesting and replenishing themselves. If one of these stopover sites is destroyed, either by humans or by a natural occurrence, it can leave migratory birds with nowhere to rest or find shelter.

The path that birds follow when they migrate usually goes along a geographic feature such as a mountain range or a river. River corridors provide many of the needs of waterfowl as they migrate each year. They can provide quiet beaches for species such as the interior least tern to fish, drink, and replenish themselves in preparation for continued migration. Birds may fly thousands of miles during their migration just one way, and it is vital that they have places where they can stop and rest.

How can you help migrating birds?

- Protect their stopover sites!
- Create a resting place for migrating birds in your own backyard.
- Put out a bird feeder.
- Plant fruit trees.
- Keep your bird bath full of water.
- Avoid using herbicides, fungicides, and pesticides on your yard. These chemicals can be very harmful for birds. Instead of using the pesticides, just try to attract a lot of birds that can feast on the insects in your yard!

Activity - What Is It Like to Migrate?

Imagine you are a bird that has just finished migrating for the season. Tell the story of your migration including…

- Why you migrated
- How you prepared
- When you left
- Your starting point and destination
- At least one major obstacle along your way and how you over-came that obstacle
- The things that helped you on your journey
- The things that made your journey difficult

Your story should be biologically accurate and can even be the specific journey of a bird species you have learned about in class. Illustrate your journey on a map, including major landmarks that may have helped along the way.

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How Do Biologists Identify Organisms?

Species identification

Proper identification of species is important to biologists if they want to compare their study area to other regions. Knowing the organisms that live in your region can help you to learn about their function within the ecosystem and why it is important to protect them.

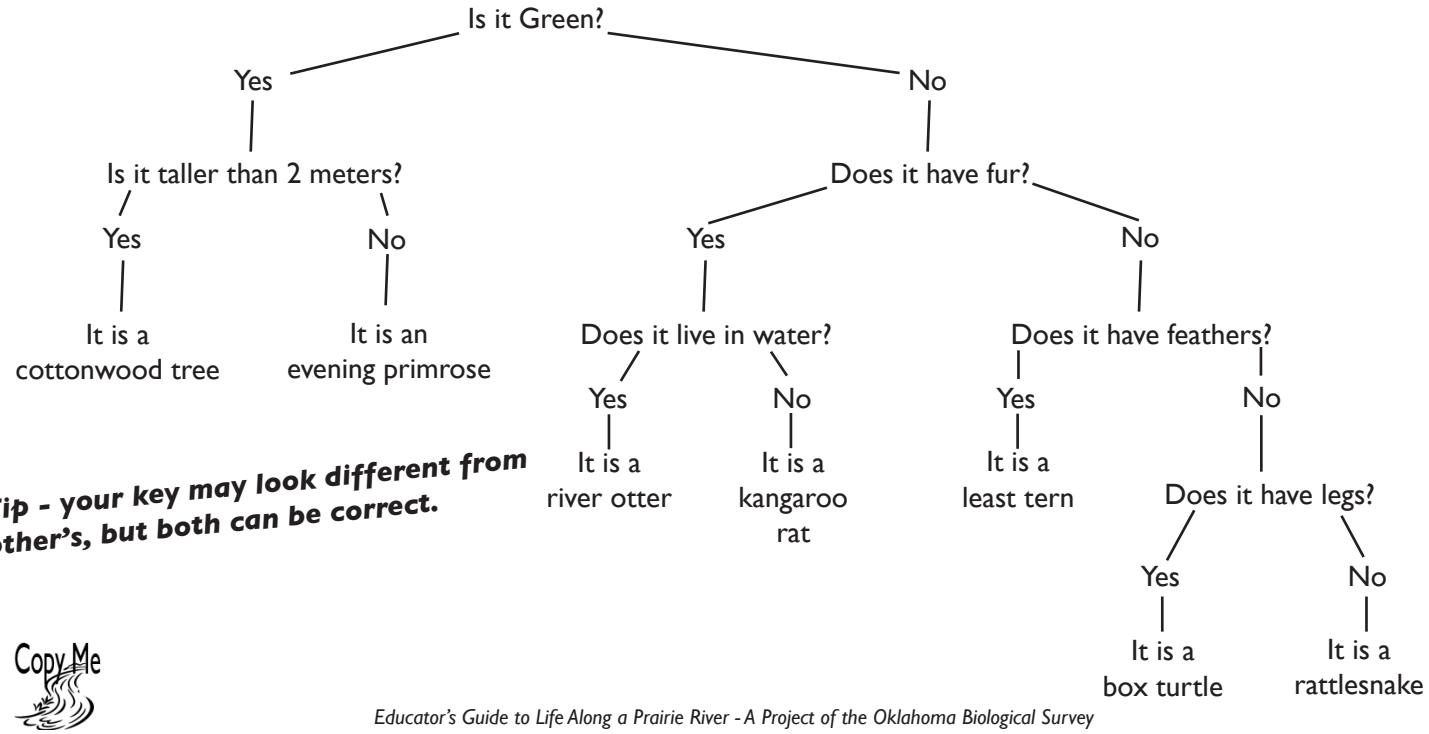
Dichotomous Keys

You have probably used a field guide to determine what bird or plant you saw on a field trip. To aid identification, many field guides group organisms based on features you can see. For example, a wildflower guide will group plants with the same flower color into one section. However, beyond that, most field guides expect you to flip through the pictures to figure out which species you observed. Unfortunately most field guides do not have an entry for all the species found in a region, and often pictures do not have all the information necessary to correctly identify a species. Biologists use identification guides that contain dichotomous keys to correctly identify species they observe. Dichotomous keys use a series of yes or no questions based on characteristics of the organism to determine the species identification.

Activity - Create Your Own Dichotomous Key

- Print out 20 pictures of organisms from your area or use the images from the Prairie River species profiles.
- Divide the pictures into two piles based on one characteristic of the organisms (*for example, does it photosynthesize?*). It doesn't matter if the piles are uneven.
- Use a large piece of paper and record the characteristic on your tree.
- Focus on one of the two piles. Divide this pile again based on one characteristic.
- Record on the tree.
- Continue dividing piles until there is only one organism in each pile.
- Repeat with your second pile from the first split.

Example dichotomous tree using some of organisms found on the poster.



Tip - your key may look different from other's, but both can be correct.

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Food Web

Energy In and Along the River

In a food web, all energy comes from the sun. Light energy from the sun is absorbed by primary producers, such as plants, and converted to chemical energy that they can use to produce more cells and grow. Primary producers are the first trophic level. Consumers are organisms that get their energy by consuming, or eating, producers or other consumers. Consumers can be herbivores (the second trophic level) and only eat plant material, or they can be omnivores (the third trophic level) and eat plants or animals, or they can be carnivores (the forth trophic level) and eat only animals. Some organisms are decomposers, which breakdown or eat non-living organic matter. Decomposers breakdown waste products like feces, dropped leaves, and dead animals. In this way decomposers are like the recyclers of an ecosystem. They are connected to everything because all living things eventually die and they can use the energy left in the waste or dead organism.

The energy transferred from one organism to another can vary. However, generally only 10% of the energy from an organism can be used by its consumer. Energy transfer is not very efficient - 90% of the energy is lost in the process, usually in the form of heat. Because so much energy is lost as you move from one trophic level to the next (as you move from one organism of a food web to the next), there needs to be many more producers and herbivores than big carnivorous predators. That's why you always see many more plants than herbivores, and herbivores are much more numerous than carnivores.

Activity - Build Your Own Prairie River Food Web

Materials

Large sheet of unlined white paper and markers
Notebook paper and pencil/pen
Tape or glue
not required, but helpful - field guides or access to other information about species listed on the next page

Procedure

Examine the list of organisms on the next page.

If you don't already know, do a little research to find out what each species produces or eats.

Think about the relationships between the species. Who produces usable energy from the sun? Who eats whom? Can more than one animal eat individuals of the same species? Can an animal be eaten by more than one predator? Can different parts of a plant be eaten by different herbivores?

When you have decided on the relationships, write the name of each species on a piece paper and cut out the names. Arrange the species names on the large piece of paper and glue or tape down. Draw lines between the organisms, representing the transfer of energy from producer to consumer. The lines will connect herbivores to primary producers, predators to prey, and decomposers to everything. Draw an arrow to indicate the direction in which energy is flowing.

Activity - Build Your Own Prairie River Food Web

Some of the Organisms found in a Large Prairie River Ecosystem

Plant Species - cottonwood, willow, cattail, tamarisk, giant rush, sunflower, grasses, box elder, evening primrose, persimmon tree

Alga - diatoms, blue-green algae, filamentous algae

Invertebrates - dragonfly, mosquito, box elder beetle, toad bug, tiger beetle, grasshopper, carrion beetle, tick, gnat, chigger, crayfish

Birds - heron, egret, indigo bunting, greycrested gnatcatcher, mallard, turkey vulture, least tern, bald eagle, Mississippi kite, gold finch

Fish - mosquito fish, catfish, Arkansas River shiner, paddlefish, bass

Reptiles - rattlesnake, red-eared slider, box turtle, soft shell turtle, ratsnake, gartersnake, snapping turtle

Amphibians - bullfrog, Woodhouse's toad, cricket frog, leopard frog

Mammals - white tailed deer, raccoon, beaver, river otter, mouse, coyote, kangaroo rat

Bacteria and Fungi

Questions for Discussion

Tip - to be realistic, some species will eat, and be eaten by, several different organisms

1. Name 2 of the primary producers in your food web.
2. Name 2 of the herbivores in your food web.
3. Name 2 of the consumers in your food web.
4. Which species are top predators?
5. What would happen to the food web if the mosquito fish or catfish disappeared?
6. What would happen to the food web if the sunflower or persimmon tree disappeared?
7. Which trophic level has the most energy?
8. How much energy is lost at each trophic level?
9. Why might it be advantageous for a large animal such as a deer to feed on tree leaves?
10. What is the difference between a cycle and a flow.
11. Does energy cycle or flow through the ecosystem? Explain.

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Biodiversity

How Many Species Are in Your Backyard?

Have you ever wondered how many different birds live in your schoolyard? Or how many different trees are in your nieghborhood? Or how many different beetles you can find in your garden? Or maybe you don't think you can find nature in your own backyard? Although humans have changed the natural habitat, you can still find biodiversity almost everywhere you look. In fact, professional scientists, families, college students, high-school groups, scout troops, and enthusiastic amateurs have been gathering together at BioBlitzes to tally biodiversity.

What is a BioBlitz?

BioBlitz is a rapid inventory of all the living species in an area. During a BioBlitz, expert biologists and citizen scientists get together to count and identify as many different species of plants and animals that they can find in a set period of time. Traditionally, a BioBlitz lasts 24 hours so that both night-time and day-time species can be found and counted. The first BioBlitz occurred in 1996 at a park in Washington, D.C. The creators of the BioBlitz idea were looking for a way for communities to learn about the diversity found in local parks and to motivate citizens to protect the species. Since the first BioBlitz, many others have been held all across the U.S. and in many other countries. In Oklahoma, our annual BioBlitz! has been counting the state's biodiversity since 2001. BioBlitz not only contributes to our knowledge of the state's species, but it also is a fun event that inspires participants to learn more about organisms that live in our state and appreciate the natural diversity found everywhere. A BioBlitz event brings together experienced and budding biologists so that they can work together on a real research expedition.

Activity - Attend a BioBlitz!

A national BioBlitz is organized by National Geographic. Each year they choose a national park for their BioBlitz site. They have held BioBlitzes in a variety of different parks including Florida's Biscayne National Park, Indiana Dunes National Lakeshore, and California's Santa Monica Mountains National Recreation Area. More information about attending the national park BioBlitz can be found on the National Geographic Web site:

http://www.nationalgeographic.com/field/projects/bioblitz.html

If you are in Oklahoma (or neighboring state) you can attend Oklahoma's annual BioBlitz! organized by the Oklahoma Biological Survey in coordination with the Oklahoma Department of Wildlife Conservation. A new site is chosen each year and in the past has included Oklahoma state parks, National Wildlife Refuges, state Wildlife Management Areas, city parks, and U.S. Army Corps of Engineers land. To find out about the next Oklahoma BioBlitz! visit the Web site:

http://www.biosurvey.ou.edu/bioblitz/BioBlitz.html

You may also try searching the Internet for BioBlitz locations around the country and world. There is probably a BioBlitz near you!

Things to think about when preparing to attend a BioBlitz

- Find out when and how to register for the event.
- Will you be camping or staying in cabins? Are meals provided?
- Ask teachers, club sponsors, troop leaders, and parents if they will help you to attend the BioBlitz (encourage them to come, too - they may have fun!)
- You might explore fundraising opportunities to pay for your trip.
- What equipment can you bring to help find organisms? Useful items are: nets (for terrestrial and aquatic creatures), binoculars, microscope, flashlight, field guides, notebook and pencil for recording observations, and camera.

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Activity - Conduct Your Own BioBlitz!

Be a botanist, entomologist, ornithologist, or any other biologist!
Be all of these things in your very own BioBlitz!

Organizing your own BioBlitz

Decide where to have your BioBlitz — You can have a BioBlitz in your own schoolyard or in the city park down the street or go to a natural area nearby. Be sure to make a map of the location marking your survey boundaries.

Decide on the date and length of your BioBlitz — Biologically, a good time for an inventory is during the height of the growing season, but you will also want to consider when your participants will be able to attend. For schools, a good time might be late spring or early fall. Many BioBlitzes are held for 24 hours, but this may be impractical for everyone. A school BioBlitz can last one school day, or even one morning.

Ask local biologists to attend — Biology professors and teachers at local colleges and high schools are often eager to share their knowledge with others. Try contacting the naturalists at nearby parks, the local native plant society, Audubon Societies, and Master Naturalists to find knowledgeable volunteers to help with finding and identifying species.

Publicize your event — You may just want to invite other students from your school, or you might want to invite the whole community. You could make fliers, write a news release, or submit information to community calendars.

Gather Equipment —

- Clock to time the event
- Map of inventory boundary
- Notebook and pencil to record the species you observe
- Field guides of plants, animals, and fungi for your area
- Camera
- Binoculars
- Hand nets
- Magnifying glass or Microscope
- Tape recorder to record the sounds you hear from birds and insects

Get Counting! — Give your volunteers instructions on where and how to record observations. You can give out copies of the data sheet on the next page. Be sure they know when to turn in their lists and who to give them to. At the designated time, sound a horn, ring a bell, or just give a big shout to signal the beginning of the BioBlitz. Designate one person to total all observations. Gather data, have fun, and count up all the species.

Announce Species Total and Celebrate the Diversity!

Reflecting on your BioBlitz — After you have finished your BioBlitz, think about what everyone observed and why biodiversity is important. Did you know you had so many different species in your own community? Did you see ways that humans are reducing or increasing biodiversity in your area? Can you help protect the biodiversity you found? How can the community help to protect the local biodiversity?

Still have questions on how to run your BioBlitz?

The coordinators of the Oklahoma BioBlitz! can offer advice and help you to get your event off the ground. Go to the Oklahoma BioBlitz! Web site *http://www.biosurvey.ou.edu/bioblitz/BioBlitz.html* or call the BioBlitz! office at (405)325-7568.

Biodiversity

BioBlitz Data Sheet

List species observed during your BioBlitz inventory. If you don't know the name, describe the organism. For example you can record: shiny green beetle, 1.5 cm long; large black bird with long tail; or 2 m tall plant with hairy leaves and yellow flowers. Be sure to tally the total number of different species you see.

Name: _____

Date: _____

Location: _____

Weather during Observations: _____

_____

Fungi, Lichens, Algae, Cyanobacteria:

Plants:

Invertebrates:

Fish:

Reptiles and Amphibians:

Birds:

Mammals:

Total number of different species observed: _____

Learn More About the Species Along the River

Arkansas River Shiner *(Notropis girardi)*

Status — Federally Threatened

In the last 45 years, this small, fresh-water fish has disappeared from over 80% of its historic range. As its name implies, the Arkansas River shiner was historically found throughout the Arkansas River drainage, which includes several prairie rivers that flow through Oklahoma, Arkansas, Kansas, Texas, and New Mexico. Now, however, the shiner is no longer found in the Arkansas River, North Canadian River, or Salt Fork of the Arkansas River. The species appears to be stable in the Canadian River; however, river flow over the years has declined. An extremely small population may still persist in the Cimarron River. Primary threats to the species include groundwater pumping, diversion of surface water, and impoundments, all which affect surface water flows and water quality.

The Arkansas River shiner is about 5 cm long and is very difficult to distinguish from other minnows found in prairie rivers. They primarily eat small aquatic invertebrates found in the shifting sand shallow of shadeless creeks and river channels. This species reproduces during the late spring and summer. Females release eggs and males simultaneously release sperm; this is called broadcast spawning. The fertilized eggs travel with the current for many miles before hatching after one or two days. Because of this unique life history pattern, the species needs long stretches of naturally flowing river for its reproduction and survival. The larvae can live on the nutrition they gained from the yolk of their egg for a few days before having to find food on their own.

Photo: Daniel Fenner
U.S. Fish and Wildlife Service, Oklahoma Field Office
www.fws.gov/southwest/es/oklahoma/

Big-Eyed Toad Bug *(Gelastocoris oculatus)*

Status — Apparently Secure

Big-eyed toad bugs live along the water's edge by lakes, ponds, and streams. They get their name because they have warty skin, hop, and feed on smaller insects… just like a toad! They are very small, oval bugs, about 5-9 mm — about half the size of a thumb nail. They are well camouflaged with a bumpy yellowish-brown exoskeleton and are hard to spot until they move.

To capture prey, toad bugs pounce onto small invertebrates and latch on with their front legs. They have bulging eyes on the side of their head for spotting their prey and for spotting things that may eat them, too! Toad bugs are "true" bugs, because they have a tiny piercing straw-like mouth part that enables them to suck. This beak-like mouth is what they use to pierce their prey, inject digesting enzymes, and suck up their food. This type of mouth also allows toad bugs to give you a painful poke if you pick one up! "True" bugs also have wings that are half hardened and half membrane.

Toad bugs can be found near the water's edge of rivers, creeks, or ponds on mud or sand. In addition to their feeding habitat, these are also suitable locations for them to lay eggs in the substrate. These bugs have a large range, from New England to Virginia, west to Manitoba and Oregon, and south to Mexico.

Photo: Tam Stuart
www.tamstuart.com

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Common Sanddragon *(Progomphus obscurus)*

Status — Apparently Secure

This dragonfly is in the family of clubtail dragonflies, so called because the end of its abdomen is enlarged and appears club-like. However, some refer to these dragonflies as burrowing dragonflies because the larvae, which live underwater, burrow into the substrate. The common sanddragon has widely spaced eyes, are 4-7 cm long, and, like all dragonflies, hold their paired wings flat out and to the sides of its body. The adult common sanddragon can be seen perching along the edges of sandy-bottomed rivers across Oklahoma and much of the eastern U.S.

Both the larvae and adults are carnivorous predators. Generally the larvae eat aquatic insects, but large dragonflies have been known to eat small fish and tadpoles. The adults like to eat mosquitoes, gnats, mayflies, and other small flying insects. The dragonfly uses its legs, which form a basket, to catch insects while flying.

Females lay eggs into the water by quickly flying low over the water's surface and tapping their abdomens on the water. This is one of the few dragonflies where the male mate guards the female while she lay eggs.

Photo: Victor W. Fazio, III
aves.net

Diamondback Water Snake *(Nerodia rhombifer)*

Status — Secure

As the name implies, this species is primarily aquatic, living in and near rivers, lakes, ponds, and riparian areas. Although called "diamondback," the dark markings that extent the length of the snake are slightly irregularly shaped forming a chain-like pattern.

Diamondback water snakes generally eat fish, but will occasionally consume large tadpoles (such as bullfrogs), frogs, reptiles, mammals, and some large invertebrates (such as crayfish). Most activity, including hunting, occurs just before dark and at night (diurnal), except during very hot weather, when it is nocturnal.

These live-bearing snakes produce young from mid-August through early October. Very large females can give birth to as many as 48–50 young, but fewer offspring is more typical. As an adult, this species of snake can reach up to 1.2 m, but because they are heavy-bodied they can appear much bigger.

These conspicuous snakes can be easily observed along shorelines and on branches that overhang water. Frequently basking on top of branches, they drop into the water when approached. In Oklahoma, this species is found statewide except the panhandle. Within North America, the distribution extends from east Texas to eastern Alabama and from central Illinois south into Mexico. This species is common in the wild, but is also found in farm ponds, streams flowing through towns, and urban lakes and ponds. In fact, they may be more common now due to the abundance of ponds in residential and commercial developments.

Diamondback water snakes are non-venomous and generally harmless, but they may bite if handled.

Photo: Laurie J. Vitt
Sam Noble Oklahoma Museum of Natural History
www.snomnh.ou.edu/personnel/herpetology/vitt

Eastern Cottonwood *(Populus deltoides)*

Status — Secure

As one of the biggest eastern hardwoods, the eastern cottonwood can grow to up to 30 m with a massive truck that can be over 1 m in diameter. This member of the willow family is one of the fastest-growing trees native to North America with an average of 1.5 m growth in one year. When trees are several years old, they can produce flowers. Male and female flowers are produced on separate trees. The flower cluster of both male and female flowers are called catkins. Catkins are not showy and the flowers have extremely small or no petals. The flowers do not attract pollinators, but are instead wind pollinated. Seeds are produced by trees with female flowers; male flowers release the pollen. The cottonwood is named for its cottony seeds that are wind dispersed in early summer. Seeds may be carried hundreds of feet by wind or may fall in the water and be carried even farther from the parent tree before being deposited on land.

The eastern cottonwood grows across North America, including Canada and Mexico, except in the far western U.S. states of California, Oregon, Washington, Nevada, and Idaho. In Oklahoma, you can find them growing along any waterway or body of water or in wet soils of valleys.

Photo: Priscilla H. C. Crawford
Oklahoma Biological Survey
www.biosurvey.ou.edu

Festive Tiger Beetle *(Cicindela scutellaris)*

Status — Apparently Secure

This attractive and brightly colored insect has been called the butterfly of the beetle world. However, they are more ferocious than this description implies. Their veracious appetite for other insects has earned them the name "tiger" beetle. These metallic colored beetles are 11-13 mm long with bulging eyes and long green legs.

Festive Tiger Beetles reproduce in the spring. The larvae live under the sand in burrows that can be up to 2 feet deep. At the top of the burrow, the larvae catch prey in their powerful jaws, holding on to sides of the burrow with special hooks on their abdomen. The beetle then drags its prey to the bottom of the burrow to eat. The larvae eat ants, spiders, and other small crawling invertebrates it can grab near the entrance of the burrow. Adult tiger beetles are fast runners and fliers. Their speed enables them to catch both crawling and flying prey, which they grasp in their sickle-shaped jaws.

Their range extends through the central and eastern regions of the U.S. and in southeastern and south-central Canada. In general tiger beetles can be found in a variety of bare, open habitats, including river sandbars, ocean beaches, mud-flats, dunes, and rocky outcrops. However, this particular species prefers deep, dry sand in which they can dig temporary burrows to spend the night and to escape the heat of the day.

Photo: Ted C. MacRae
beetlesinthebush.wordpress.com

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Fourpoint Evening Primrose *(Oenothera rhombipetala)*

Status — Secure

As a biennial, this plant produces a rosette of leaves during its first growing season, then produces flowers during the following year. In the second year the plant will grow to 0.3 - 1 m tall with large spikes of flowers. The yellow flowers are 5-8 cm wide with diamond shaped petals. In fact, diamond petal primose is another common name for this showy flower. The flowers open around sunset and wither the following morning. Being open at night allows moths to drink nectar from the long floral tube and as a result pollinate the flower. These flowers will bloom from June to October.

You can see fourpoint evening primrose on sand dunes, sandy prairies, river valleys, and roadsides. This plant is common and lives across Oklahoma, except in the far eastern region, where deciduous forest dominates. In the appropriate habitat, this species can be found throughout central North America.

Herbivorous mammals, such as white-tailed deer, will eat fourpoint evening primrose, as well as herbivorous insects, like grasshoppers and caterpillars. Humans have used the oil from this family of plants to make lotions and creams because it has emollient properties that may hydrate and soften the skin.

Photo: Priscilla H. C. Crawford
Oklahoma Biological Survey
www.biosurvey.ou.edu

Great Blue Heron *(Ardea herodias)*

Status — Secure

With its long legs and neck, the Great Blue Heron is a tall, bluish-grey wading bird standing 1.5 m high. When flying, the long neck is folded in an s-shape, the long legs extend along the body, and the long, rounded wings make slow wing-beats. This heron nests mostly in colonies, sometimes with several hundred other pairs. Colonies are often located on islands and in wooded swamps; these isolated locations discourage nest predation by snakes and mammals. The great blue heron eats mostly fish, but also amphibians, reptiles, birds, mammals, and invertebrates. During the winter it may hunt in upland fields for rodents. However, these herons typically hunt fish and other aquatic animals while wading in shallow water.

The Great Blue Heron is one of the most widespread and adaptable wading birds in North America. Found year 'round throughout the U.S., some will migrate north in summer to southern Canada, and migrate south to Central and South America in the winter. This heron lives in both coastal and fresh water habitats. In Oklahoma, you are likely to observe herons in and along any body of water: rivers, lakes, wetlands, and even in roadside ditches and suburban ponds.

Photo: Jim Arterburn
www.pbase.com/oklahomabirder

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Indigo Bunting *(Passerina cyanea)*

Status — Secure

Indigo buntings are small migratory songbirds (12 cm from head to tail) that prefer to live on the edge of forests, in brushy thickets, and within old fields during their summer breeding season. The vegetation around prairie rivers is great habitat for nesting buntings. Adult males are brilliant blue, while females and juveniles are brown with light streaks on the breast. As a migratory bird, the indigo bunting arrives in Oklahoma in mid-April and nests May through July. They usually raise two broods during that time. In a cup-like nest of leaves, grasses, stems, and bark, the bunting lays 3-4 bluish white eggs. The female is the primary care giver and will protect and feed the chicks for about three weeks after the eggs hatch.

Their bright blue coloring and cheerful song make them easy to find in the breeding season, but the males' plumage changes to brown and their vocalizations are fewer during the winter. Being a long-distant migrant, the indigo bunting travels about 2,000 km from its wintering ground to its breeding ground. It breeds throughout the eastern U.S. and parts of Arizona and New Mexico and winters primarily in southern Florida, Mexico and Central America, and on islands in the Gulf of Mexico. Indigo buntings can be observed across Oklahoma, but are rare in the extreme western edge and panhandle where trees, their preferred nesting locations, are scarce.

Photo: Steve Metz
www.pbase.com/stevemetz

Least Tern *(Sterna antillarum athalassos)*

Status — Federally Endangered

Interior least terns are a subspecies of the least tern that live in the Great Plains and Mississippi Valley. Other least tern subspecies live on the Gulf, Atlantic, and California coasts. Least terns are the smallest member of the gull family of birds. In Oklahoma they can be found along the large prairie rivers and Great Salt Plains from May to September. During this time they court mates and set up nesting colonies. Typically, people think birds nest in trees, but least terns (and many other species) nest on the ground. They scrape away the ground to form a shallow bowl in bare sand, gravel, or shells on dry mudflats, salt plains, or in sand and gravel pits. Both the male and female sit on the nest of two or three speckled eggs for about three weeks. After hatching, the chicks are tended by both parents. They can fly at three weeks old, but remain dependent upon the adults for food. Least terns eat primarily small fish, but may also eat aquatic invertebrates.

Preparation for migration begins in mid-July and birds have left Oklahoma by early September. During this time, terns congregate in large flocks and fuel up for the long trip to South America. Juvenile terns are able to practice their fishing skills and learn to become independent during pre-migration. Little is known about their life in South America during the winter.

Photo: Jim Arterburn
www.pbase.com/oklahomabirder

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North American River Otter *(Lutra canadensis)*

Status — State Species of Greatest Conservation Need

These playful mammals are returning to America's rivers after being extirpated from many of their original native areas. Being sensitive to environmental pollution, their populations had dwindled. In recent years, biologists have reintroduced them to several river and wetland systems across the country, including Oklahoma. These transplanted otters are doing well and the species is recovering. They now can be found throughout Canada and the U.S.

River otters construct dens from burrows abandoned by other animals or they use natural hollows. They are semi-aquatic and streamlined with short legs ending in webbed claws. They have thick tapering tails and long whiskers. Their long whiskers allow them to sense prey in these aquatic habitats where their other senses may be diminished. If you are looking for otter tracks, look for tracks that have five webbed, clawed toes and probably some of the tracks are rubbed out by their dragging tail.

River otters can weigh more than 20 pounds and are about 1-1.25 m long. Typical habitats are lakes, rivers, coastal habitats, marshes, and swamps. These agile swimmers are able to stay under water for up to eight minutes. They mainly eat other aquatic animals such as fish, turtles, and amphibians, but have been known to eat birds and other small terrestrial animals. River otters typically live eight or nine years in the wild. They usually live alone except for females and their young, who stay together until the pups are about six months old.

Photo: Dustin Holmes
www.flickr.com/photos/dustinholmes

Ord's Kangaroo Rat *(Dipodomys ordii)*

Status — Secure

Ord's kangaroo rat is widely distributed, occupying the short grass prairie of the Great Plains and living in a variety of habitats where there is fine sandy soil. In fact, this animal is one of the few able to make burrows in loose sand, making sandy banks and sandbars of prairie rivers good habitat. Including their long tail, Ord's kangaroo rat is usually 24-36 cm long. With a superior sense of smell, excellent hearing, and marvelous night vision, kangaroo rats are active on cloudy nights. Bad weather keeps them in their burrows and moonlit nights expose them to predators, such as owls and coyotes. When escaping a predator, this species can jump up to 2 m in a single bound. If the rat cannot immediately flee, it can use their back legs to kick sand into the predator's face.

Being nocturnal, you may have a difficult time observing kangaroo rats, but can observe their tracks in the sand. When traveling, they hop on their hind legs leaving tracks of only two feet. They move on all four feet and drag their tail when feeding. Ord's kangaroo rats eat mostly seeds, which are collected in fur-lined cheek pouches and taken back to their burrows for storage. During the summer these rats may also eat insects, such as grasshoppers and moths. Kangaroo rats rarely drink water, instead they use water, which their body produces when breaking down food.

Photo: Nicholas J. Czaplewski
Sam Noble Oklahoma Museum of Natural History
www.snomnh.ou.edu

Ornate Box Turtle *(Terrapene ornata)*

Status — Secure

Box turtles are terrestrial and their high, domed shell, or carapace, and unwebbed feet are adapted for life on land — not water. Box turtles get their name from their hinged shell that allows them to close up like a box, pulling in their head, tail, and legs. The carapace of the ornate box turtle is dark with many yellow lines, which in older turtles may become dull. Although box turtles are not aquatic, they can be found along prairie rivers in the open sandy habitat. Their tracks are easy to spy and if followed you may find the animal that made them. Ornate box turtles also can be found in a variety of open, sandy habitats, such as prairies and woodlands. There, box turtles can find their preferred prey of insects, namely grasshoppers, beetles, and caterpillers.

Adult male turtles have red eyes and more colorful heads and forelimbs compared to females. Females generally have brown irises. Box turtles can live for several decades. Each scale, or scute, of a box turtle's shell has an annual growth ring. For turtles up to ten years old, the rings are easily counted, but older turtles's rings may be worn away and not visible. Box turtles mate in the spring and females lay two to eight white eggs. Hatchlings emerge in two to three months; however, some clutches laid in summer may not hatch until the following spring. Box turtles have a small home range of about two to five acres. However, juvenile turtles may travel, and these are the turtles you see crossing roads in the spring.

Photo: Priscilla H. C. Crawford
Oklahoma Biological Survey
www.biosurvey.ou.edu

Spiny Softshell Turtle *(Apalone spinifera)*

Status — State Species of Greatest Conservation Need

Softshell turtles have smooth and leather-like shells. The spiny softshell has distinct spines or bumps at the front and back of the shell. Mature female spiny softshell turtles can grow to 40 cm in length, but the males are much smaller. They are about half the size. Spiny Softshells are totally aquatic and are common in Oklahoma's rivers, streams, and lakes. May through July, they lay their eggs in sandbars in clutches of 3–40 eggs. They may lay eggs once or twice each breeding season. The eggs hatch in August and September. Spiny softshell turtles eat mostly insects and aquatic invertebrates (like snails and crayfish), but are considered omnivorous and will eat plants.

They live throughout most of Oklahoma. The only place you can't find them is part of the panhandle. Softshell turtles are powerful swimmers and can move quickly on land, too. Their sharp beaks and powerful jaws encourage you to handle them with care. These turtles can be seen sunning themselves on sandbanks of prairie rivers and on logs and beaver dams in connected waterways. Although common, these turtles may difficult to spy because they bury themselves under the sand on the river bottom.

Photo: Laurie J. Vitt
Sam Noble Oklahoma Museum of Natural History
www.snomnh.ou.edu/personnel/herpetology/vitt

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Paddlefish *(Polyodon spathula)*

Status — State Species of Greatest Conservation Need

Paddlefish are the oldest surviving animal species in North America. Fossil records indicate that it is older than dinosaurs (300 million years). The species is distinguished by their large mouths and a long paddle-shaped nose, or rostrum, which is about 1/3 their entire length. That is a pretty long nose considering the fish can reach a length of 1.5 m and weigh about 27 kg on average. This makes them one of the largest fresh water fish in North America.

The large rostrum has given them the nickname of the spoonbill. It was originally thought that they used their rostrum to dig up food from the bottom of a river, but we now know they eat zooplankton by swimming with their mouths open and filtering the organisms with tiny structures called gill rakers. Their rostrum has sensitive electroreceptors on its paddle, which is believed to help the fish to find their prey. Like sharks, paddlefish have skeletons made entirely of cartilage, not bone. Also, paddlefish have no scales.

To reproduce, females release many sticky eggs that attach to gravel and rocks. Several different males will swim by and fertilize the deposited eggs. Both male and female paddlefish must be several years old before reproducing. Hatchlings are self-sufficient and receive no parental care. By the end of the first year, paddlefish can reach 25 cm in length. Biologists believe paddlefish can live more than 50 years. Living in large, deep, slow moving rivers, paddlefish are now found only in the Mississippi drainage system. Primary threats to the species include impoundments and habitat modification.

Photo: Tom Stailey
Tennessee Aquarium
www.tnaqua.org

Glossary to Life Along a Prairie River

Abiotic – non-living or physical components of an ecosystem; for example soil type, weather, or slope of a hill.

Alien – a species from a different continent or region that has been introduced to a new area by humans.

Aquatic – of the water; living in or near the water.

ATV – all terrain vehicle; for example four-wheeler, dirt bike, or truck with four-wheel drive.

Biodiversity – the variety of different organisms that live in an area.

Benthic – organisms that live in the sediment at the bottom of a body of water.

Biotic – living parts of an ecosystem; for example the plants and animals.

Breeding habitat – the location where animals find mates, reproduce, and raise their offspring.

Camouflage – appearance that helps an organism blend in with its surroundings.

Carnivore – organism that only eats animals.

Channel – the area between the riverbanks, most of the river water flows down this part of the river; prairie rivers can have more than one channel, referred to as braided.

Colonization – the process of organisms establishing in new or open habitat.

Competitors – organisms that are fighting each other for the same resources; for example two neighboring plants competing for water in a dry environment.

Conservation – protecting and restoring native habitat.

Consumer – an organism that consumes others to obtain energy for metabolism.

Decomposer – an organism that obtains energy or nutrients from dead organisms or organic material.

Dichotomous – dividing into two parts.

Disturbance – a natural or human made disruption of ecosystem; for example flood, fire, or sand mining.

Dredge – to scoop out sediment such as mud, sand, or organic material from the bottom of a river or other body of water.

Ecosystem – a community of organisms interacting with each other and the physical environment.

Endangered – a species that is likely to go extinct without human intervention and protection.

Environmental conditions – the abiotic components affecting an organism's existence; for example sunlight, temperature, or water.

Extinct – a species that has no living individuals; for example *Tyrannosaurus rex*, passenger pigeon, and dodo.

Filamentous algae – single-cell algae that form long threads, or filaments, that bind to form at mat; also known as pond scum.

Floodplain – low-lying area along a river that is subject to regular flooding, the soil of the floodplain is usually made up of river deposits and sediments.

Fungicide – a chemical that kills fungus.

Habitat – natural home or environment of an organism.

Herbicide – a chemical that kills plants.

Herbivore – an animal that only eats plants.

Introduce – the movement of an organism by humans to a new area from its native region.

Invasive – an alien organism that out-competes native organisms for environmental resources such as food or water; these species usually cause environmental or economic harm.

Invertebrate – an animal without a backbone, 95% of all animals species are invertebrates; for example insects, spiders, and snails.

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Glossary to Life Along a Prairie River

Larva – immature form of an animal that usually looks very different from the adult form.

Levee – a barrier built along a river to prevent flooding, often made of earth.

Migrate – to move from one habitat to another, often in response to a seasonal change (noun – migration).

Monoculture – growth of a single species in an area; for example, a wheat field.

Native – a species that is found and grows naturally in an area and was not introduced to the area by humans.

Niche – the habitat and role of an organism within its environment.

Nymph – immature form of an animal that looks like a small version of the adult form.

Omnivore – an organism that eats both plant and animal material.

Organic – from living organisms; contains carbon.

Pesticide – a chemical that kills any organism that is considered a pest.

Predation – an animal hunting and killing another for food.

Predator – an animal that hunts and kills another for energy (food).

Producer – an organism that converts solar energy or inorganic molecules into chemical energy; for example, a plant that uses photosynthesis to convert sunlight into plant material.

Reach – a stretch of river, often between river bends or inlets of creeks.

Reproductive potential – a measure of the reproductive success of an organism based on the number of offspring and how often offspring are produced.

Riparian habitat – the transition zone between aquatic and upland habitat, usually found on margins of streams, lakes, ponds, wetlands, seeps, and ditches.

River corridors – a term used to refer to both the river habitat and the habitat found on adjacent land.

Riverbed – the bottom of the river, usually under water.

Sandbars – a long, narrow area of bare sand that is above the water line of the river, it can be an island within or along the side of the river channel.

Saturate – be thoroughly soaked with water.

Sediment – particles, usually of rock or soil, that flow with the river water and are deposited on the riverbed.

Species – a group of organisms that are similar and can produce offspring with each other.

Species diversity – the variety of species that live in a given area.

Subspecies – a group of organisms within a particular species that are set apart from the rest of the species; for example they are separated geographically or they have a different coloration.

Substrate – a layer that is underneath, a surface on which an organism lives.

Terrestrial – pertaining to the land; an organism that lives on land.

Threatened – a species that is likely to become endangered in the foreseeable future.

Trophic – relating to the transfer of energy from one organism to another in a food web.

Turbid – cloudy or muddy from sediment.

Vegetation – all of the plants of a habitat.

Wetland – land that is usually saturated with water; examples are marshes, bogs, or swamps.

National Science Standards and Oklahoma PASS Skills

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  - Life Science grade 6 - Standard 4.1, 4.2

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- *National Science Standards for grades 5-8*
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Human Impact, pg. 11-12
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Migration, pg. 16
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Identification and Classification, pg. 17
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  - Life Science grade 7 – standard 3.1, 4.2
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