WETLAND ANIMAL ENGINEERS

Wetlands are a challenging place to live! How do animals living in wetlands adapt in order to survive in this ever changing ecosystem?

LESSON AT A GLANCE

GRADE LEVEL

- 9th - 12th grades

CORRELATING STANDARDS

- SC.HS.5.5.E
- SC.HS.7.2.C
- SC.HS.7.2.E

ACTIVITY TIME

- 20 min - Warm Up:
  - Mind Map and Discussion
- 45-60 min - Main Activity:
  - Create a Campaign Advocating for Species
- 45-60 min, 2 sessions - Extension Activity:
  - Design a Solution

MATERIALS

- Paper (one per student)
- Pen or Pencil
- Printed list or digital list of endangered and threatened species that depend on wetlands in Nebraska

INTRODUCTIONS

Wetlands are unique aquatic ecosystems in Nebraska. The diverse species that live there have incredible methods for survival. These adaptations can be physical (on their bodies) or behavioral (how they act). Often, these are tied closely together. For this lesson we're taking a closer look at the species that have adaptations to engineer structures that allow them to survive in a very unique habitat - wetlands!

OBJECTIVES

This lesson was designed to be used in partnership with the video "Wetland Animal Engineers". The video and lesson will allow students to better understand that some Nebraska species can address their environmental challenges well by engineering a home or shelter that will meet their needs.

<u>As a result of this lesson:</u>

- Students will understand that habitat loss across Nebraska will impact its species in wetlands and beyond, and animals must adapt in order to survive.
- Students will design, evaluate and refine a solution for increasing the positive impacts of human activities on wetlands in Nebraska.

BACKGROUND INFORMATION

What is a Wetland?

How do we define wetlands? This type of habitat is made unique by three key characteristics:

1. **Vegetation - water loving plants adapted to growing in highly saturated conditions grow here**
2. **Hydric soils - soils found here have developed under saturated conditions that limit oxygen (anaerobic conditions), they often carry a rotten egg smell**
3. **Hydrology - wetlands are saturated by water at some time during the growing season (the time when plants are actively growing)**

Wetlands in Nebraska include marshes, lakes, river and stream backwaters, oxbows, wet meadows, fens, forested swamps, and seep areas. These wetlands vary greatly in nature and appearance due to physical features such as geographic location, water source, water permanence, and chemical properties. At some points during the year we may find that some wetlands are bone dry while others always contain some amount of water. There are instances where we may come back after a steady rain and the wetland will be filled to the brim with water. Some wetlands receive their water from groundwater aquifers while others are totally dependent on precipitation and runoff. And finally, the water chemistry of wetlands ranges from fresh to saline (salty), and from acidic to basic. These descriptions identify the extremes of wetland characteristics. Nebraska's wetland resources possess these extremes and virtually every combination in between.

The vegetation, soils, and water that make up a wetland provide habitat for our native species. The wildlife that depend on these habitats for survival often face challenges due to living in such a dynamic environment. Many of these organisms have incredible adaptations that allow them to act as engineers, changing their environment to fit their needs. Using special structures on their body, they construct incredible feats of engineering. From nests above water and below, to dens, lodges, webs and casings, a wide variety of species are capable of making these fascinating changes to their wetland environment in order to meet their needs and survive.

Begin by watching the video Wetland Animal Engineers found at:

https://youtu.be/rFU21Or_jEo
or scan the QR code

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Types of Engineering in Wetlands

Nests

Several wetland species in Nebraska build nests in order to create a safe space to raise their offspring and survive. But not all of these nests are created in the same way! Birds are a great example of these types of nest-building engineers found living in wetlands and their nests can look very different. Some birds build directly on the ground like swans, geese, killdeer and avocets. Yellow-headed Blackbirds, Red-winged Blackbirds and Marsh Wrens are mid-height weavers, interlacing strips of plants together to create a cup-like nest in the cattails and sedges growing on the edges of the water. Moving into the trees we find the acrobatic Baltimore Oriole who weaves fibers into a sock-like pouch while the Great Blue Heron gathers in groups at the treetops building their nests out of sticks and dried grasses. The methods of building each nest differ, but for most the function is the same. To provide a protected home in which to raise young and continue their life cycle. Did you know that birds aren't the only ones building nests? Take a dip under the water's surface and you'll find that some fish species like the Bluegill will carve out a nest in the sandy bottom of a lake or pond. After the eggs are laid, the males will protect them until they are ready to hatch.

Dens and Lodges

When we imagine an animal engineer, it's nearly impossible not to think of beavers. We have lots of them here in Nebraska, and they are capable of drastically changing the environment in order to meet their needs. Whether they are building a dam to stop or slow water, a lodge to live in, or even a den in the bank of a wetland - these mammals sure know how to design a variety of natural architecture. Beavers are incredibly skilled wetland engineers, and there are others too!

Smaller with a rat-like tail, the Muskrat is also a common mammal found in wetlands engineering mound-like lodges and dens all around the water's edge. Other species like ducks, geese, and swans can also use these mounds to grab a better vantage point, and may even build their own nest upon them! Of course, we can't leave out the American river otter, another member of the den engineering team. They like to grab a hollow space under tree roots or claim an abandoned den, which they alter to fit their needs and can access from under the water for extra security.

Types of Engineering in Wetlands

Dens and Lodges Continued...

There's even a miniscule den-digging organism called the salt creek tiger beetle that has earned its place as an engineer. This endangered insect relies on Saline wetlands near Lincoln, Nebraska to complete its life cycle. The larvae burrow underground, spending around two years growing there until they are ready to emerge as an adult beetle.

Species digging dens and building lodges in these ways can dramatically impact the environment at large, while smaller tunneling can affect the micro-habitats that exist within the larger habitat. From mammal to insect, each species is altering their environments to meet their needs and live well in their ever-changing surroundings.

Webs and Cases

Often small and overlooked, insects are incredible engineers that make alterations to their environment in order to survive. One such insect is the caddisfly larvae. While this insect ultimately grows into a winged, moth-like adult insect, they actually begin their life cycle underneath the water as a worm-like larva. Being in such a vulnerable state, the caddisfly larva can become easy prey for fish and other aquatic insects. To avoid becoming a snack, the caddisfly actually builds a casing around its body made out of sand particles, gravel, bits of wood and even plants. Whatever can be found in the underwater environment is taken by the caddisfly and built up around its fragile body to become a case that acts as both camouflage and protection. Amazing!

Additionally, an arachnid often found engineering in wetlands is the long-jawed orb weaver. This spider uses its strong silk to weave a circular web, perfect for trapping winged insects. Webs built on the edges of wetlands like this are an ingenious way of capturing insects commonly found flying nearby.

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ACTIVITY PROCEDURES

Warm Up Activity:
Mind Map and Discussion (20 minutes)

Setting: Indoors or outdoors

1. Either before or after watching the animal engineers video, have your students create a mind map or concept map around the word WETLAND.
   - This should be an opportunity for students to gather what they already know or have learned about a wetland and group this information into key points.
   - The outcome of this initial warm up should be to get students thinking about wetland habitats, the species that live there, the factors that influence wetlands, and the relationships that tie them all together. Creating this visual can allow students a better personal understanding of the topic.
2. Give students about 5 minutes to work on this. An alternative option to this activity is to create a group mind map using sticky notes or a white board around the topic of wetland. Students may see aspects of a wetland they didn't consider before.
3. Lead a discussion for 10-15 minutes among students regarding engineering, habitats, and species found in Nebraska wetlands. This can be done in partners with questions written on the board, or as a whole group.
4. First, discuss the creation of the mind map:
   - What were the first ideas that came to mind when students heard the word wetland?
   - What are some key ideas that most thought of regarding wetlands?
   - Who lives in wetlands?
   - Have they ever thought of engineering occurring in Nebraska's habitats by species that aren't humans?
   - What surprised students from the video?
5. Second, discuss engineering practices in and with nature:
   - What is a practice that learns from and mimics the strategies found in nature to solve human design challenges? If this wording is too complex, try: What is it called when humans work to solve design challenges by mimicking the strategies found in nature?
     - Biomimicry
   - What are some examples of biomimicry that can be seen in Nebraska? Beyond? These will function like nature does.
     - Prairie Ecosystems have inspired more sustainable and efficient agriculture.

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ACTIVITY PROCEDURES CONTINUED

        - Native peoples practiced what is called regenerative agriculture for hundreds of years, and more recently other cultures are catching on, calling it permaculture. They utilize polyculture and cooperative crops. Such systems mimicking nature require substantially less irrigated water, prevent soil erosion, have inbuilt pest resistance and increase the health of the plants.
    - Burrs from plants like stickseed sticking in a dog's fur inspired the creation of velcro.
    - Thick down feathers provided the strategic design of down coats for humans.
    - The web of spiders is very strong and has been copied by automotive engineers so windshields crack but don't shatter in crashes.
    - Termite mounds have an incredible cooling effect and have inspired architects to design more energy efficient buildings.
    - Visit https://www.learnbiomimicry.com/blog/best-biomimicry-examples for more fascinating examples!
6. The **Biophilia Hypothesis** suggests that humans have an ingrained tendency to seek connections with nature and other forms of life. It may also refer to "a love of life or living things". Do students have any personal evidence to support this hypothesis?
7. In architecture, **biophilic design** is a sustainable design strategy that incorporates reconnecting people with the natural environment. It may be seen as a necessary complement to green architecture, which decreases the environmental impact of the built world but does not address human reconnection with the natural world
8. Has there ever been a time where students learned something directly from nature because of an experience they had? If so, what was it? Was it positive or negative?
9. If students could build or create something inspired by nature, what would it be?

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ACTIVITY PROCEDURES CONTINUED

Main Activity:

Create a Campaign: Advocating for An Endangered Wetland Species in Nebraska (45 minutes - 3 sessions)

Setting: Indoors or outdoors

1. Print off or display on the board the list of endangered and threatened species found in Nebraska that depend on wetlands. The list of species that depend on Nebraska's wetlands is attached at the end of the lesson. You may also expand the species to include those from any of Nebraska's habitats in order to have more options.
2. In this activity, students will explore the endangered and threatened species found in Nebraska and advocate for their conservation. This is an opportunity for students to better understand what it takes to successfully support a species and its habitat.
3. Begin by discussing with students what makes a species threatened or endangered.
    - Threatened and endangered species are animals and plants whose continued existence in Nebraska is in jeopardy. By officially designating a species as endangered or threatened, plans can be put in place to restore the species, to prevent extirpation (where species no longer exist in a region) or extinction (species no longer exist anywhere).
    - Under the Endangered Species Act (ESA), plant and animal species may be listed as either endangered or threatened.
        - "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range.
        - "Threatened" means a species is likely to become endangered within the foreseeable future.
4. Give students time to look over the list of species found in Nebraska, and have them choose a species they find interesting.
5. Depending on time available in the classroom, instruct students to research this species to better understand what it needs to survive. This could be done within 30-45 minutes or for smaller periods of time throughout a week or two.
6. Students may use the following resources for their research:
    - Check out the List of Nebraska's Threatened and Endangered Species Profiles
        - https://outdoornebraska.gov/learn/nebraska-wildlife/threatened-and-endangered-species/
    - Download the State Wildlife Action Plan
        - https://outdoornebraska.gov/conservation/conservation-efforts/natural-legacy-project/

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ACTIVITY PROCEDURES CONTINUED

7. Instruct students to gather information that can help them advocate for this species. This should include:
    - Species name
    - Species status (threatened vs. endangered)
    - Species food needs
    - Species habitat type(s) and area(s) in Nebraska being used / range
    - Species threats
    - Species population status
    - Species management and outlook
    - Conservation actions
8. Students will create a social media campaign to advocate for their species. They may use a variety of platforms to create these visuals as long as the school has approved them. Canva is a great one online, or they may create physical artwork, a website, etc.
9. Students should create 5 different posts for social media. They may do this from the perspective of a human or through the eyes of the species. Creativity is welcome and encouraged.
10. Students should create posts that:
    - Highlight the species and its status
    - Share the habitat where this species lives and its needs for survival
    - Highlight if there are specific human actions that are affecting the species
    - Address if there are easy steps that would benefit the species
    - Highlight the work conservationists are doing to support the species
    - Interesting information about the species that would increase the value that people place on it
11. Grading of this project can vary depending on the classroom. Work that scores highly will include:
    - The details and information about the species they chose (see list above)
    - Thorough research practices
    - Creativity
    - Communication of a clear conservation message
    - Positive conservation actions that may help the species they chose

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ACTIVITY PROCEDURES CONTINUED

Wrap Up:
Discussion Questions (10 minutes)

1. What species did students decide to advocate for?
2. Are there existing programs in Nebraska that promote the survival of a chosen species? If so, what are they? What conservation partners work on them?
3. What is one new thing students learned about their chosen species?
4. What is one new thing students learned about conservation work in Nebraska?
5. What did it feel like to represent their chosen species? Was it difficult, easy? What made it so?

Extension Activity:
Design a Solution (15 - 20 minutes)

Setting: Indoors

1. Begin by splitting students into table groups of 3-4 students each.
2. Using the State Wildlife Action Plan, which can be downloaded here, students will work together to explore an Ecoregion of their choosing. Within this ecoregion, there are unique species that depend on Biologically Unique Landscapes.
3. Each ecoregion also includes key stresses to the environment.
4. This activity will be equal parts scientific research AND use of creativity/imagination.
5. First, students must choose a key stressor found in their ecoregion. This stressor should relate to an animal from that region that is impacted by that stressor.
6. For example:
    - In the short grass prairie ecoregion:
        - Altered hydrology and channel degradation of rivers and streams is a key stressor
        - Students could choose an aquatic species like the plains topminnow
        - This is where they get to be creative, use their imagination, and worry less about the science. Students work together to think of a form of engineering that the plains topminnow may be capable of in order to combat the key stressor.

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ACTIVITY PROCEDURES CONTINUED

- Students will work as the animal species to create "engineer plans" that provide a solution to this key stressor the animal is facing. One idea could be that the plains topminnow creates some sort of tunnel system that locks in water longer and prevents it from evaporation. The design solution does not have to be realistic, but it should be well thought out!

7. Students will present their engineered designs to the class, and explain their ecoregion, chosen species, and how they all fit together.
    - If it's useful, hang each students' engineered designs and do a walk through as a class. Students can give feedback in real time, or leave notes with the design.
8. Facilitate a discussion regarding the Nebraska's State Wildlife Action Plan.
    - Have students worked with this document before?
    - Why is it important to have a state wildlife action plan?
    - What is the role of Nebraska Game and Parks with this plan?
    - Did students learn anything new about Nebraska and conservation?
    - Students hopefully had fun coming up with imaginary adaptations for their species of choice. Did this exercise cause them to think more in depth about our species, and what they must do to survive these very real threats?

Check out the Entire Wetlands of Nebraska Project:
Take a deep dive into Nebraska's best wetlands resources, including expanded website content, documentaries featuring Nebraska's five main wetland types, printed guides and more!
Find it at www.nebraskawetlands.com, or scan the QR code.

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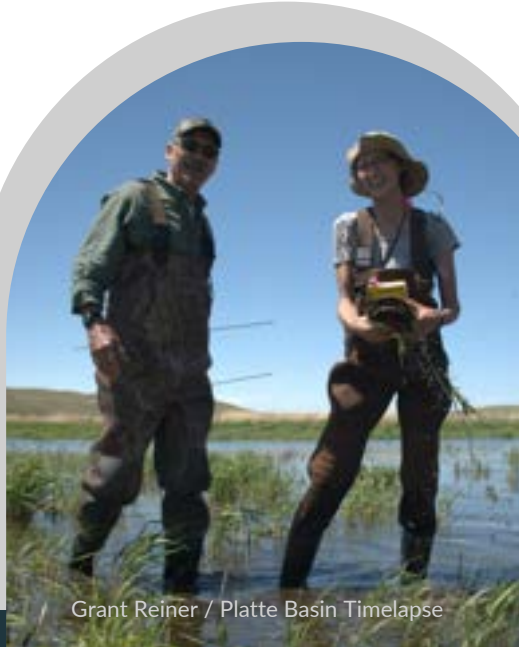
WETLANDS of nebraska

Author: Grace Gaard
Nebraska Game and Parks Commission, 2023

Contact: NGPC.WildlifeEd@nebraska.gov



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NEBRASKA WETLANDS ANIMAL SPECIES LIST

Mammals
- Beaver
- Big Brown Bat
- Long-tailed Weasel
- Meadow Jumping Mouse
- Meadow Vole
- Mink
- Muskrat
- Raccoon
- River Otter
- Short-tailed Shrew
- Southern Bog Lemming
- White-tailed Deer

Amphibians
- American Toad
- Bullfrog
- Central Plains Toad
- Chorus Frog
- Common Tree Frog
- Great Plains Toad
- Leopard Frog
- Northern Cricket Frog
- Rocky Mountain Toad
- Spadefoot Toad
- Tiger Salamander

Reptiles
- Blanding's Turtle
- Box Turtle
- Common Water Snake
- Graham's Water Snake
- Massasauga
- Northern Painted Turtle
- Plains Garter Snake
- Red-sided Garter Snake
- Snapping Turtle
- Spiny Soft-shelled Turtle
- Western Fox Snake
- Yellow Mud Turtle

Bold - Threatened
Bold/Red - Endangered

Fish
- **Blacknose Shiner**
- Bluegill
- Carp
- Fathead Minnow
- **Finescale Dace**
- Grass Pickerel
- Green Sunfish
- Iowa Darter
- Largemouth Bass
- Mosquito Fish
- Northern Pike
- **Northern Redbelly Dace**
- Paddlefish
- **Pallid Sturgeon**
- Pearl Dace
- Plains Killifish
- Plains Topminnow
- Small-mouth Buffalo
- Stickleback
- **Sturgeon Chub**
- **Topeka Shiner**

Non-Insect Invertebrates
- Clam
- Crayfish
- Leech
- Pond Snail
- Scud (Amphipod)

Insects
- Common Backswimmer
- Damselfly
- Dragonfly
- Great Gray Copper Butterfly
- Midge Fly
- Mosquito
- Predaceous Diving Beetle
- **Salt Creek Tiger Beetle**
- Viceroy Butterfly
- Water Boatman
- Water Scorpion
- Water Strider
- Western Tiger Swallowtail Butterfly
- Whirligig Beetle

Birds
- American Bittern
- American Coot
- Avocet
- Bald Eagle
- Belted Kingfisher
- Black Tern
- Black-necked Stilt
- Blue-winged Teal
- Canada Goose
- Common Snipe
- Common Yellowthroat
- Double-crested Cormorant
- Eared Grebe
- Great Blue Heron
- **Interior Least Tern**
- Mallard
- Northern Harrier
- Pectoral Sandpiper
- Pied-billed Grebe
- **Piping Plover**
- Red-winged Blackbird
- Redhead
- Ring-billed Gull
- Sandhill Crane
- Short-eared Owl
- Snow Goose
- Sora
- Swamp Sparrow
- Tree Swallow
- Trumpeter Swan
- White Pelican
- White-fronted Goose
- **Whooping Crane**
- Willow Flycatcher
- Wilson's Phalarope
- Wood Duck
- Yellow Warbler
- Yellow-headed Blackbird