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

- 6th - 8th grades

CORRELATING STANDARDS

- SC.6.9.3.A & B
- SC.7.8.4.E
- SC.8.10.5

ACTIVITY TIME

- 20 min - Warm Up:
  - Habitat Loss
- 45-60 min - Main Activity:
  - Relationships Between Wetlands and Wildlife
- 15-20 min - Extension Activity:
  - Engineering and Nature

MATERIALS

- Habitat squares
- Computer access
- Relationships between Wetlands and Wildlife worksheet
- List of Nebraska wetland species

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 know that certain animals in wetlands have adaptations, some of which include engineering behaviors, that allow them to survive well.

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

SCAN ME

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.

Ethan Freese / Platte Basin Timelapse

ACTIVITY PROCEDURES

Warm Up Activity:
Habitat Loss (20 minutes)

Setting: Indoors or outdoors

1. In this activity, students will experience what habitat loss feels like and think about how a species' adaptations can enable a species to survive in a habitat when that environment changes.
2. Find 6-10 items that you can use as the "habitat". This may be carpet squares, orange bases, or even painters tape marking out square habitats across the room.
3. These habitats can all be considered wetlands across Nebraska, or you can have the students decide what type of habitat they are in (forest, prairie, wetland or river/stream).
4. Students should think of an animal that would live in a Nebraska wetland, assume the identity of this species, and stand with at least one foot on/in the habitat.
5. When all students are in their positions, share a short explanation of changes that regularly occur in a wetland (or in a Nebraska habitat). Walk students through the following examples, but word it like a story. You're all going about your business when…
    - Humans needed a place to build a large housing development, but a wetland was in the way. Construction professionals drained the wetland and homes were built. Walk over to one of the habitat mats and remove it, displacing the students that were using it.
    - The animals/students that were using this habitat must now move to find themselves a new habitat where they can fit. If students are unable to survive in a new habitat, they will have to stand to the side and be "out".
6. Continue removing habitats with the following storylines, leaving only 2 behind.
    - In this area, there was a massive drought, and this wetland dried up.
    - This habitat was turned into cropland and tilled over.
    - A new google data center is being built and to make room for this, the habitat was removed.
    - A valuable resource was found in this habitat that is used to make electronics, and the site was heavily mined, destroying the habitat.

Ethan Freese / Platte Basin Timelapse

ACTIVITY PROCEDURES CONTINUED

7. Were all of the students able to adapt to a new habitat? How did they feel having to find a new home?
8. Anxiety may build as students are forced to crowd into the remaining habitats, encouraging the spread of disease and aggression with one another. This is something that tends to happen in nature. End the activity at this time.
9. Discuss how this activity made students feel.
10. These were big changes that destroyed the environment. Can they think of animals that have adapted well to changes like these in Nebraska?
11. What about smaller changes that may only impact some animals? This could be new species moving into a habitat, flooding, drought, disease and more.

Main Activity:
Relationships Between Wetlands and Wildlife (45-60 minutes)

Setting: Indoors

1. Many animal species in Nebraska's wetlands have unique adaptations that allow them to survive! Some use these adaptations for engineering a shelter, while others survive by using their adaptations to hunt or behave in a unique way.
2. Thinking about the video, students will dive deeper into understanding how a species' special adaptations allow it to survive and how this relationship might be affected if the environment changes.
3. If possible, this activity will be more beneficial if students have access to a computer or research tools.
4. Print out the Relationships Between Wetlands and Wildlife worksheet for each student. On the back there is a list of animal species that are found in wetlands across Nebraska. Students will choose one of these species to focus on as they fill out the sheet.
5. Students will work through the worksheet to understand the:
    - Species Name
    - Sketch of the species based on observation
    - Habitat Preferences
        - While we may know that these species use wetlands, there are a wide variety of wetlands found across Nebraska. Species may also only use this habitat during certain times of year in our state, or prefer specific areas of the wetland.
    - Adaptations that are unique to the species
    - Understanding whether the species is adapted to engineer anything for survival in a wetland

Ethan Freese / Platte Basin Timelapse

- What aspects, such as resource availability, would allow or not allow the species to survive in a wetland?
  - For example, a toad species that consumes insects can rely on the presence of this resource during warmer months, but the lack of this resource during winter months has caused the toad to adapt to brumation - a process similar to hibernation for ectothermic or cold-blooded animals.
- How could this environment change in the future and how might this affect the species and its adaptive abilities?

6. Give students 30-40 minutes to work on their species profile, sketch and understand the relationship between the species, its habitat and the adaptations that have been formed over time.
7. Ask students to share their species with a partner for 5 minutes. How do their species and their adaptations compare? If desired, have students fill out a venn diagram to help visualize the similarities and differences between species.
8. If you have time, have students arrange their species profiles on the walls and do a walk through. Students can give a brief introduction to their species and its adaptations to the whole class or in small groups.
9. Conclude the activity by spending 10 minutes discussing the following with students.

Wrap Up:
Discussion Questions (5-10 minutes)

1. What species stood out for their adaptation to engineer structures?
2. Were there any species that utilized a specific behavioral adaptation in order to survive in their habitat with the resources available to them?
3. What types of resources were limiting for species to survive?
4. How may the environment of this species change?
   - Are these natural changes?
   - Human-caused changes?
5. Animals don't get warnings when their environment is about to change. How do we think this impacts their survival?

Dakota Altman / Platte Basin Timelapse

ACTIVITY PROCEDURES CONTINUED

Extension Activity:
Engineering and Nature (15 - 20 minutes)

Setting: Indoors

1. Begin by asking students questions to get them thinking about engineering, nature, and Nebraska's habitats. Start by introducing this concept:
   - Biomimicry is a practice that learns from and mimics the strategies found in nature to solve human design challenges.
     - To put it simply, Biomimicry is when humans work to solve design challenges by mimicking the strategies found in nature.
2. 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.
     - 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!
3. 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?

Ethan Freese / Platte Basin Timelapse

ACTIVITY PROCEDURES CONTINUED

4. 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.
5. 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?
6. If students could build or create something inspired by nature, what would it be?

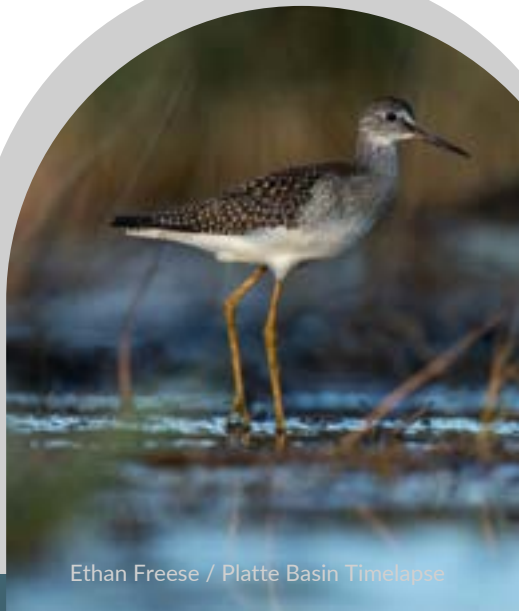
Check out the Entire Wetlands of Nebraska Project:
Take a deep dive into Nebraska's best wetlands resources, including expanded website content, documentaries featuring Nebraska's five main wetland types, printed guides and more!
Find it at www.nebraskawetlands.com, or scan the QR code.

SCAN ME

WETLANDS of nebraska

Author: Grace Gaard
Nebraska Game and Parks Commission, 2023

Contact: NGPC.WildlifeEd@nebraska.gov



Ethan Freese / Platte Basin Timelapse

Name: _____ Date: _____

RELATIONSHIPS BETWEEN WETLANDS AND WILDLIFE

Sketch the animal species you have chosen to learn more about. Fill out the profile below to share what you have learned about the relationship between the species, its adaptations, and its habitat.

Species Name:

Habitat Preferences:

Adaptations:

Does this species engineer anything as part of it's adaptive abilities?
If yes, what do they build?

What aspects of this species' habitat, such as resource availability, might affect its' survival?

How could this habitat change in the future and impact this species?
Will the species be able to adapt?

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