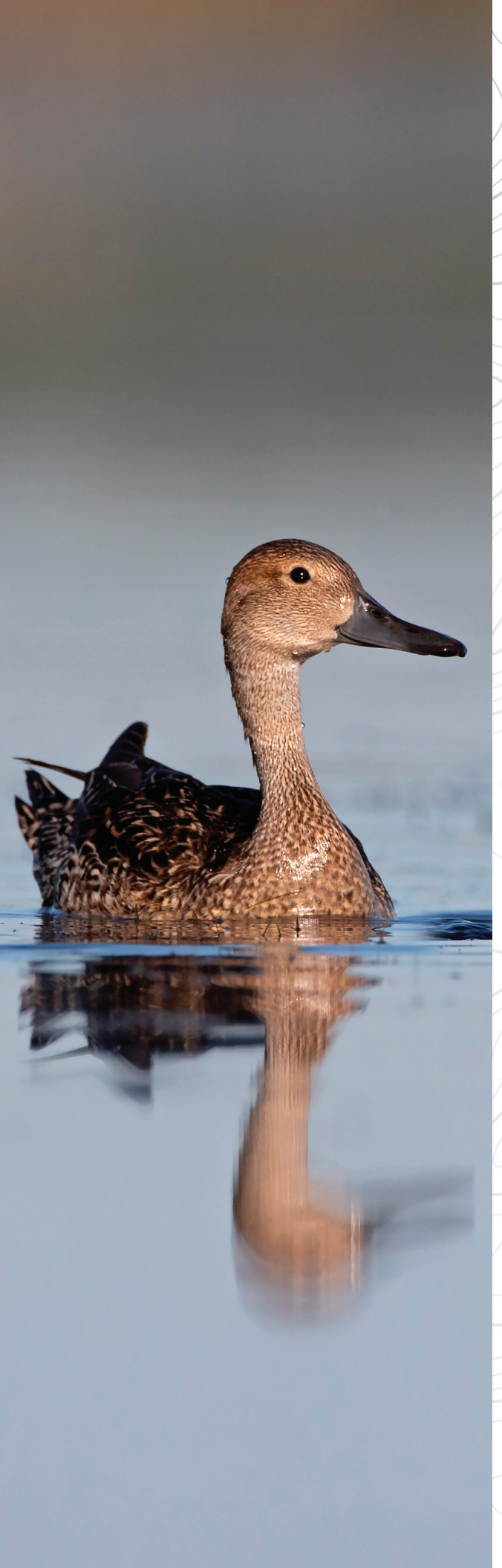

NARRATED BY
MICHAEL KEATON
WINGS
OVER WATER



WINGS OVER WATER

EDUCATOR GUIDE

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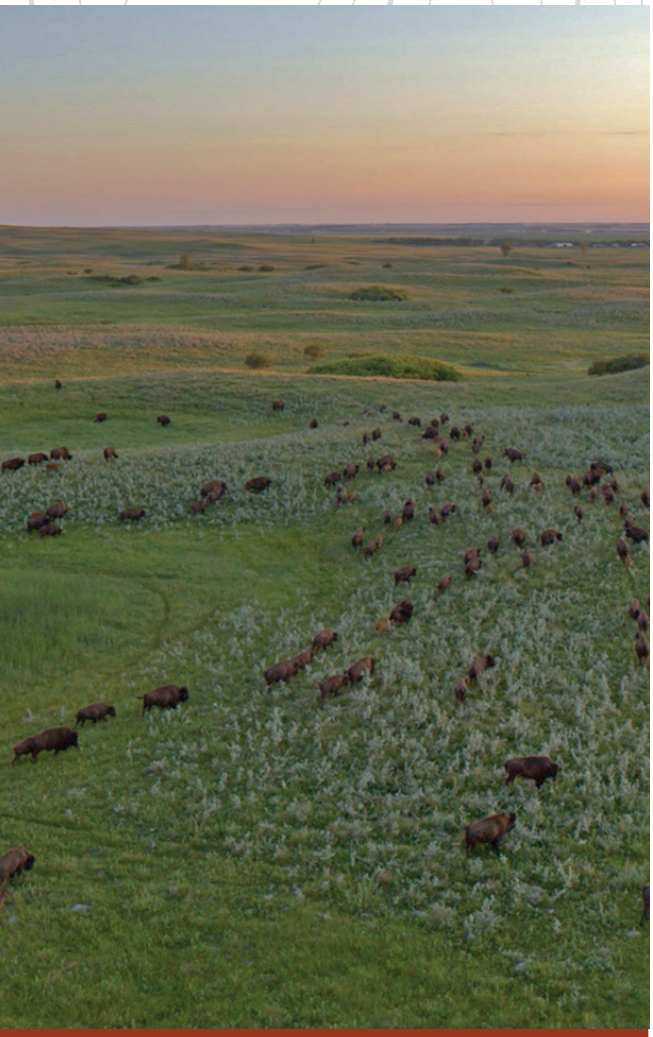
Wings Over Water



A herd of bison, traveling the plains.

INTRODUCTION TO THE GUIDE

The Educator Guide for *Wings Over Water* was created by Discovery Place Education Studio for use by formal and informal educators looking to inspire their kindergarten through eighth grade students. Activities are envisioned to live alongside the film and support further exploration of major themes. They are designed around the U.S. Next Generation Science Standards, but educators are encouraged to adjust them to best fit the standards or programming needs of their school board.

Activities in the guide encourage students to model the dynamics of ecosystems, creatively describe relationships between these magnificent birds and the landscape they navigate, and better understand the ways in which they relate to each other. They also help students consider their role in the natural world as citizen scientists, both as active participants and observers of nature.

As the glaciers retreated at the end of the last ice age, they left an astounding gift of connected rivers, lakes and wetlands across the heartland of North America. Today, these largely unknown water highways remain an oasis for sustaining wildlife from the herds of bison that still roam the Great Plains to the vital honeybees that pollinate our crops and especially for the millions of magnificent birds that migrate along these “flyways.”

Wings Over Water, narrated by Michael Keaton, tells the compelling story of the epic journeys of three amazing bird families – the sandhill crane, the yellow warbler and the mallard duck – with extraordinary footage of their fascinating behaviors. All of them depend on the wetlands for their survival. Audiences will be captivated by the triumphs and challenges of these remarkable creatures that defy all odds and soar across mountains, deserts, cities, and forests as they head home to raise their young.

EDUCATOR GUIDE

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WINGS
OVER WATER

LESSON 1

Prairie Pit Stop

Standards (NGSS): K-ESS3-3 Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Grade Levels K-1: 40 minute lesson

MATERIALS LIST

- Tape for creating squares indoors
  (chalk for creating squares outdoors)
- Printed threat cards
- Printed bird cards (one per student)
- Hole punch
- String or yarn
- Something to use as a marker
  (beanbag, pencil, eraser…)

Optional:

- Card stock
- Laminate

FROM THE FILM:

The film, *Wings Over Water,* follows three bird species on their migrations to the prairie wetlands. This special type of wetland is a bird paradise providing feeding and nesting sites for hundreds of different species of birds including the sandhill crane, the mallard, and the yellow warbler.

LESSON OVERVIEW:

Students will simulate the importance of these freshwater areas, also known as prairie potholes, to the survival and propagation of waterfowl.

Students will consider how the destruction of wetlands makes migration more difficult for the birds. They will then brainstorm strategies to protect and restore this vital ecosystem, and how their actions impact their local environment.

EDUCATOR PREP:

Set up your Central Flyway and prairie potholes. This can be done in a traditional hopscotch pattern or spread out in a more natural formation, there should be at least 10 squares. Make sure squares are arranged to allow students to successfully hop from square to square.

Print bird cards and threat cards, *(optional: print on card stock and laminate for future use)*. Hole punch the top of each bird card and thread with string to create a necklace, *(one for each student).*

LESSON 1

Prairie Pit Stop

Prairie potholes serve as important rest and recovery areas during migration.

FOR VIRTUAL LEARNING:

This lesson could be attempted virtually as is, with each student creating their own flyway to migrate through at home. Teachers would lead the introductory discussion, then students would migrate on their own, and rejoin the class to discuss threats. Students would migrate a second time before brainstorming ways to protect birds and the prairie potholes.

EDUCATOR GUIDE:

1. Today students will be taking on the role of one of the three bird species highlighted in the film *Wings Over Water*: the sandhill crane, the mallard, and the yellow warbler. Give each student a bird necklace.

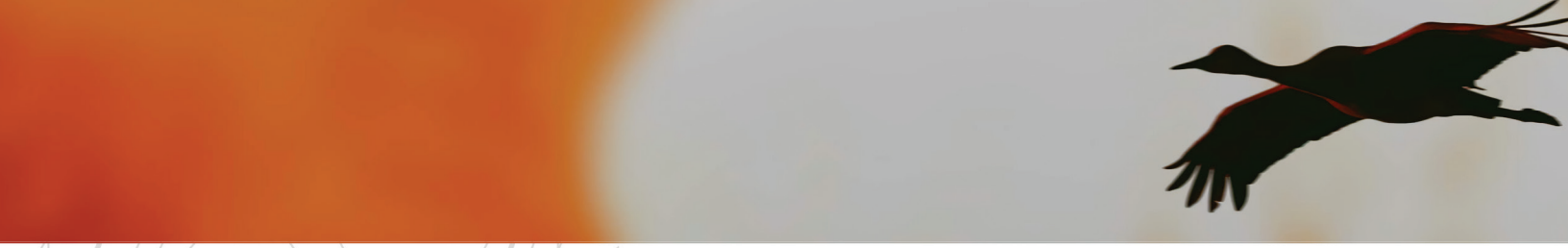
What do students notice about their bird?

These birds are different colors, different sizes, they eat different things, and they are living in different places.

Can students think of any ways these birds are the same? Is there anything they have in common?

All birds have wings, feathers, and a beak. Birds all lay eggs.

All three of these birds, mallards, yellow warblers, and sandhill cranes, migrate along a similar path to the prairie wetlands.



NOTES:

Have students ever heard the word migrate or migration? Does anyone know what it means? Allow students time to discuss their ideas.

Migration is a seasonal, large scale movement of a species to areas of higher resources, primarily food and nesting sites. Lots of animals migrate including reindeer, salmon, butterflies, and many species of birds.

It might help students to think about migrating like a long car trip. They must find places to stop and rest and places to eat along the way. Animals face these same challenges, which is one of the reasons the path our birds take is so special, each prairie pothole is an important stopping point on the bird's migration route.

The sandhill crane, the mallard, and the yellow warbler all migrate along the Central Flyway heading to the prairie wetlands.

2. Explain to students that they are going to migrate along the Central Flyway through the prairie wetlands. The Central Flyway is one of four main migration routes over North America. It covers ten states (Montana, Wyoming, Colorado, New Mexico, Texas, Oklahoma, Kansas, Nebraska, North and South Dakota) and three Canadian provinces (Alberta, Saskatchewan, and the Northwest Territories).

This area includes a unique habitat known as the prairie wetlands. The prairie wetlands contain millions of small wetlands called prairie potholes. According to *Ducks Unlimited®,* the Prairie Pothole Region is the most important and also the most threatened waterfowl habitat in North America. It is their top conservation priority area. Hundreds of different plant and animal species rely on this habitat for nesting and feeding, including over fifty at risk species, and our three species of migrating birds. Each and every pothole is an important link in this ecosystem.

Migrating birds, silhouetted against the evening sky.

3. Line students up at one end of the Central Flyway you created earlier. Each student will take a turn to toss a marker, *(bean bag or eraser),* onto one of the prairie potholes.

Then they will hop to each square to retrieve their marker. Students will pick up the marker and hop back through the squares to return to the start position. This is their migration!

4. Allow each student to take a turn migrating through the flyway. While students are waiting to migrate engage them with discussions of their own observations about birds and migration:

What kinds of birds have the students seen near where they live?

Answers will vary based on location, but some easy to spot birds include cardinals, robins, geese, and mockingbirds.

Have students seen birds migrating? Were they flying in a special shape?

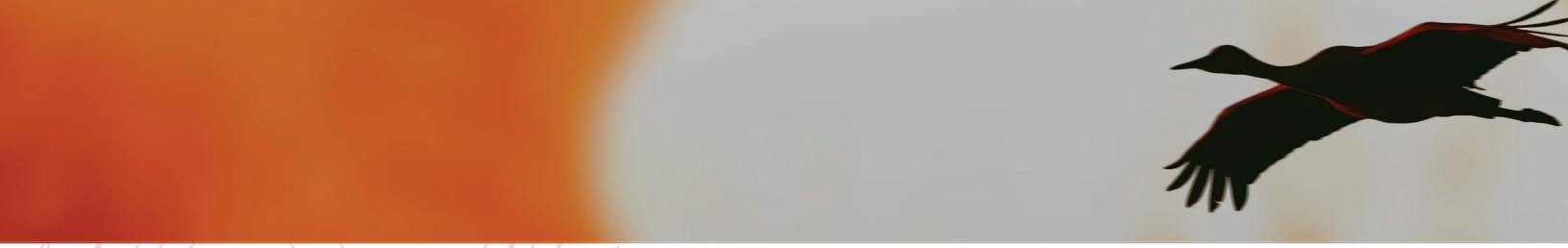
Ducks and geese are famous for flying in a V formation and other birds migrate in a loose flock.

Do students have a favorite bird?

Answers will vary. Teachers should be prepared to share their favorite bird as inspiration.

Can students flap like a bird?

Flap quickly like a hummingbird, soar like an eagle.



NOTES:

5. After all the students have had a turn migrating, introduce the idea that the prairie potholes are in trouble. In the United States and Canada, around 70% of the prairie wetlands are gone.

What do students think has happened to the wetlands? What do they think the threats are to the wetlands?

Show students the threats to the prairie pothole cards as you discuss the challenges facing wetlands.

Threats include:

- ***Pollution-*** *the introduction of materials, including trash and chemicals, that harm or damage the habitat.*

- ***Invasive species-*** *when new and different plants and animals move to a habitat they are not from, they change the food chain and create competition for food and nesting spaces.*

- ***Urban sprawl-*** *as populations and cities grow, birds must go somewhere and often wetlands are filled in to make room for roads and buildings.*

- ***Farming-*** *the prairie pothole region has rich and fertile soil making it ideal for farming. However, wetlands have been seen as wasted space and filled in to make room for more farming.*

Can students think of any threats to the prairie wetlands or habitats closer to their homes? ***Write student answers on the blank "threat" cards or allow each student to create a "threat" card using the blank template.***

Student ideas will vary but could include things like throwing trash in the water, cutting down trees, outdoor cats eating birds, and birds being hit by moving vehicles. Encourage students to think about their own actions and how those might affect the prairie wetlands and birds.

If each student creates a threat card, select the most common idea, using only one or two cards per square.

70% of the prairie wetlands like this one, no longer exist.

6. *Place each threat card on one of the squares after discussing it with students and explain that this prairie pothole is no longer a usable habitat for the migrating birds, so they must fly over it.*

7. *Students will attempt to migrate again, but without hopping in the "destroyed potholes."*

8. *As students are migrating talk about how this migration is different from their first migration.*

Which migration was harder?

This new migration should be harder since there are not as many places to hop in and the distance between them is farther.

How do students think this compares to their bird's migration?

Fewer prairie potholes means there is less food for birds to eat and fewer places for them to build nests and raise their young. It also means the birds have to fly farther without being able to stop and rest and there are fewer places to stop and eat along the way.

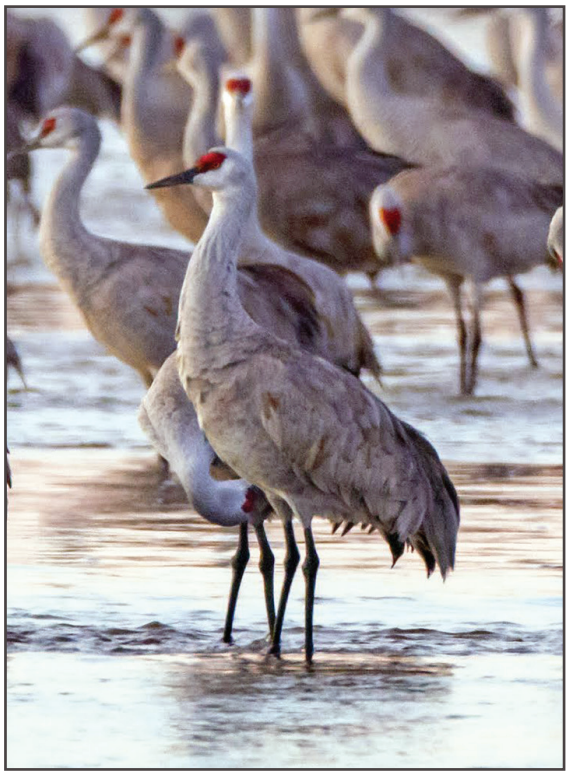
What are things students think they can do to help protect this environment and migratory birds?

Encourage students to brainstorm ideas that they, the students, can do to help the environment. Student answers may include:

- *Minimize single use plastics*
- *Recycle*
- *Turn familiar spaces (school yard, backyard, apartment balcony) into bird friendly habitats.*

9. Students will remove the threat cards as they come up with ways to help the environment and the birds.

10. Allow students to go on a final migration.

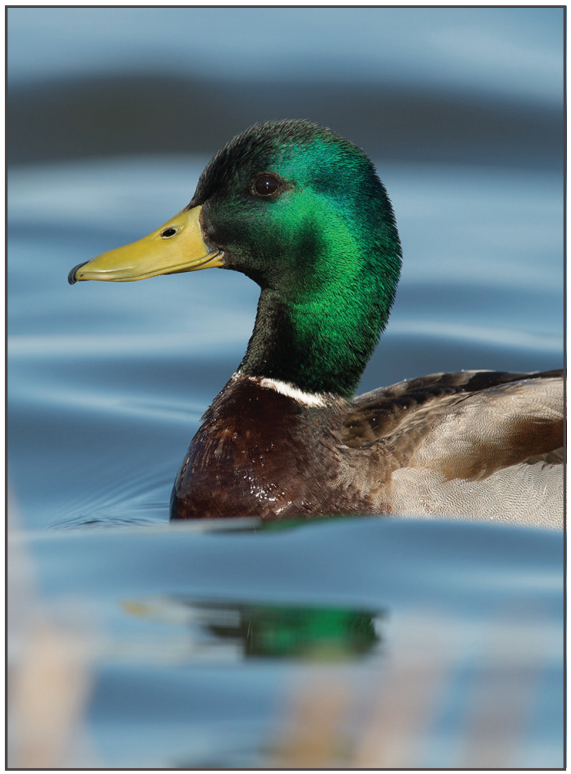


Sandhill Crane

Wingspan:	about 6 feet
Weight:	7.5-11 pounds
Diet:	Omnivore
Migration:	Starting point is a semi-arid area in New Mexico
Fun Fact:	Can reach speeds up to 35 mph / 56 kph

Yellow Warbler

Wingspan:	about 8 inches
Weight:	9-11 grams (about 3 pieces of paper)
Diet:	Insectivore
Migration:	Starting point is the Costa Rican rainforest
Fun Fact:	One of the first species of warblers to migrate in the spring.



Mallard Duck

Wingspan:	about 3 feet
Weight:	7.5-11 pounds
Diet:	Omnivore
Migration:	Starting point is a flooded forest in Arkansas
Fun Fact:	Leafy greens are a much healthier treat for ducks than bread

Invasive Species

Pollution

Farming

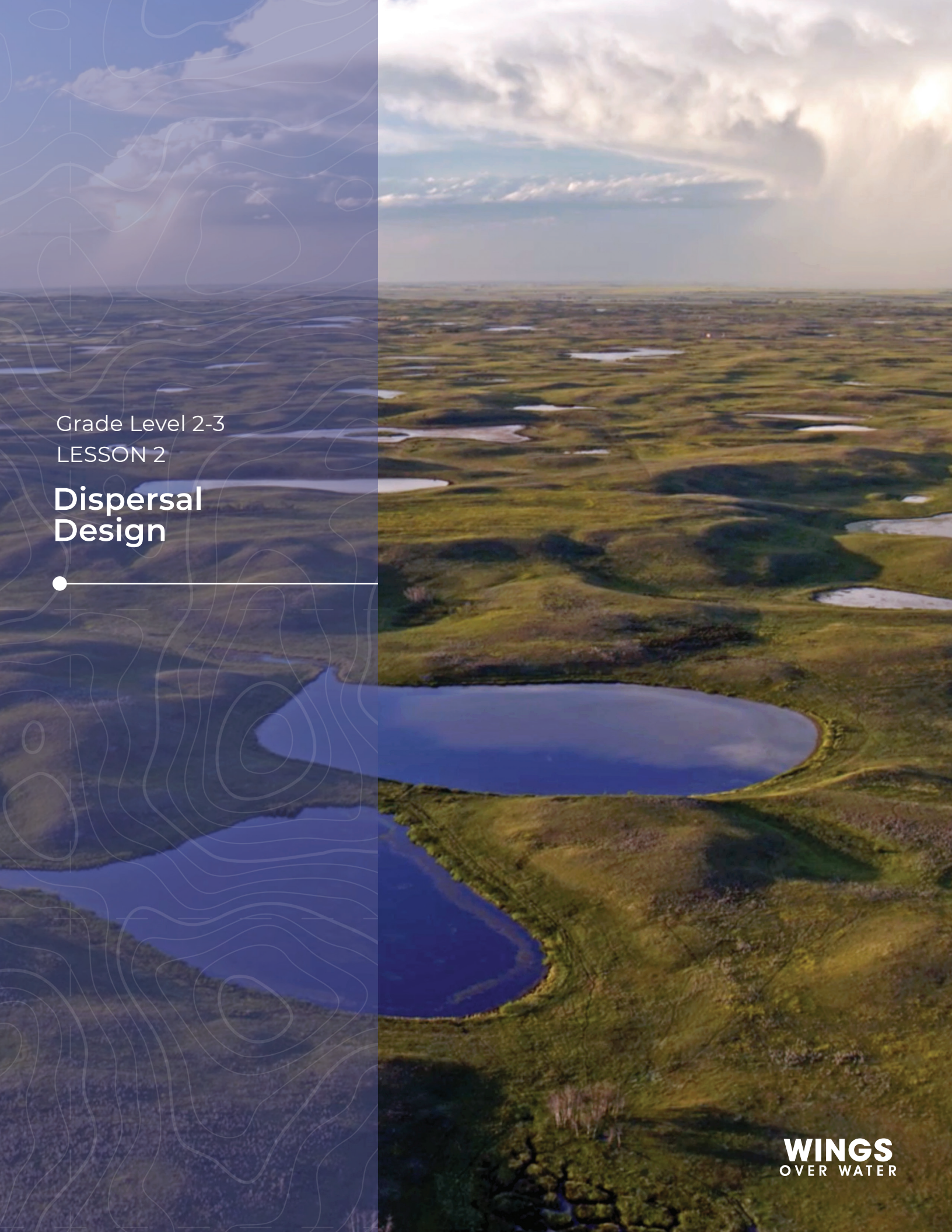
Urban Sprawl

Threat to the prairie wetlands.

Threat to the prairie wetlands.

Threat to the prairie wetlands.

Threat to the prairie wetlands.

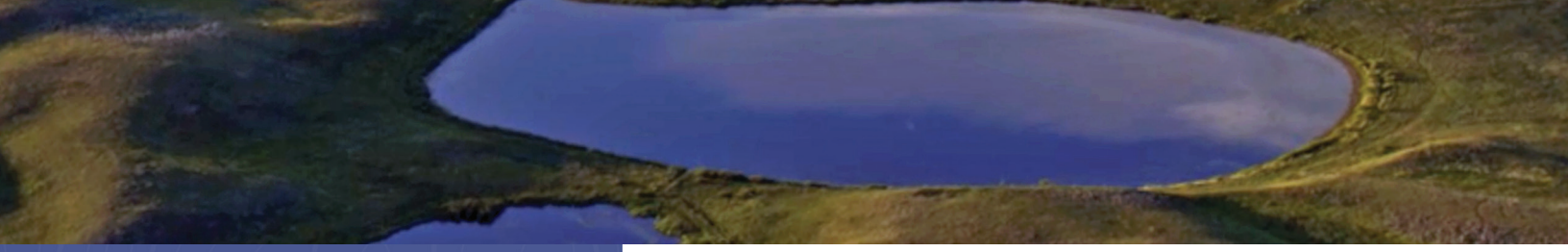


Grade Level 2-3

LESSON 2

Dispersal Design

WINGS OVER WATER



LESSON 2

Dispersal Design

Standards (NGSS): 2-LS2-2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

Grade Levels 2-3: 40 minute Lesson

MATERIALS LIST

- Cardboard
- Pipe cleaners
- Glue
- Masking Tape
- Googly eyes
- Feathers
- Construction paper
- Markers & Pencil
- Scissors
- Foam board
- Felt
- Bird seed
- Dispersal Animal Design Sheet (one per student)

FROM THE FILM:

In the film we learn that bird droppings play a key role in the wetland ecosystem. Bird droppings provide the ecosystem with nutrients. Seeds that have passed through the birds' digestive tract are dispersed along their entire migration route. This helps connect the various ecosystems that birds travel through.

LESSON OVERVIEW:

After learning about how mallards and other birds spread seeds from the film, students will design their own seed dispersing animals. They will learn about the dispersal process and apply their understanding to design a unique animal that will successfully aid in this process. Students will have the chance to brainstorm and build their animals, share their creations with their peers, and evaluate their designs. This activity will reinforce the important role that animals play in spreading seeds and increase understanding of the dispersal process.

EDUCATOR PREP:

Print enough design sheets for each student to have one. Print the Dispersal Animal design sheet or load it as a digital document to present. Gather design supplies for students and familiarize yourself with the questions and answers in the "Educator Guide" section.

LESSON 2

Dispersal Design

Wild bison roaming the plains aid in seed dispersal as they graze on vegetation.

FOR VIRTUAL LEARNING:

If using this lesson for virtual learning, have students design their animals from their own locations. Emphasize the sketching portion of the activity or use digital art tools to design your animals if access to art supplies is limited. The brainstorming and gallery walk portions of this activity should still be included so that students have the opportunity to participate in the peer review process. Utilize breakout rooms to encourage communication in smaller groups.

EDUCATOR GUIDE:

1. Today students will be thinking about what it takes for seeds to spread with the help of animals and then design an animal that would help to disperse seeds.

2. Prompt students to think back on the birds in *Wings Over Water*. While watching The film, we observed that the birds that travel through the prairie wetlands eat plants and poop out seeds as they migrate.

3. With students working together in small groups or individually, answer the following questions.

What are some ways that plants are important to animals?

Answers may include that most plants produce their own energy and are typically the lowest organisms in the food chain. Animals eat plants to get energy. Plants pull carbon dioxide from the atmosphere and store it preventing it from contributing to the greenhouse effect. Plants also provide shelter, habitat space, and oxygen to breathe.

NOTES:

What are some ways that animals are important to plants?

Answers can include that some animals, like bees, butterflies, flies, and bats, help plants reproduce by pollinating flowers. Animal waste can also help provide plants with nutrients. That is why cow manure is sometimes used as plant fertilizer. Animals can also spread seeds to new areas.

At this point the idea of dispersal may have been brought up organically or students will likely have mentioned that animals eat plants. Depending on your classroom, either introduce the term dispersal or ask students to come up with a definition.

What is dispersal?

Dispersal is the process by which a new generation of animals or plants move away from the area where their parents live.

Most animals can move around and disperse on their own, how do plants move around?

There are many ways that plants can disperse, but most will disperse their seeds with the parent plant staying in the same spot. The seeds will be carried to a new place where they will grow into new plants. Some of the most common ways that plants disperse their seeds are by wind, water, or animals.

- ***Wind-*** *Some plant seeds have structures that help them catch the wind and float through the air. One common plant that disperses through the air is a dandelion.*

- ***Water-*** *Lots of plants that grow in or near the water have seeds that will float and drift in the water to reach new places to grow. An example of a seed that floats in the water to disperse is a coconut.*

- ***Animals-*** *Many plants disperse their seeds with the help of animals. We saw this in the film* ***Wings Over Water*** *with migratory birds.*

Flocks of migrating birds play a key role in the dispersal of seeds.

Why is dispersal important for animals and plants?

Animals need to disperse to find new resources like food, water, and shelter.

Plants need to disperse to an area where they can better reach resources like space to grow, light, water, and nutrient rich soil. A seed that drops under a parent tree will have a hard time growing in the shade.

For both animals and plants, dispersal helps spread populations to new areas and reduces the chance of competing with parents for resources.

What are some ways that migratory birds disperse seeds?

Answers can vary depending on the background knowledge students have. The film highlights that migratory birds disperse seeds through their droppings. Birds can also disperse seeds that may have gotten attached to their feathers, beaks, or feet. Some seeds have barbs or hooks that can get attached to the bodies of animals. As the animals travel to new locations, the seeds travel with them until they are dislodged in a new area.

Use the seed dispersal example cards to visually reinforce these examples.

What other animals help disperse seeds?

There are a lot of animals that disperse seeds. Squirrels will bury oak seeds, acorns, before winter, and if the squirrel does not dig it up in the spring, the acorn can grow to form an oak tree. Dung beetles unintentionally disperse seeds by moving around large quantities of herbivore dung, which can sometimes contain lots of seeds. Fish can also act as dispersers when they ingest fruit that falls into the water and eventually release the seeds via their poop.

Some seeds will only grow if they have been digested and deposited in poop first. Seeds will also attach to the fur and bodies of other animals besides birds. An engineer was inspired with the idea for Velcro after cockle-burs stuck to his pants and his dog's fur. The list of seed dispersers is nearly limitless.

NOTES:

What are some things that animals do or traits that animals have that help them to disperse seeds?

- ***Physical traits*** *– A good nose that can smell fruit from far away, eyes that can see the bright colors of fruit or seeds. The body parts that help them fly, climb, or swim to reach the foods that they like.*

- ***Behavioral traits*** *– burying and caching seeds, carrying seeds to underground burrows, and searching for fruits and seeds to eat.*

The following questions are optional but can be asked here or after students design their animals to enforce more complex ideas or challenge advanced classrooms.

What are some traits that plants have that facilitate dispersal by animals?

Seeds can be adapted to travel on the outside or inside of an animal. For seeds that travel internally, the animals must eat the fruit of a plant or the seed itself. Plants can produce delicious fruits that smell good to attract fruit eating animals. These fruits can also be brightly colored so they can be easily spotted. Once the animal eats the seed, it passes through their digestive tract and is deposited in a new area once the animal poops.

For external dispersal to occur, the seed must stick to the fur, feathers, scales, or body of an animal. Some seeds have hooked barbs that can stick like Velcro to an animal that brushes against it.

Are animals trying to spread seeds?

Probably not, when animals eat fruit or bury seeds they are getting food for themselves. Animals are adapted to find and eat food. Plants are adapted to use animals to spread themselves to new places.

One exception to animals intentionally dispersing seeds is people. We choose to move plants that we think are pretty, that we like to eat, or plants that we just think are cool!

Plants and animals need healthy habitats like this for animal-based seed dispersal.

How could humans have a positive impact on seed dispersal?

Humans can pick up seeds in the same ways as animals, by digesting seeds and by carrying them in our hair and clothing. However, we can move them much further and faster than animals, even migratory birds, when we travel with cars, trains, planes, boats, etc. When we understand the ecological impacts of seed dispersal, we can help to move plants around the world in a positive way.

How could humans have a negative impact on seed dispersal?

By reducing the populations of plants, migratory birds and other seed dispersing animals through habitat alteration and destruction, we may be lessening the amount of seed dispersal.

People also move seeds and plants into areas where they might not have dispersed to naturally. When we bring new species to a place where they don't have any predators or controlling factors, they can crowd out native species and keep them from growing. These are called invasive species.

Climate change may also be affecting the ways that seeds disperse through water and wind. Climate change is also changing the areas where plants can successfully grow once their seeds have been dispersed.

Do meat eaters disperse seeds?

Yes! Lots of seeds are eaten by herbivores and then the herbivores are eaten by carnivores. When the carnivores poop, a new plant can grow from the seeds in their poop.

What are some advantages of animal-based dispersal?

Seeds carried by animals, either internally or externally, have a better chance of ending up in a place where they are able to grow because they are able to reach new areas, further away from their parent plant.

NOTES:

4. Explain to students that they will use their creativity, imagination, and engineering skills to design a seed dispersing animal. Their animal does not have to be real, and it does not have to be a bird.

5. Pass out the worksheet *"Dispersal Design Animal Student Sheet"* along with a blank piece of paper and a pencil. Explain to students that they will be designing animals that will disperse seeds. Ask them to think about what traits an excellent seed dispersing animal would have. Think back to the traits that the birds in the film have, or why squirrels are good dispersers. These traits can be behavioral, physical, or both.

6. Before students begin constructing their animal, it is important to give them time to brainstorm and discuss their design with their peers. Explaining their design to another student can help them fully understand the traits and behaviors that their animal has.

7. Students can use the design sheet to guide their thought process. They should use their blank piece of paper to draw their animal before they are given materials. Their drawings should be detailed, labeled, and display all the animal's seed dispersing characteristics.

8. Once students have completed their drawings, they can spend time creating their seed dispersing animal using the prepared materials. They can also test out their creation using actual bird seeds.

With proper planning, waterfowl and farms can peacefully co-exist.

9. Students should be able to answer the following questions about their animals:

What traits does your animal have that makes it an excellent seed disperser?

Student answers should connect with the mechanism of seed dispersal shared earlier, including fur that catches seeds, burying behaviors, digestion of the seeds.

What can you improve about your design?

Student answers will include reflections about feedback that they may have received through the questions of their peers and new ideas that may have emerged as they viewed other creations.

10. Have students share their creations by posting them around the classroom and conducting a gallery walk.

DISPERSAL EXAMPLES:

Coconut seeds spread by floating in the water. As they float, coconuts start to grow, so they can take root on land.

Dandelion seeds disperse when they are blown from the flower into the air. They will float to a new spot and start to grow!

When birds or other animals eat fruit, they often swallow the seeds. When the birds poop, if the seed lands in a good spot it may start to grow.

Bears can find fruit and berries to eat with their keen sense of smell. They swallow the berries and poop out the seeds!

DISPERSAL ANIMAL DESIGN SHEET

What type of animal will you be creating?
Mammal, fish, bird, reptile, amphibian?

Where does your animal live?

What does your animal eat?

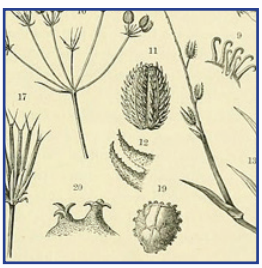
Does your animal carry seeds inside or outside of their body?

DISPERSAL EXAMPLES:

Squirrels bury seeds to store for later but don't always come back to eat them. Forgotten seeds can grow into new trees.

Dung beetles use the poop of other animals to support their young. They will spread seeds stuck in the poop that they're using.

When fruits and seeds fall into water, fish eat them and poop them out in new locations that can be far from the parent plant.



Seeds attach to passing animals with external structures like spikes or hooks. The seeds then fall off and grow where they land.

How does your animal move (wings, fins, tail, legs, etc.)?

Where does your animal move from and where does it move to?

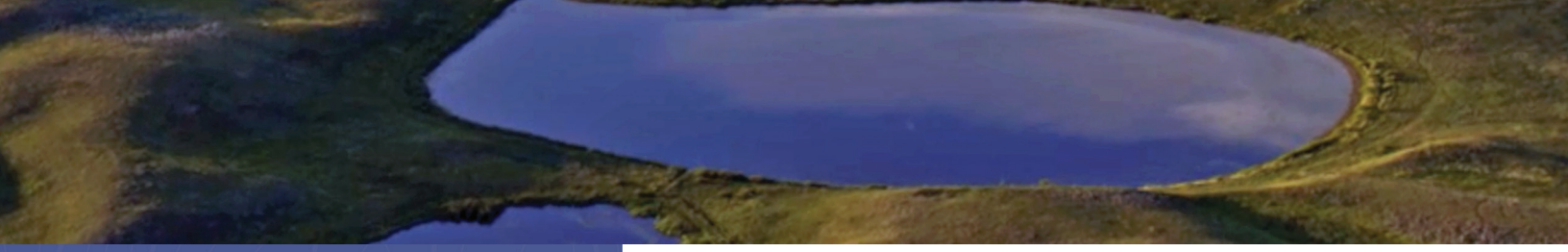
What animal(s) inspired your design?

Grade Level 2-3

LESSON 3

Glacier Grind

WINGS
OVER WATER



LESSON 3

Glacier Grind

Standards (NGSS): 2-ESS2-2 Develop a model to represent the kinds of land and bodies of water in an area.

Grade Levels 2-3: 40 minute lesson

MATERIALS LIST

- Pans of clay (one per group or student)
- Crushed ice (one cup per group or student)
- Loose soil (one cup per group or student)
- Printed copies of *"Glacier Grind Recording Sheet"* (one per student)
- Colored pencils
- Silly Putty® and paper plate *(for teacher demonstration)*
- Air dry clay
- Paint
- Sturdy plates or pieces of cardboard (for students to build on)
- Toothpicks
- Painter's tape for labeling toothpicks

FROM THE FILM:

In the film we learn that the Great Plains of North America were once covered by glaciers. When those glaciers retreated, they left behind millions of pothole-like depressions that filled with water. These ponds, lakes, and marshes now make up the prairie wetlands, an ecosystem that once covered nearly 300,000 square miles and contained approximately 25 million wetlands.

LESSON OVERVIEW:

Students will model the formation of the prairie wetlands. Each group of students will be given a tray of clay, a cup of crushed ice, and a cup of soil. They will embed pieces of ice in the clay and then cover them with a thin layer of soil. After the ice has melted, they will observe the "potholes" that have formed in their soil. They will sketch their observations and create before and after pictures showing how the prairie wetlands were created.

EDUCATOR PREP:

Crush the ice into pieces roughly one inch in diameter. Prepare a layer of clay one inch thick at the bottom of each pan. The clay should be flat and cover the whole pan. Print copies of "*Glacier Grind Recording Sheet*" for each student. Access this article from the National Park Service:

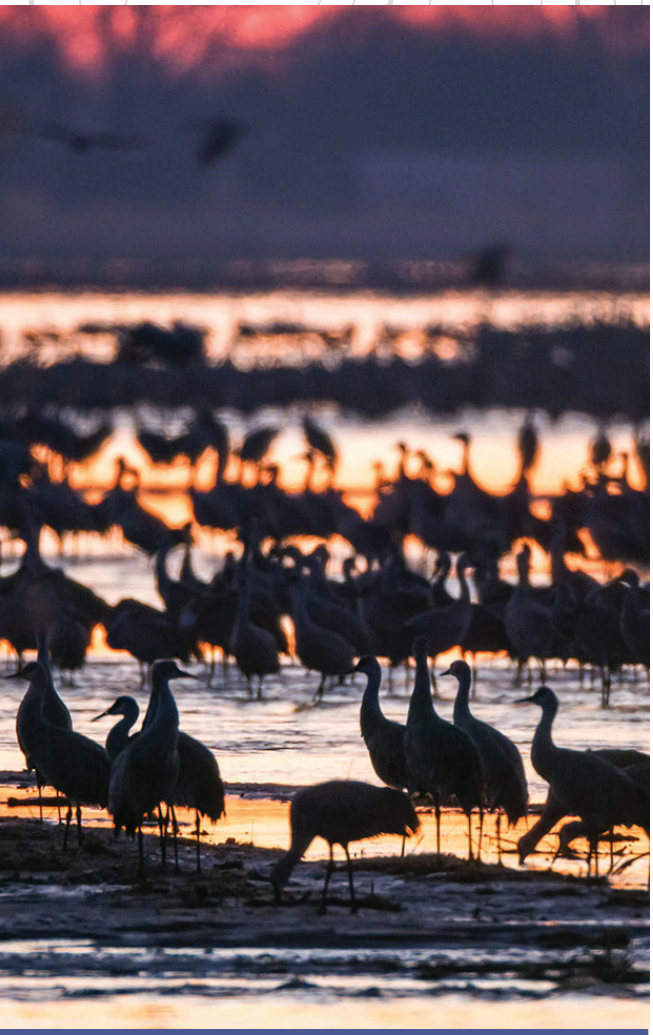
https://www.nps.gov/articles/icesheets.htm

Use this resource from the National Park Service to find additional pictures of glaciers and glacial landforms:

https://www.nps.gov/subjects/glaciers/types-of-glaciers.htm

LESSON 3

Glacier Grind



Sandhill cranes searching for food in a wetland.

FOR VIRTUAL LEARNING:

If using this lesson for virtual learning, the teacher can complete the activity as a demonstration while the students watch and record their predictions and observations.

EDUCATOR GUIDE:

Begin by discussing the Prairie Pothole Region that was featured in the film *Wings Over Water*.

1. Give students time to discuss the following questions with partners or small groups before discussing as a class:

What are wetlands?

A wetland is an environment where the ground is partially or fully covered by water. Examples of wetlands include bogs, swamps, and marshes. These environments can be permanently wet or can become wetlands only during certain seasons. There are many plants and animals that are specially adapted to living in a wetland ecosystem.

What is important about the Prairie Pothole Region?

The Prairie Pothole Region contains millions of freshwater marshes and is one of the most important wetland regions in the world.

Many different plant and animal species rely on this region, especially migratory waterfowl like those shown in the film. It is a critical nesting and breeding habitat for over 50% of North America's migratory waterfowl including over 50 at-risk species.

NOTES:

When did the prairie potholes get there?

In the film, we learned that the prairie potholes formed thousands of years ago at the end of the last ice age.

What is an ice age?

Students may be familiar with the concept of ice ages from movies and other media. An ice age was a period when the Earth was much colder than it is now. There have been many ice ages in Earth's history, but the last one ended about 12,000 years ago. During that time, many places in the world, including parts of North America, were covered in ice, snow, and glaciers.

What is a glacier?

Students may not have background knowledge of glaciers. Use the National Park Service resources provided in the Teacher Prep section to familiarize them with what glaciers are and where they are found.

Glaciers are giant sheets of ice that form over hundreds of years as fallen snow is packed down and turned into ice. Glaciers "flow" like very slow rivers as the weight of the ice forces the edges to move outward.

There are many different types of glaciers. Some are known as alpine glaciers. They flow like rivers down mountains and into valleys. The glacier that once covered the Prairie Pothole Region was a continental glacier known as an ice sheet. Ice sheets are huge masses of continental ice that cover tens of thousands of square miles. Today, ice sheets are found only in Antarctica and Greenland.

*The **Wings Over Water** film crew captures a brilliant sunrise over the pond.*

2. Use the silly putty to show how a continental glacier spreads. First roll the putty into a sphere and place it on the paper plate in the front of the room.

Ask students:

> **What do you think will happen to the putty if I leave it on the plate? Will it keep its shape?**
>
> *Students may predict that the putty will slowly spread out on the plate. Allow them to make predictions by talking to a neighbor and then sharing with the group.*

3. After the putty has flattened out some explain that the weight of the putty causes it to spread out when it is left on a flat surface.

> **What would happen if I added more putty on top?**
>
> *Students should understand that the more putty is added, the further out it will spread. They should be able to connect this demonstration to the way a continental glacier spreads out as more snow and ice accumulates on its surface.*

4. Show students the National Park Service photo reconstruction that demonstrates the spread of the ice sheet during the last ice age:

https://www.nps.gov/articles/icesheets.htm

5. Instruct students that as glaciers grow and retreat, they change the landscape underneath them. We can still see the effects of ancient glaciers in landforms today, including in the prairie wetlands. Tell students that today they will be observing how the prairie wetlands formed, by creating their own mini wetlands in the classroom.

NOTES:

6. Pass out a tray of clay to each student/group. Explain that the smooth clay represents the prairies before the retreat of the glaciers.

7. Have students to discuss the following questions:

How might glaciers affect the land they move over?

Students may need help brainstorming some possible effects of glacier activity. Use the National Park Service resources to show pictures of some glacial landforms.

As they move, glaciers can cut and scrape away parts of the land creating rivers, streams, and valleys. They also push soil, rocks, and other sediments along with them, creating new layers in the ground.

What does it mean when a glacier "retreats?"

It means the glacier is melting at a faster rate than new ice can be added.

8. Pass out the cups of crushed ice. Explain that as glaciers retreat, sometimes big chunks of ice can break off the main glacier. Tell students to pretend the glaciers are retreating and place some chunks of ice in their tray as if they have broken off the main glacier. Even though our pieces of ice are somewhat small, the chunks of ice from a real glacier would be huge and very heavy.

What do you think would happen if a piece of ice that big and heavy sat for a long time on top of soft ground?

Help students understand that eventually the ice would start to sink into the ground.

9. Have students demonstrate what would happen by pressing their ice chunks into the clay.

How would another ice age affect the appearance of the prairie wetlands?

10. Students should complete the box labeled **Observation 1** on their *Glacier Grind Recording Sheet.* Tell them to be as detailed as possible when drawing the location and approximate size and shape of each piece of ice.

11. Remind students that glaciers do not retreat all at once. They go through periods of growth and retreat over many years.

What might happen if the main glacier moved back over the area where the ice chunks have been left?

Glaciers push sediment along with them and create new layers of soil. Students should be able to predict that a layer of sediment would eventually cover the ice.

12. Pass out the cups of soil and ask students to pretend the glacier had fully retreated, leaving behind a new layer of sediment on the ground. Students should now pour the soil on top of the clay, making a thin layer that just covers the ice.

13. Place the pans somewhere out of the way, preferably in the sun, and leave them for approximately 30 minutes or until the ice has melted.

14. While waiting, students will predict what they think the trays will look like in 30 minutes. Have students share their predictions with the class or with their groups and then fill out the **Predict** section of their recording sheets by drawing a picture and writing about what they think will happen.

15. Discuss the following questions:

If we could travel to the prairie wetlands during the last ice age, what do you think they would look like?

They would not look like wetlands at all but would be covered in ice and snow. They would probably look more like Antarctica or Greenland, where there are still continental glaciers today.

NOTES:

What plants and animals do you think we would see? How would they be similar or different from the plants and animals we saw in the film?

The plants and animals would probably be very different because it was so much colder. Students may have knowledge of ice age plants and animals that are now extinct. There would not have been many plants or animals living on the glacier but nearby there may have been animals like mammoths, mastodons, and saber tooth tigers. The plants and animals would be different than they are now because they would have to be able to survive in much colder temperatures.

16. When all the ice has melted, tell the students to observe the changes to the soil in their trays. If moving the trays, be careful not to disturb the features in the soil.

Discuss the following questions as a group:

How does the "land" in the tray look different now that the ice has melted?

Students should be able to observe that small depressions have formed in the soil.

What happened to the pieces of ice that were buried in the soil?

The ice has melted, leaving behind holes where the pieces were.

How is what happened in the trays similar to what happened thousands of years ago in North America?

There was once a giant glacier covering a large part of the land. As the glacier receded, it left behind millions of potholes, like the ones that formed in our trays. These potholes fill with water from rain and melting snow each spring and become a wetland ecosystem.

*The **Wings Over Water** film crew films the wonder of the wetlands.*

17. Give students time to finish their *Glacier Grind Recording Sheet.* Instruct them to make a detailed drawing in the box labeled **Observation 2** and then answer whether or not their prediction was correct.

On the back students should use colored pencils to draw a picture of the prairie wetlands today, showing the many pothole lakes and ponds that were formed by ancient glaciers.

Optional: Have students make a 3D model of the prairie pothole region using air-dry clay and sheets of cardboard. After the clay has dried the students can paint their models and use toothpicks to label the different features.

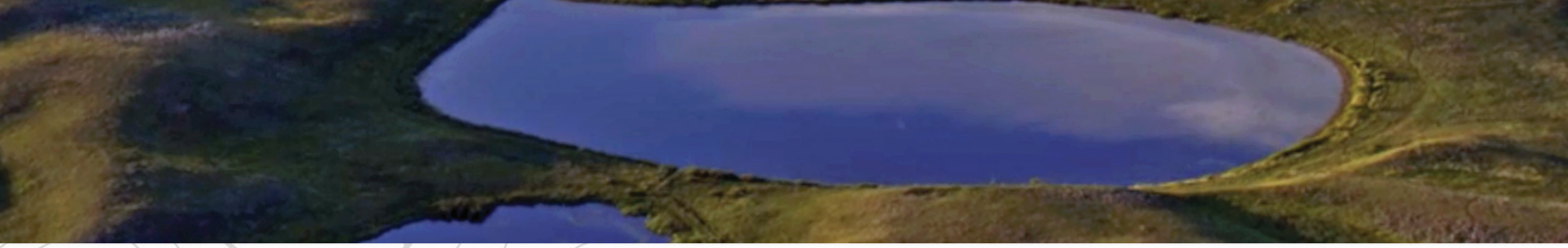
OBSERVE & PREDICT:

GLACIER GRIND RECORDING SHEET

Observation 1:

Draw a sketch of your prairie after ice has broken off of the glacier.

Predict:
What do you think the prairie will look like after 30 minutes?



OBSERVE & PREDICT:

GLACIER GRIND RECORDING SHEET

Observation 2:

Draw a sketch of your prairie after the glacier has retreated.

Conclude:
Was your prediction correct?
Why or why not?

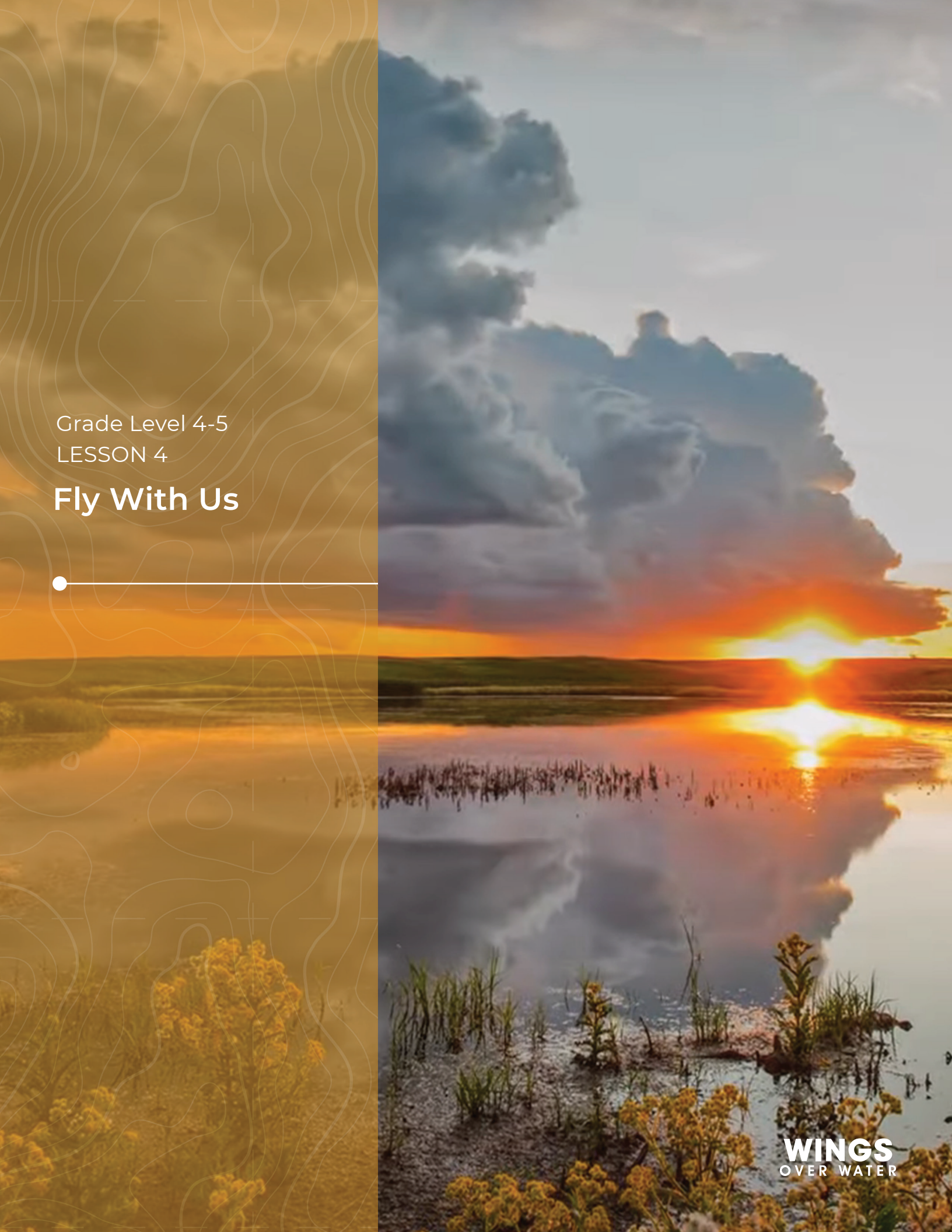
OBSERVE & PREDICT:

GLACIER GRIND RECORDING SHEET

Observation 3:

Make a drawing of the prairie wetlands today, showing the features that were created by ancient glaciers.

Be as detailed as you can.



Grade Level 4-5
LESSON 4

Fly With Us

WINGS
OVER WATER

LESSON 4

Fly With Us

Standards (NGSS): 5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Grade Levels 4-5: 40 minute lesson

MATERIALS LIST

- Pencils (one per student)
- Paper for planning and notes
- *Fly With Us* Migration Fact Sheets

FROM THE FILM:

In the film we learned that sandhill cranes, mallard ducks, and yellow warblers all undergo lengthy migrations to reach the prairie wetlands. Each bird species has its own unique way of migrating and traits that help them complete their journey.

LESSON OVERVIEW:

Using the provided datasets, students will take the role of migratory birds and work in groups to create a short, approximately five-minute skit to show off the advantages of their species' migration.

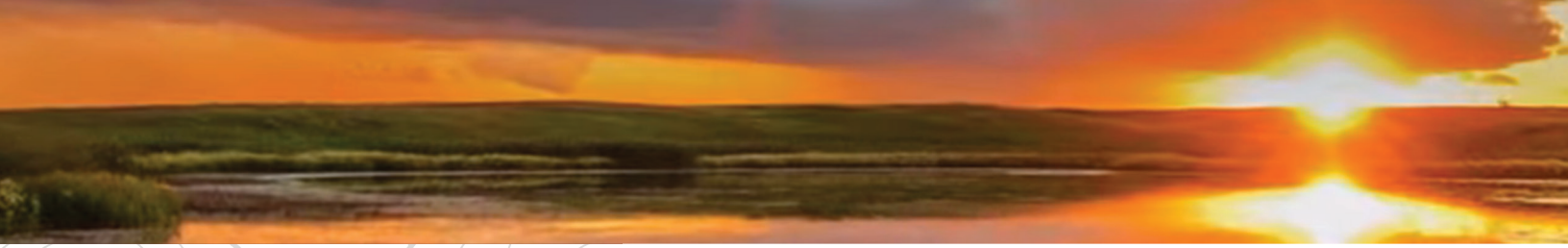
Each group will create a compelling vision of the journey including how they will navigate, what the flightpath will be, and how to plan the flight (V-formation, scheduled stops, flight speed etc.) to make it easier than travelling alone.

Don't go at it alone, join your fellow birds and let's make this incredible journey together!

EDUCATOR PREP:

Print out enough copies of the bird datasets and graphic organizers for each group.

Groups will use this data to inform their skits.



LESSON 4

Fly With Us

Lunchtime for yellow warbler chicks.

FOR VIRTUAL LEARNING:

If using this lesson for virtual learning, suggest that students create a skit that emphasizes auditory performances or minimizes the need for in person interaction. For example, performances could be modeled after a conversation through a web conferencing program, or in the style of a radio drama or podcast. If interaction between students is not an option, have students create a poster or brochure for their migration.

EDUCATOR GUIDE:

1. In the film we learned that spring marks the arrival of migratory birds in the prairie wetlands. Large cranes, speedy ducks, and small songbirds travel extreme distances to reach their summer home.

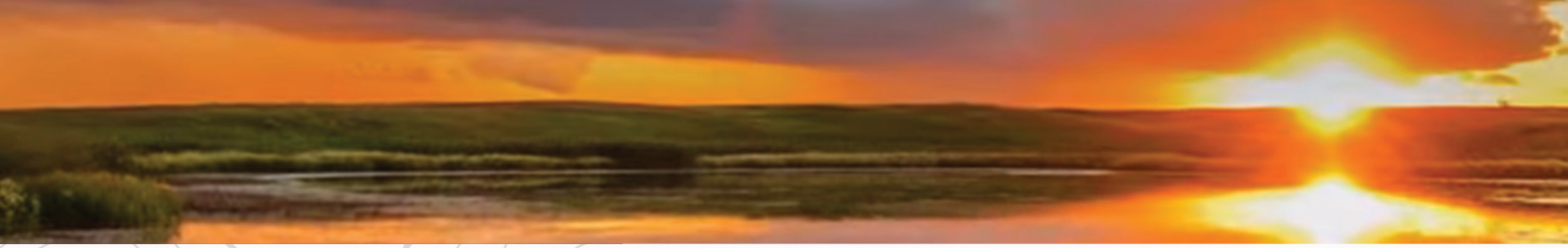
With students working in small groups or individually, start a discussion on animal migration. Ask the following questions to guide the discussion.

What is migration?

Migration is the synchronized movement of animals from one geographic location to the another. Typically, animals will travel the same paths from one area to another and back.

Why do animals migrate?

Animals migrate to reach better living conditions. Many birds migrate south in the winter to warmer areas where food is more abundant. Other animals like salmon migrate upstream to reach sheltered areas where they can breed and lay their eggs. Migrations can bring animals across continents, or up and over mountains.



NOTES:

2. Continue the discussion, connecting students' personal experiences with travel to migration and leading the conversation to migratory birds.

When going on a long journey what are some things you may bring with you?

Answers will vary but may include food, water, appropriate clothing, and a map. Emphasize to students that animals need to prepare for journeys just like we do.

How do you know where to go when you go back and forth from to places in your everyday life?

When you first travel to a place you may need to put directions into a GPS or look at a map. After making the trip a few times you may be able to navigate with landmarks or by memory.

How do migratory birds know how to get to their migration destinations?

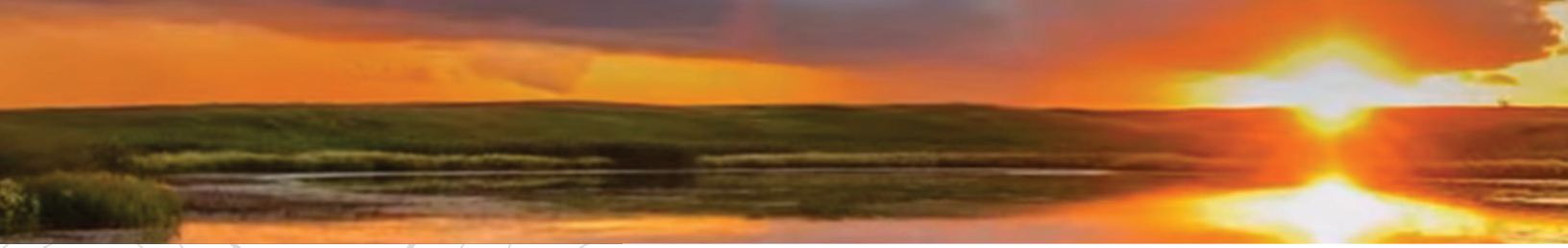
The ways that birds navigate is not fully understood, but some birds navigate by smell, others by sensing patterns in Earth's magnetic field with either their ears or their eyes.

Do you think migrations are risky?

Migrations can be perilous journeys. Migrating animals will face drastically different environments as they travel, each with its unique dangers.

Migration also takes lots of energy and animals need to be able to stock up on food or risk starvation. With the distance and physical toll, animals can be extremely tired after traveling long distances, making them vulnerable to predators.

In addition to natural threats, migrating birds must avoid man made dangers. Highways, buildings, wind turbines, and reduced resource availability from habitat loss all pose dangers to migratory birds.



Sandhill cranes at rest in a wetland.

How do migratory birds overcome some of the dangers of migration?

Birds have developed traits and behaviors to make migration easier and safer. Some birds travel together in large flocks to avoid predators. It is better to have more than one pair of eyes looking for danger. Others travel at nighttime when most other animals are not active.

3. Inform students that they will be playing the role of different migratory bird species and creating skits to convince others to join them on their species' migration. Students will work in groups to create a migration skit that highlights their specific migration abilities and choices to attract other birds to migrate with them. Students will use real data to form their arguments.

4. Ask students:

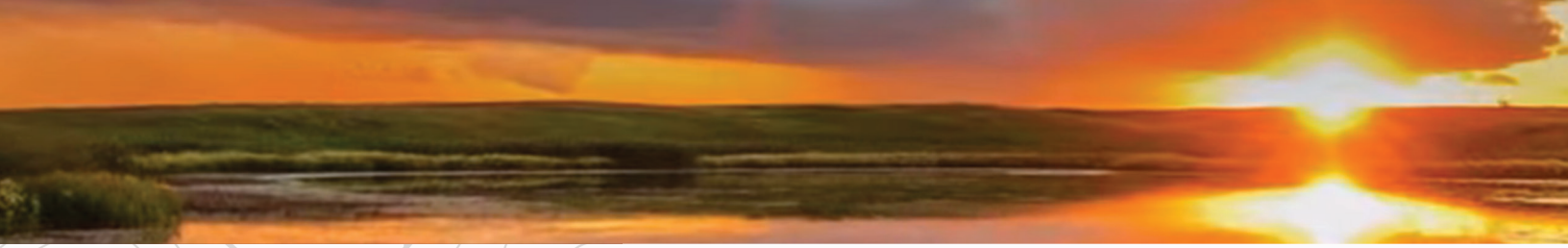
What are the qualities of a good skit?

A good skit should capture the attention of its intended audience. The skit should be fun and have a "pull factor" that makes it catchy and memorable. Skits should also be informative but not packed with too much information that overwhelms the audience. Having a tagline or slogan can also really make a skit shine!

5. Split students into four groups and assign each group one of the following birds:

- **Mallard Duck**
- **Sandhill Crane**
- **Yellow Warbler**
- **Canada Goose**

6. Inform students that their skits should include information on the way each type of bird interacts with their environment to make their migration successful. Relevant information can include flight paths, formations, scheduled stops, potential dangers and any other information they think is important.



NOTES:

7. Break students into groups and give each group a bird fact sheet and graphic organizer to plan out their skits. Lay out the time frame for students to plan out their skits and remind them that their skits should incorporate the following to be the most compelling for their fellow birds:

- *A catchy title or tagline that attracts other birds of the same species.*
- *At least three fun facts about the journey.*
- *Fun and creativity to really make the skit effective.*

8. Make sure to reserve time for each group to present their skits to the class.

SKIT GRAPHIC ORGANIZER

Use this graphic organizer to help plan out the different parts of your skit including different parts, the main idea of your skit and the information that you want to highlight.

Name of skit:

Characters/Roles:

Main idea:

Detail 1

Detail 2

Detail 3

Additional Information:

Catch Phrase or Slogan:

YELLOW WARBLER

Setophaga petechia

Start and End Points: *Travel back and forth from the United States and Canada to Central America and northern South America.*

Flightpath: *Fly in winding routes that keep them over land as much as possible.*

Flight formation and timing: *Large groups of warblers will move together in the same direction but in a loose group, unlike ducks or geese that fly in formation. Will often travel at night and with favorable wind conditions.*

Distances and Flight Speed: *Complete approximately 2,300 mile migrations with an average of 55 miles traveled each day.*

Altitude: *Not completely known, but some warblers reach altitudes of over 6,000 feet.*

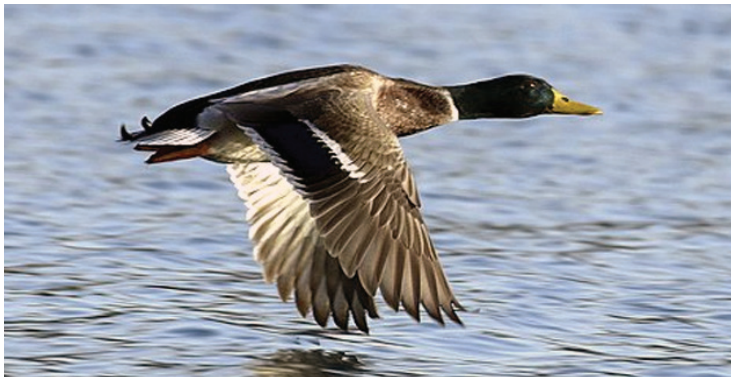
Scheduled Stops: *Stops in the forests and along the coastlines of Florida, Cuba, and the Yucatan Peninsula while flying through Central America to reach wintering sites.*

Travel Timing: *Migrations usually take less than three weeks and spring migration north is a race to get back and claim the best territories prior to the start of breeding season.*

Navigation: *Travel is guided following the stars and by sensing of the Earth's magnetic field.*

Hazards: *Severe weather, man-made obstacles like buildings, destroyed habitat and introduced predators like cats can put warblers in danger.*

Other Information: *Yellow warblers are among the first of the warblers to begin their migration up the North American continent in spring. Yellow warblers can live to 10 years and migrate several times over their life. Yellow warblers only weigh as much as three pieces of paper. During migration warblers use so much energy that they can lose 20% of their body mass.*



MALLARD DUCK

Anas platyrhynchos

Start and End Points: *Migratory populations move from Mexico and the southern United States to the northern United States and Canada*

Flightpath: *Fly from wetland to wetland while moving north and south on flight corridors.*

Flight formation and timing: *Fly in V-shaped formation with the lead duck cutting a path in the wind and making it easier for the following ducks. Each duck flies behind the duck in front of it moving up and down to reduce wind resistance and glide on the updrafts from the leading bird. Will often travel at night.*

Distances and Flight Speed: *Complete up to 800 mile migrations with speeds up to 50 mile per hour and some flights lasting for 8 hours straight.*

Altitude: *Travel is usually between 400 and 2,000 feet but occasionally higher.*

Scheduled Stops: *Stop in the same wetlands and bodies of water along their flightpath on each migration. Will take three to seven day breaks on the way to replenish their energy after eight hour flight days.*

Travel Timing: *Migrations usually take between 18 and 48 days with about 12 days of stopover time during migration.*

Navigation: *Travel is guided in part with internal sensing of the Earth's magnetic field. Mallards have specialized protein structures in their eyes that help them to orient on magnetic north.*

Hazards: *Ducks are at special risk from predators when in disturbed habitats. Manmade structures are also collision hazards.*

Other Information: *Smaller wing size prevents mallards from soaring well, but their long pointed wings and rapid wingbeat, up to ten times per second, help them reach their fast speeds. Mallards will store fat to make sure they have energy before migration and can lose approximately 20% of their body-weight during travel.*

SANDHILL CRANE

Antigone canadensis

Start and End Points: *Migration from the southern United States and Mexico to the Arctic.*

Flightpath: *Travel through Canada, the Midwest United States, and Mexico along the Central Flyway.*

Flight formation and timing: *Flight formation and timing: Travel in groups of tens of thousands. Sandhill cranes will fly a V-shaped formation with the lead crane cutting a path in the wind and making it easier for the following cranes to fly in their wake. Cranes also synchronize their wingbeats to make it easier for other birds to follow in formation.*

Distances and Flight Speed: *Travel between 200 and 300 and up to 500 miles per day at speeds of 25-35 miles per hour.*

Altitude: *Travel is usually less than 5,000 feet up but can reach up to 12,000 feet.*

Scheduled Stops: *Over 80% of populations (around 600,000 cranes) stop in the Great Plains to rest and feed.*

Travel Timing: *Spring migration goes from February to April.*

Navigation: *Migration follows learned and remembered routes with landmarks passed down from generation to generation.*

Hazards: *Natural obstacles include severe weather and changes to habitat from climate change. Manmade obstacles like power lines also make it harder for cranes to migrate. Habitat loss in nesting areas and along migration routes adds additional risk.*

Other Information: *Sandhill cranes can save 20-30% of their energy by flying in V-formation. Cranes may use their wing feathers to sense air currents and optimize their travel. Sandhill cranes mate for life and live for 20-40 years.*

CANADA GEESE

Branta canadensis

Start and End Points: *Migratory populations move from the southern United States to the northern United States and Canada up to the arctic.*

Flightpath: *Follow multiple flight corridors across North America. Migrating geese will follow the same paths each year.*

Flight formation and timing: *Fly in V-shaped formation with the lead goose cutting a path in the wind and making it easier for the following geese. Each goose flies behind the goose in front of it moving up and down to reduce wind resistance and glide on the updrafts from the leading bird. Communicate with honks to coordinate, shift positions, and keep the lead geese from getting tired.*

Distances and Flight Speed: *Complete 2,000 to 3,000 mile migrations with speeds between 40 and 70 miles per hour. Sometimes travel 1,500 miles in a day if the conditions are good.*

Altitude: *Travel is usually between 750-3,500 feet but occasionally higher.*

Scheduled Stops: *Stop in wetlands and agricultural fields to feed and rest by large bodies of water where they can escape predators.*

Travel Timing: *Fall migration begins when freezing sets in in the goose's northern range. Spring migration follows the melting snow. Migrations take weeks to days with fall migrations going faster.*

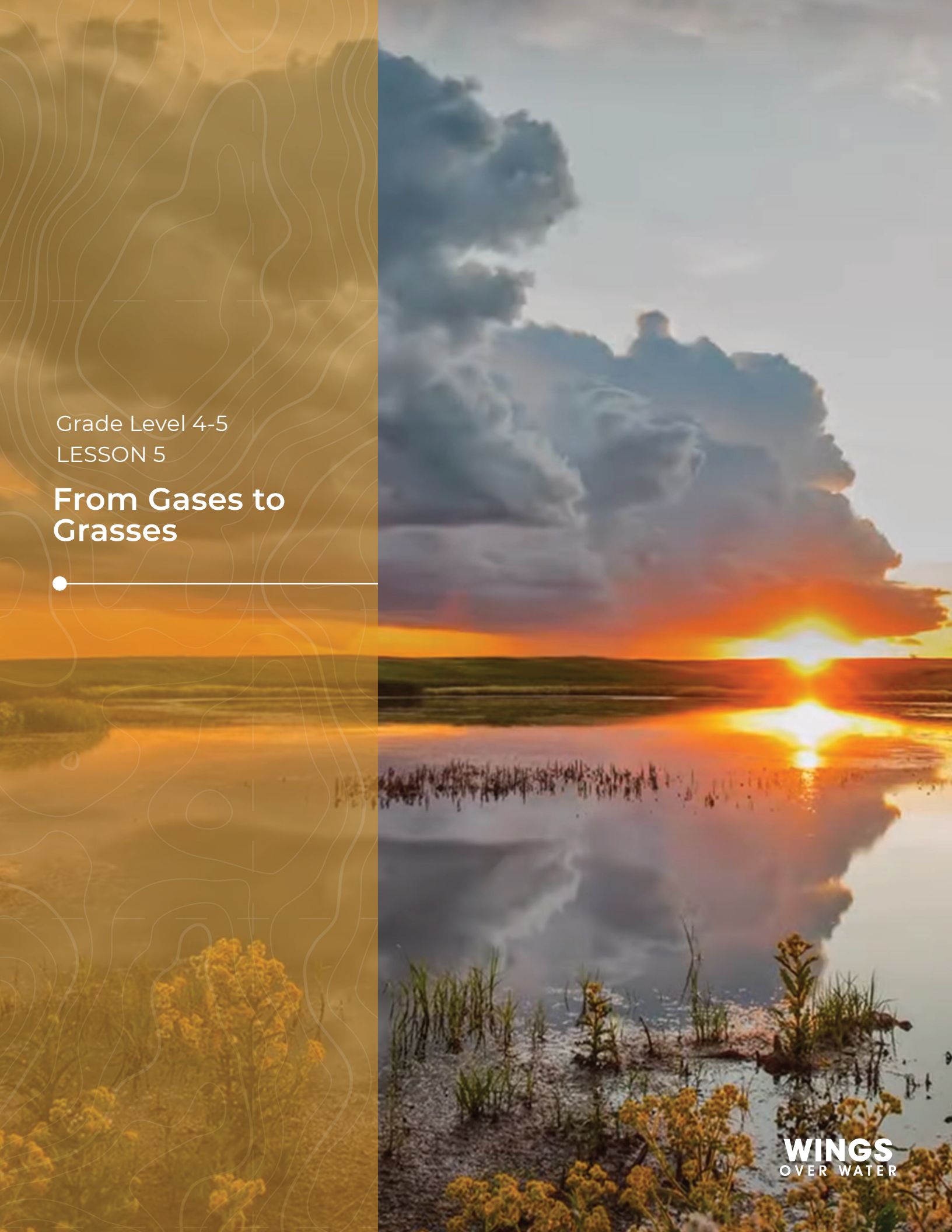
Navigation: *Exact navigation methods are not known but Canada geese are believed to navigate by memory using topographical landmarks, the sun, and stars. Geese may also be able to detect Earth's magnetic field.*

Hazards: *Geese are at risk from colliding with aircraft and from predators like eagles, owls, coyotes, and wolves.*

Other Information: *Canada geese mate for life and nest in the same area year after year. They return to nest in the same place where they originally hatched. Canada geese are tough and will attack predators, biting and hitting with their wings. Not all Canada geese migrate, many in urban areas stay year round.*

Grade Level 4-5
LESSON 5

From Gases to Grasses



WINGS
OVER WATER

LESSON 5

From Gases to Grasses

Standards (NGSS): 5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Grade Levels 4-5: 40 minute lesson

MATERIALS LIST

- Pencils (one per student)
- *Gases to Grasses* worksheets (one per student)
- Station sign printouts
- Dice printouts
- Tape
- Scissors
- Space to spread out stations around classroom

Optional:

- Laminate
- Card stock

FROM THE FILM:

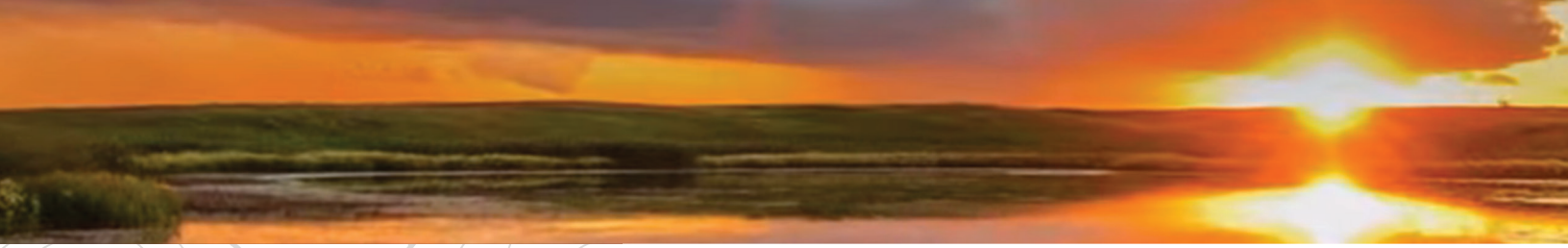
In the film we get a bird's-eye view of the prairie wetland ecosystem. We zero in on the roles both living and nonliving components play in the expanse of the prairie and the ecosystem that extends beyond it. We learn that each component of the wetland has an important role in the carbon cycle, most notably the extensive roots of the prairie grasses and their ability to store carbon deep underground.

LESSON OVERVIEW:

What better way to learn about the carbon cycle than by experiencing it firsthand? Students will explore the journey a carbon atom takes through the prairie wetland ecosystem by becoming carbon atoms themselves. Students will map their journeys and use their knowledge and observations to discover the importance of carbon and where they fit in the carbon cycle.

EDUCATOR PREP:

Print *Gases to Grasses* worksheet and make copies (one per student). Print station signs (optional: print on card stock and laminate for future use). Assemble dice by printing templates provided on pages 56–61, (consider printing on card stock). Trim along the solid lines and fold along the dotted lines. Tape each die together, forming a cube. Spread stations throughout the classroom allowing for adequate space between stations.



LESSON 5

From Gases to Grasses

Female mallard ducks have duller colors than males.

FOR VIRTUAL LEARNING:

Instead of students rotating through stations in a classroom, teachers will provide them with the virtual flow sheet. This sheet allows students to roll a die (or use a die rolling internet application) to map the journey of their carbon atom at home.

EDUCATOR GUIDE:

1. Today we are going to learn about carbon.

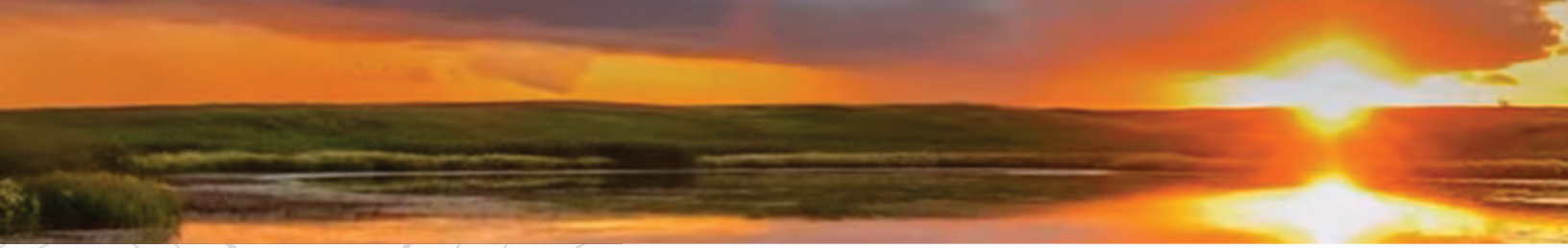
Ask students if they have ever heard of carbon and allow students to share their preexisting knowledge before introducing the idea that carbon is key to life and an integral part of many nonliving things as well.

Students might be familiar with things like carbon dioxide, but are probably not familiar with the importance of carbon dioxide making our planet habitable by trapping the right amount of heat or that plants rely on carbon dioxide to perform photosynthesis.

Carbon is an element that is found in all living (organic) things, but also many nonliving (inorganic) things.

Pure carbon forms one of the world's hardest substances (diamonds) and one of the softest (graphite).

Carbon forms more compounds than any other element.



NOTES:

2. The amount of carbon on Earth is fairly constant. Carbon is stored in different reservoirs or sinks. Most of Earth's carbon is stored in rocks, but it's also found in the atmosphere, soil, water, and all plants and animals. Carbon moves between these sinks through a process called the carbon cycle. The movement of carbon through the carbon cycle is similar to the way water moves through the water cycle, which students may be more familiar with, these cycles are called **bio-geochemical cycles**.

3. Explain that students are going to become carbon atoms and travel through the carbon cycle. This activity focuses on the carbon cycle in the Prairie Pothole Region. Before starting, go over the carbon sinks highlighted in the activity.

- **Atmosphere**- Carbon exists in the air around us. Many sources release carbon into the atmosphere, but not many can directly absorb it.

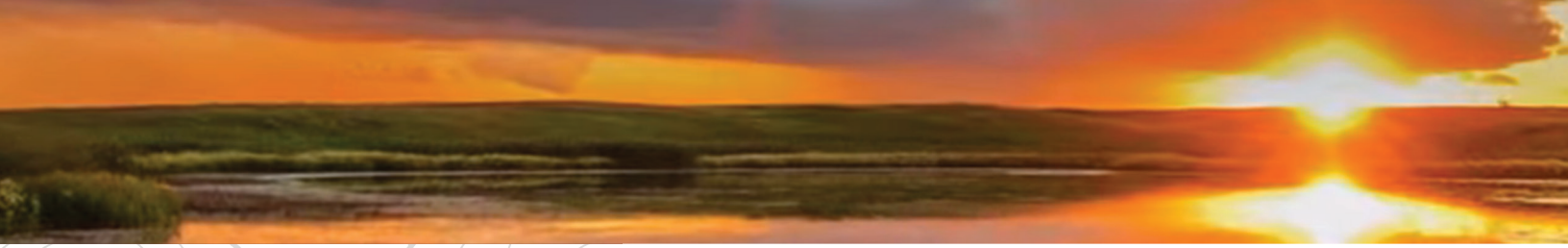
- **Animals**- Animals acquire most of their carbon from the food they eat and use it for body processes.

- **Fossil fuels**- Coal, oil, and natural gas store huge amounts of carbon, but take millions of years to form.

- **Plants**- Plants, like prairie grasses, absorb carbon dioxide during photosynthesis, which they use in food production and growth. The roots of prairie grasses hold vast amounts of carbon.

- **Soil**- Soil can store carbon underground. The roots of many prairie grasses can transfer carbon from the plant to the soil.

- **Water**- Water can absorb and carry carbon from the atmosphere. The prairie potholes hold carbon in the water and transfer it back and forth with the atmosphere.



Mallard duck with ducklings.

4. Give each student a copy of the *Gases to Grasses* worksheet and explain that they will record their travels on the sheet. When they arrive at a carbon sink, they will fill the name of the sink into one of the numbered squares. Next, they will roll the die at the station to see what happens to them. They will write down what they roll in the arrows on the sheet before moving to their next carbon sink.

5. Divide students into groups and send them to their first station. As students rotate and document their journey, walk through the room offering feedback and asking guiding questions to keep students engaged. Possible questions:

- **Where have you already traveled to?**
- **Have you noticed any patterns in your journey?**
- **Which carbon sink do you think is the most important? Why?**
- **Have you gotten stuck anywhere?**
- **Why do you think you were stuck there?**
- **Do you think this represents what really happens in the carbon cycle?**

Answers will vary, but should focus on student observations and their ability to relate back to existing knowledge and compare what happened in the activity to what students think would happen in nature.

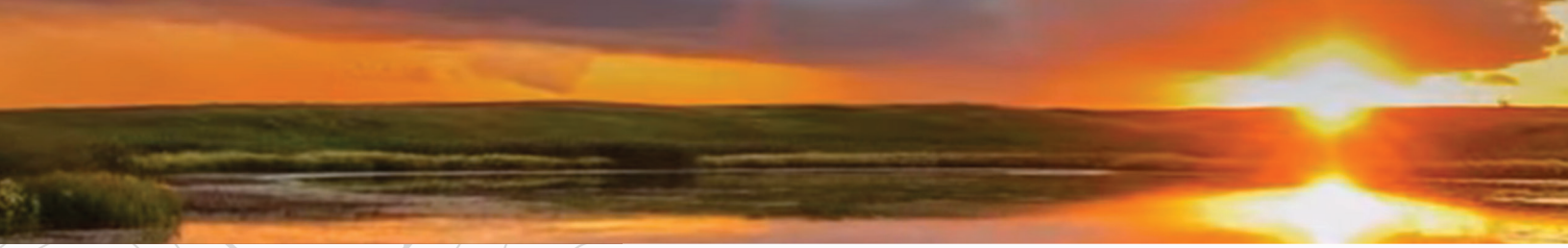
6. After students have completed their cycle and filled in their worksheet, they should return to their seats.

7. Have some students share their journeys.

Do any students have the same journey?
Chart how many students went to each station.

Were there certain stations that students went to the most? Did carbon build up in any of the stations? Do students think this represents what really happens in the carbon cycle?

Answers will vary.



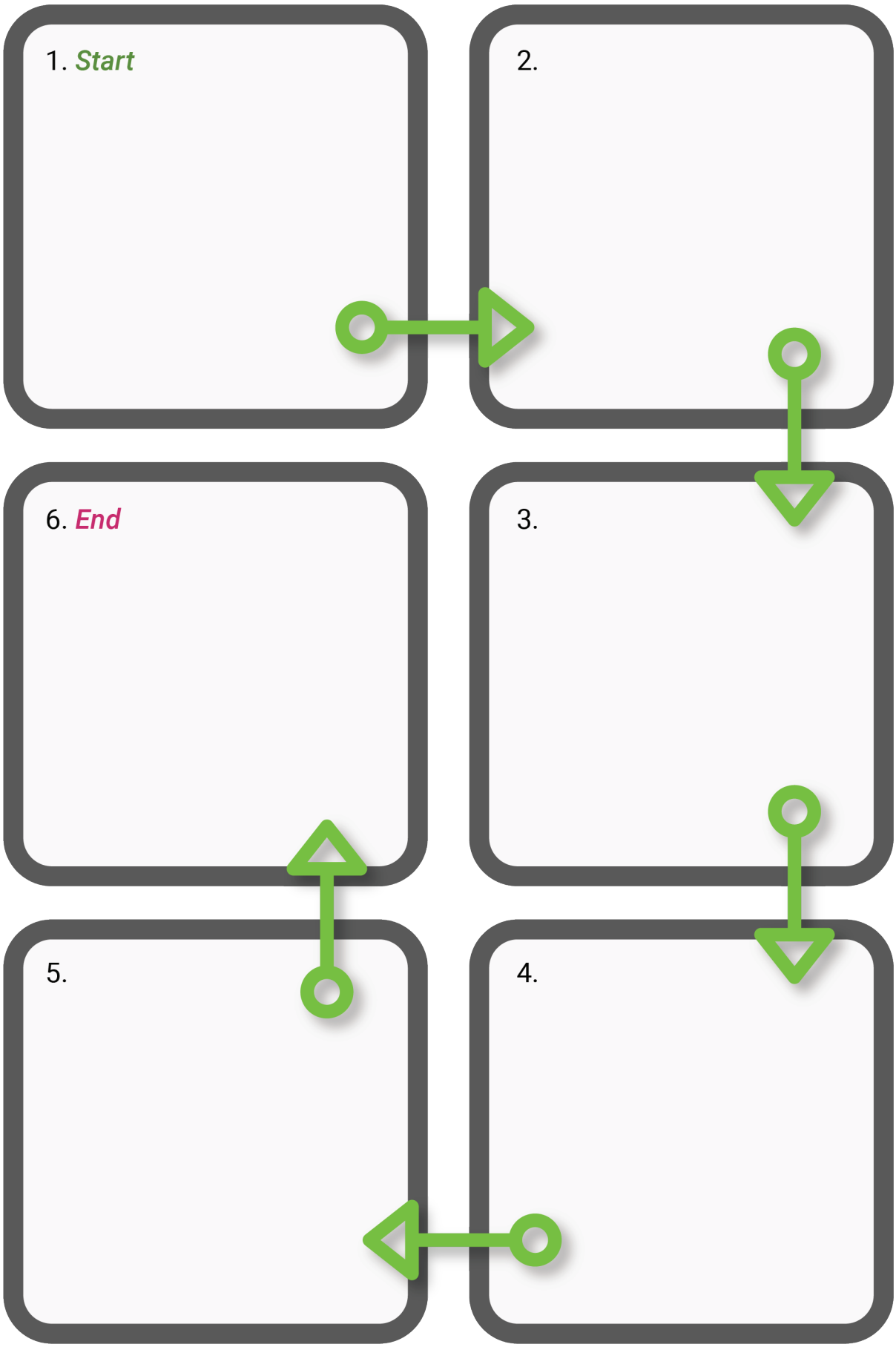
NOTES:

8. Using what they learned and saw during the activity, students should answer the following questions on the back of their worksheet:

- What does the carbon cycle have to do with me?
- How do the prairie wetlands influence the carbon cycle?

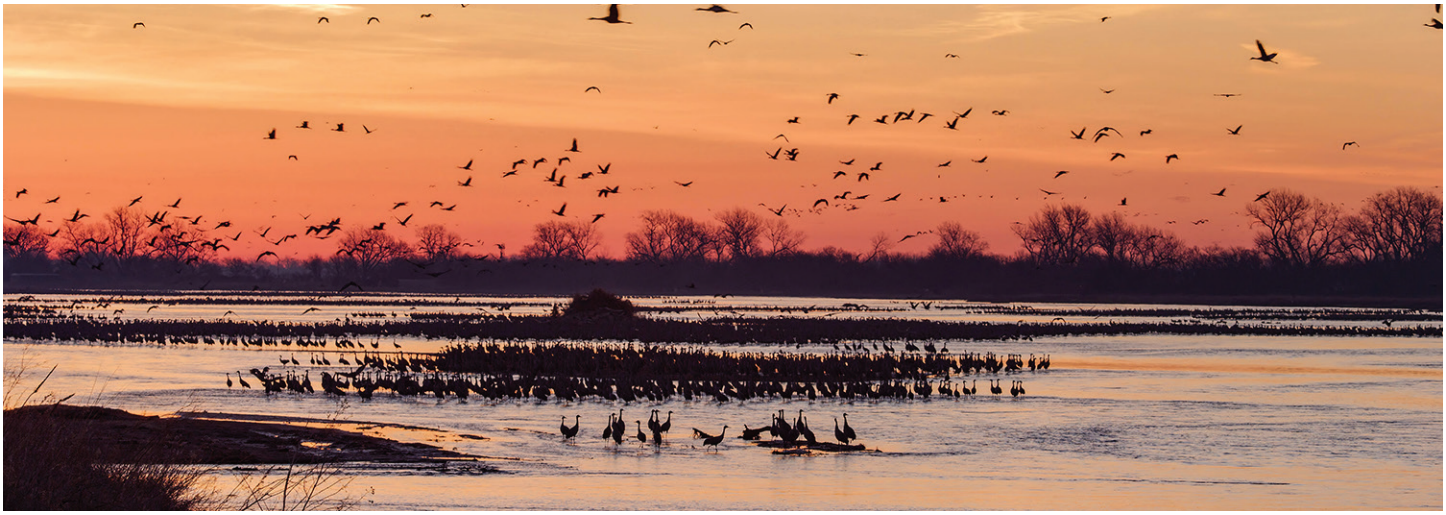
Optional extension: Have students write a short story about their carbon atom's journey through the carbon cycle and the prairie wetlands.

9. Collect students' worksheets at the end of the lesson.


1. Start
2.
3.
4.
5.
6. End

ATMOSPHERE: Carbon dioxide is an important greenhouse gas that is needed to trap heat around Earth allowing plants and animals to survive. If there wasn't carbon dioxide in the atmosphere, the Earth would be an ice planet and unable to support life. However, too much carbon dioxide in the atmosphere will trap more heat and lead to rising global temperatures.

PLANTS: Plants take carbon dioxide from the atmosphere to create food during photosynthesis. They can store carbon in their leaves, stems, and roots. Prairie grasses have an extensive root system which allows them to store carbon. When prairies and forests are cleared they are often replaced by plants or structures with little or no capacity to store carbon.



WATER: Water in the prairie potholes absorbs carbon directly from the atmosphere through chemical reactions. Leaves and animal waste settle at the bottom of the potholes and slowly breakdown, returning their carbon into the soil. Carbon from soil runoff accumulates in the prairie potholes. Carbon in the water can be used by freshwater plants and animals

SOIL: Soil is more than just the dirt on your shoes. Soil is a unique ecosystem that includes water, minerals, organic matter, air, and many types of organisms including bacteria, fungus, worms, and microbes. Soil regulates water, filters pollutants, absorbs and releases key nutrients, provides support and stability, and can store as much carbon as a forest.

FOSSIL FUEL: Fossil fuels are natural, non-renewable fuels created from organic material (plants and animals) that have been buried under layers of sediment and rock for millions of years. These carbon rich fuels include oil, coal, and natural gas, accounting for the majority of our energy needs. Fossil fuels are also used for heat, electricity, transportation, and in the production of many different products.

ANIMALS: Animals need carbon to grow, move, and function. Carbon is in the proteins that makes up our bodies and part of our DNA molecules. Animals obtain carbon through the food they eat (both plants and animals contain carbon) causing carbon to travel up the food chain. Some aquatic animals also use carbon in the building of their shells.

VIRTUAL FLOW SHEET

ATMOSPHERE: Carbon dioxide is an important greenhouse gas that is needed to trap heat around Earth allowing plants and animals to survive. If there wasn't carbon dioxide in the atmosphere the Earth would be an ice planet and unable to support life. However too much carbon dioxide in the atmosphere will trap more heat and lead to rising global temperatures.

Roll 1,3, or 5 move to water carbon enters the prairie potholes through diffusion.

Roll 2,4, or 6 move to plants carbon dioxide is taken in by plants to be used during photosynthesis.

PLANTS: Plants, like prairie grasses, take carbon dioxide from the atmosphere to use during photosynthesis as they create food. Plants store carbon in their leaves, stems, and roots. Prairie grasses have an extensive root system which allows them to store carbon deep underground. When prairies and forests are cleared, to make space for farming or urban development, they are typically replaced by plants or structures with a lower ability to store carbon.

Roll 1 move to soil when plants die, they are broken down and their carbon enters the soil.

Roll 2 or 4 move to animals when the plants are eaten by animals the carbon travels up food web .

Roll 3 move to atmosphere carbon is released into the atmosphere as prairie grasses are burned to make space for farming.

Roll 5 move to fossil fuel over millions of years the carbon in dead plants is turned into fossil fuels.

Roll 6 stay at plants carbon remains stored underground in the roots of prairie grasses. Roll again.

ANIMALS: Animals need carbon to grow, move, and function. Carbon is a part of our DNA molecules and in the proteins that makes up our bodies. Animals get carbon through the food they eat (both plants and animals contain carbon) causing carbon to travel up the food chain. Some aquatic animals use carbon in the building of their shells.

Roll 2 or 4 move to atmosphere when carbon is exhaled from animals as carbon dioxide.

Roll 1 move to water animal waste, like duck poop, filters through the prairie potholes returning carbon to the water.

Roll 3 or 5 move to soil as animals decompose their carbon is returned to the soil.

Roll 6 move to fossil fuel over millions of years the carbon in animals is turned into natural gas, petroleum, and coal.

FOSSIL FUEL: Fossil fuels are natural fuels created from organic material (plants and animals) that have been buried under layers of sediment and rock for millions of years. These carbon rich fuels include oil, coal, and natural gas. Fossil fuels account for about 80% of our energy needs on Earth including being used for heat, electricity, and transportation. Fossil fuels are also used in the production of many different products including steel and plastics, but fossil fuels are not a renewable energy source.

Roll 1,2, 3, 4, or 5 move to atmosphere as fossil fuels are burned.

Roll 6 stay at fossil fuel as an untapped store of carbon. Roll again.

WATER: Water in the prairie potholes absorbs carbon directly from the atmosphere through chemical reactions. Leaves and animal waste settle at the bottom of the potholes and slowly breakdown returning their carbon into the soil. Carbon from soil runoff accumulates in the prairie potholes. Carbon in the water can be used by freshwater plants and animals

Roll 1, 3, or 5 move to atmosphere reenter the atmosphere through diffusion.

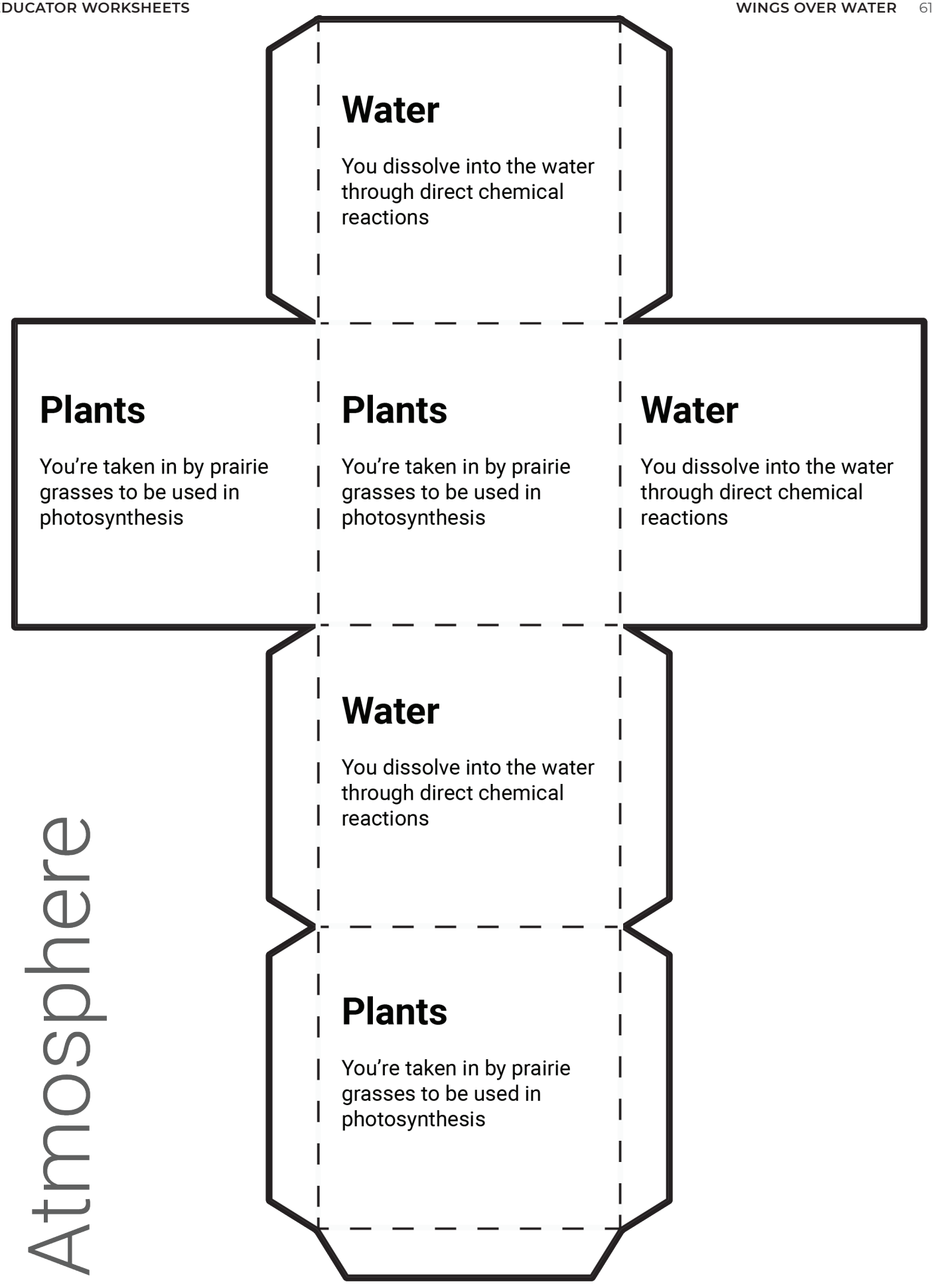
Roll 2 or 4 move to soil as organic matter is broken down at the bottom of a prairie pothole.

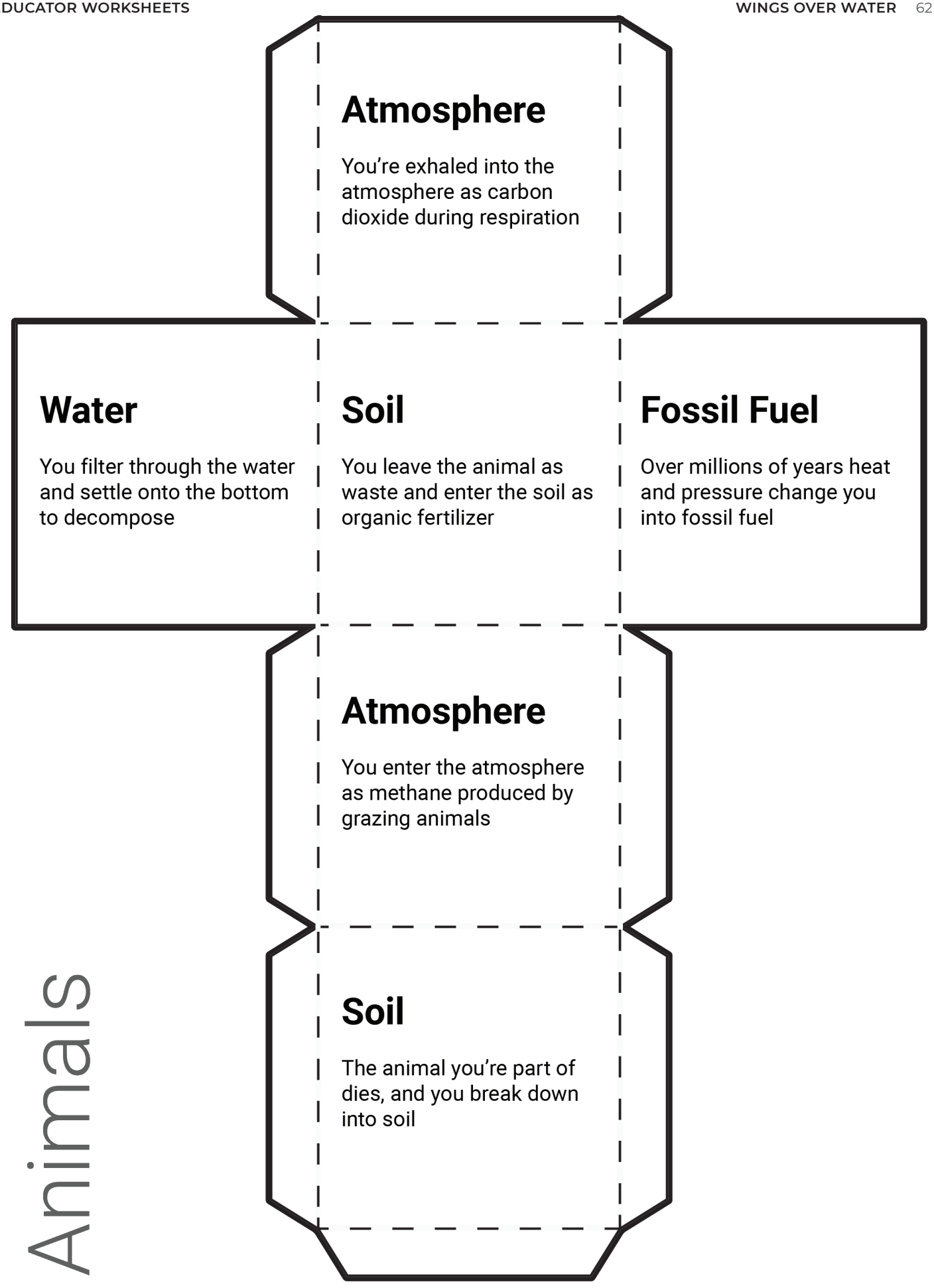
Roll 6 move to animals when an aquatic snail uses carbon to form its shell.

SOIL: Soil is more than the dirt on your shoes. Soil is a unique ecosystem that includes water, minerals, organic matter, air, and many types of organisms including bacteria, fungus, worms, and microbes. Soil regulates water, filters pollutants, absorbs and releases key nutrients, provides support and stability, and has the capability of storing as much carbon as a forest.

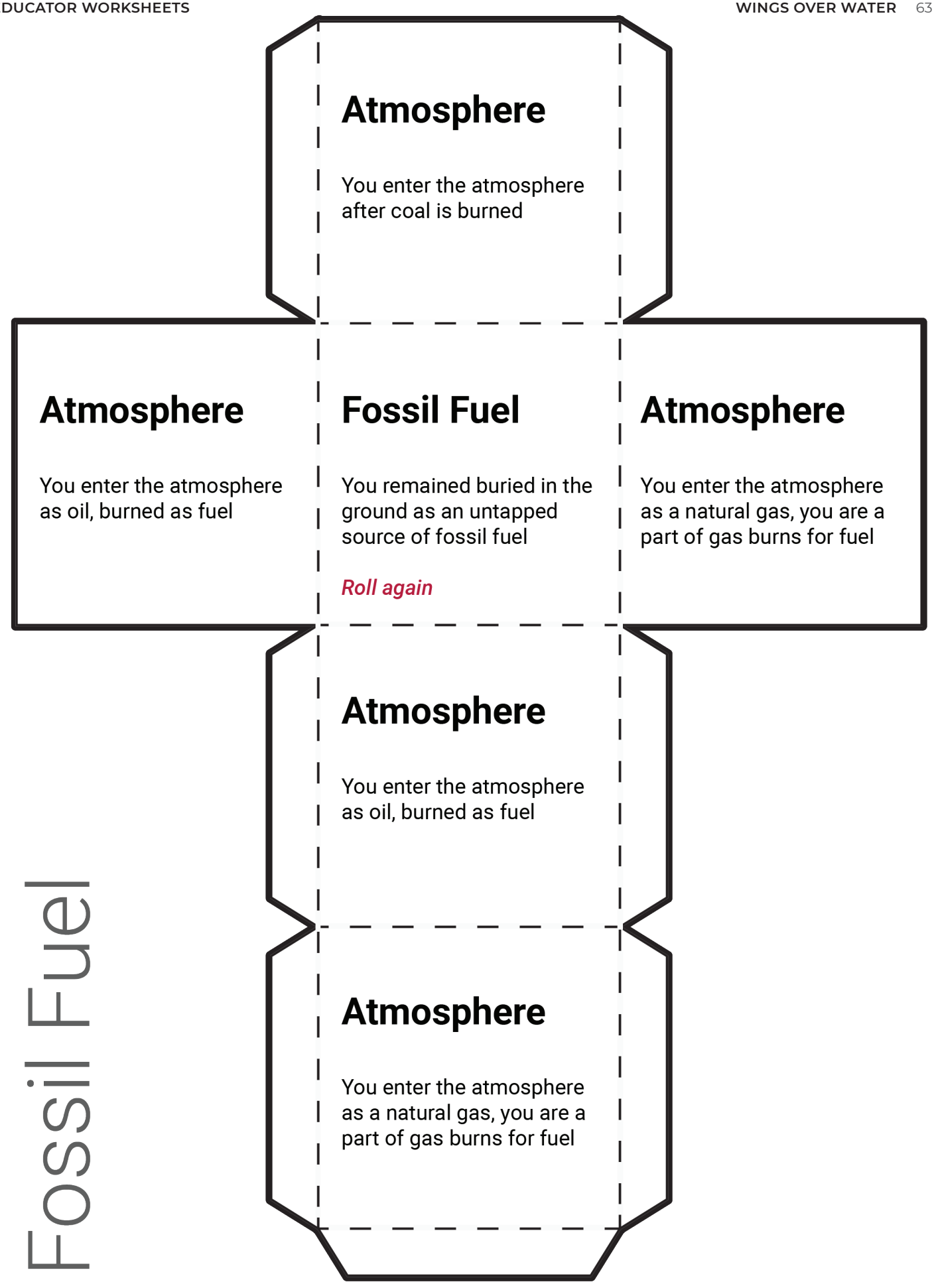
Roll 1, 3, 5, or 6 move to water as runoff from fields washing carbon into the prairie potholes.

Roll 2 or 4 move to fossil fuel as the carbon found in the organic matter in the soil is compressed over millions of years into coal, oil, and natural gas.


Water
You dissolve into the water through direct chemical reactions
Plants
You're taken in by prairie grasses to be used in photosynthesis
Plants
You're taken in by prairie grasses to be used in photosynthesis
Water
You dissolve into the water through direct chemical reactions
Water
You dissolve into the water through direct chemical reactions
Plants
You're taken in by prairie grasses to be used in photosynthesis
Atmosphere


Atmosphere
You're exhaled into the atmosphere as carbon dioxide during respiration
Water
You filter through the water and settle onto the bottom to decompose
Soil
You leave the animal as waste and enter the soil as organic fertilizer
Fossil Fuel
Over millions of years heat and pressure change you into fossil fuel
Atmosphere
You enter the atmosphere as methane produced by grazing animals
Soil
The animal you're part of dies, and you break down into soil

Animals


Atmosphere
You enter the atmosphere after coal is burned
Atmosphere
You enter the atmosphere as oil, burned as fuel
Fossil Fuel
You remained buried in the ground as an untapped source of fossil fuel
Roll again
Atmosphere
You enter the atmosphere as a natural gas, you are a part of gas burns for fuel
Atmosphere
You enter the atmosphere as oil, burned as fuel
Atmosphere
You enter the atmosphere as a natural gas, you are a part of gas burns for fuel

Fossil Fuel

Soil

You enter the soil as plant residue after the prairie grass dies

Animals

You've been eaten by an animal and are used for energy

Atmosphere

You're release back into the atmosphere after a prairie wildfire

Fossil Fuel

Over millions of years heat and pressure change you into fossil fuel

Animals

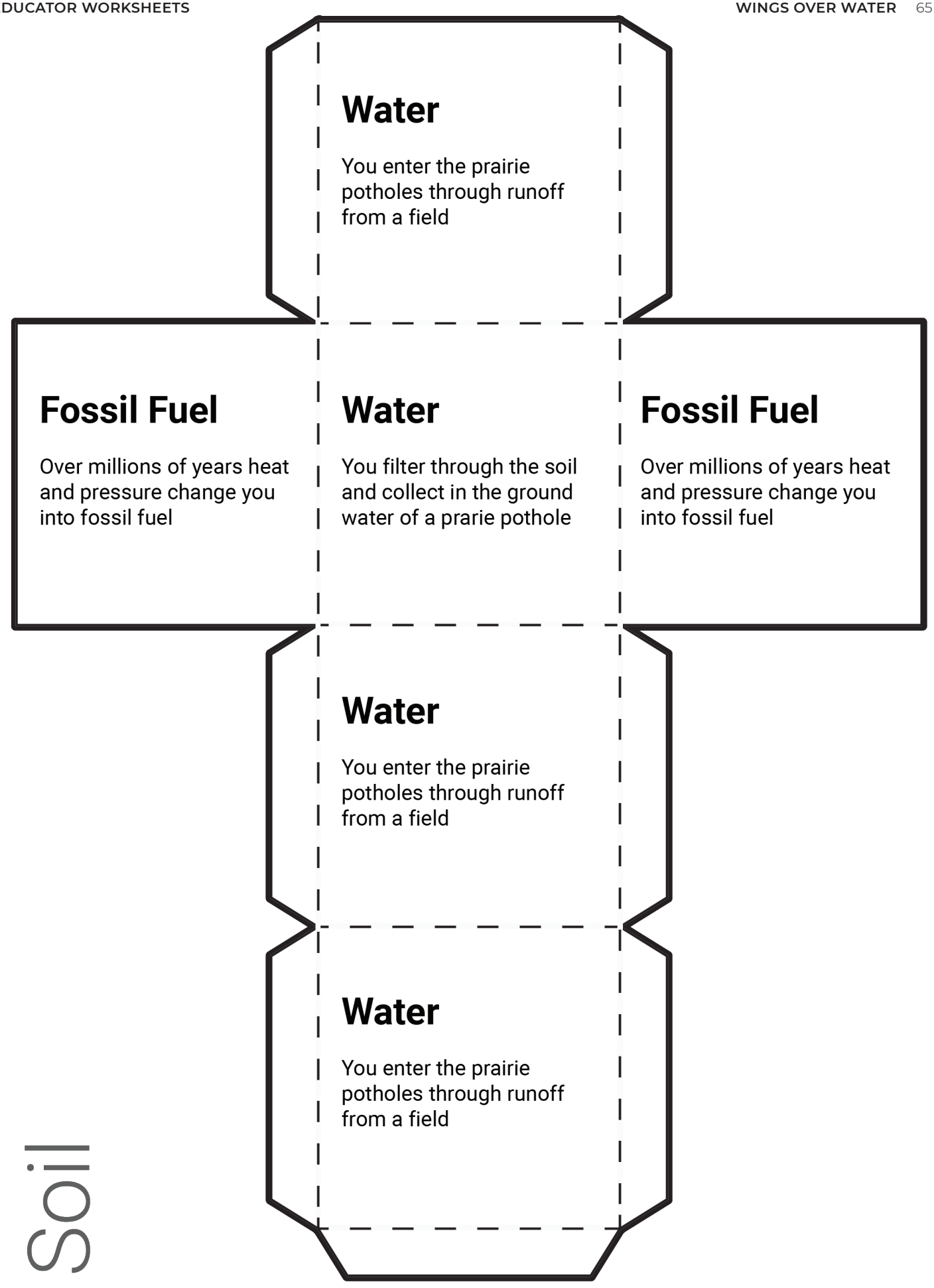
You've been eaten by an animal and are used for energy

Plants

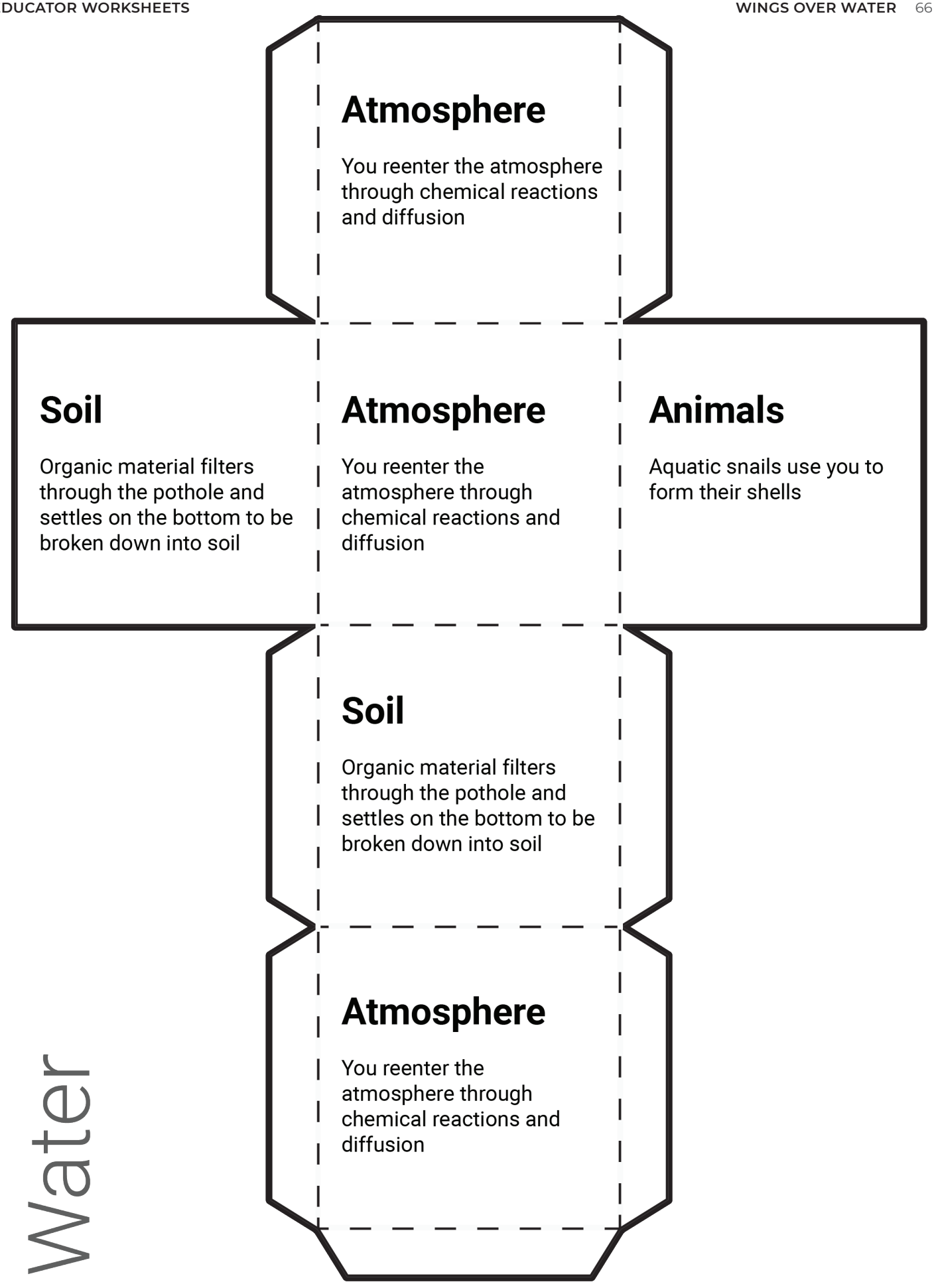
You're stored in the roots of the prairie grasses.

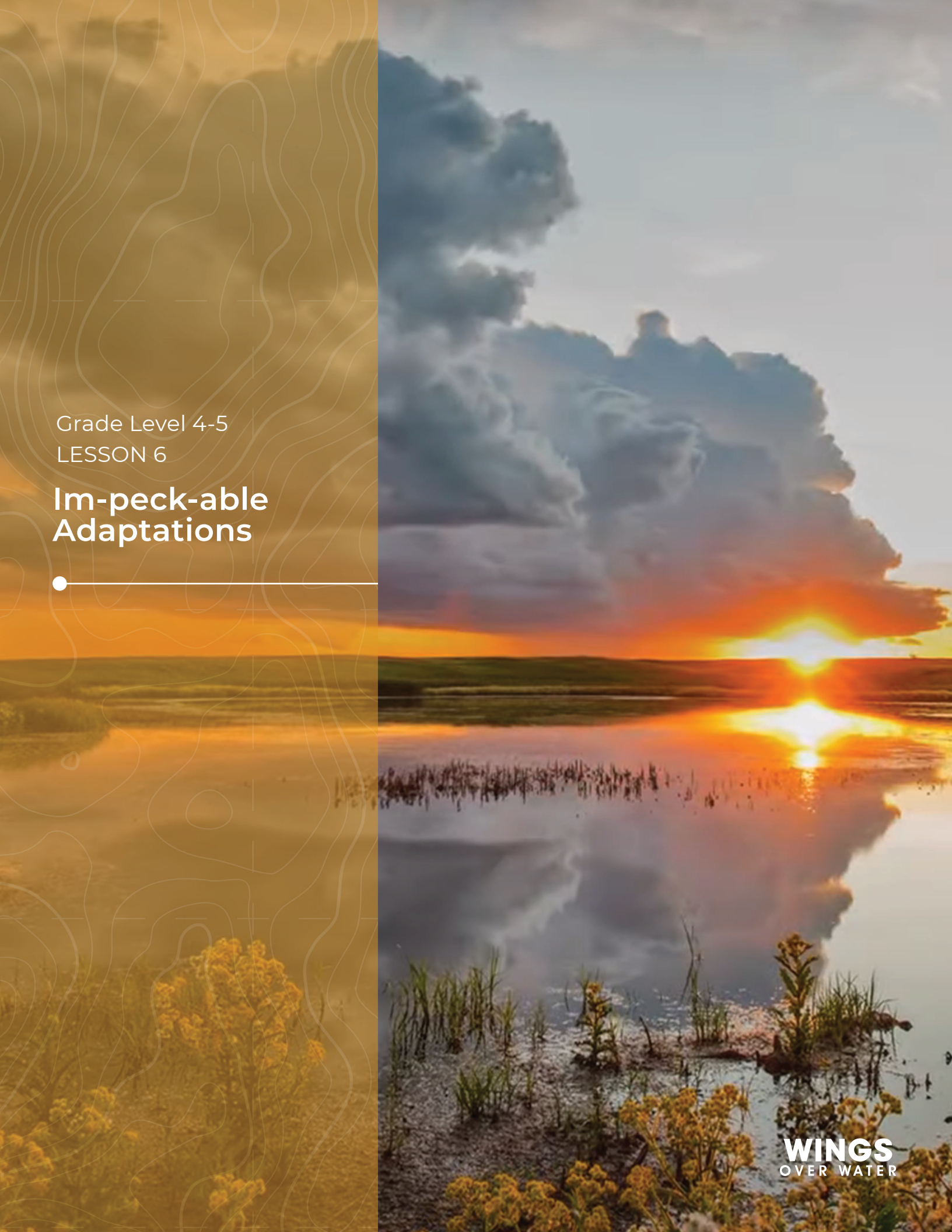
Roll again.

Plants


Water
You enter the prairie potholes through runoff from a field
Fossil Fuel
Over millions of years heat and pressure change you into fossil fuel
Water
You filter through the soil and collect in the ground water of a prarie pothole
Fossil Fuel
Over millions of years heat and pressure change you into fossil fuel
Water
You enter the prairie potholes through runoff from a field
Water
You enter the prairie potholes through runoff from a field

Soil


Atmosphere
You reenter the atmosphere through chemical reactions and diffusion
Soil
Organic material filters through the pothole and settles on the bottom to be broken down into soil
Atmosphere
You reenter the atmosphere through chemical reactions and diffusion
Animals
Aquatic snails use you to form their shells
Soil
Organic material filters through the pothole and settles on the bottom to be broken down into soil
Atmosphere
You reenter the atmosphere through chemical reactions and diffusion
Water



Grade Level 4-5
LESSON 6

Im-peck-able Adaptations

WINGS
OVER WATER

LESSON 6

Im-peck-able Adaptations

Standards (NGSS): 4-LS1-1 Construct an argument that plants and animals have internal
and external structures that function to support survival, growth, behavior, and reproduction.

Grade Levels 4-5: 40 minute lesson

MATERIALS LIST

- *"Build a Bird"* worksheets, (1 per student)
- Paper for drawing, (1 per student)
- Paper spinner for each station
- Information sheet for each station
- Colored pencils
- Metal brads
- Paperclips

FROM THE FILM:

In the film, *Wings Over Water,* we learn that migratory birds have special adaptations that allow them to migrate long distances. They use their powerful muscles and specialized wings to fly for hundreds of miles at a time. In addition, specialized beaks, feet, and feathers help them find food and mates in their native habitats.

We can learn a lot about how different birds survive by studying the physical adaptations specific to their species.

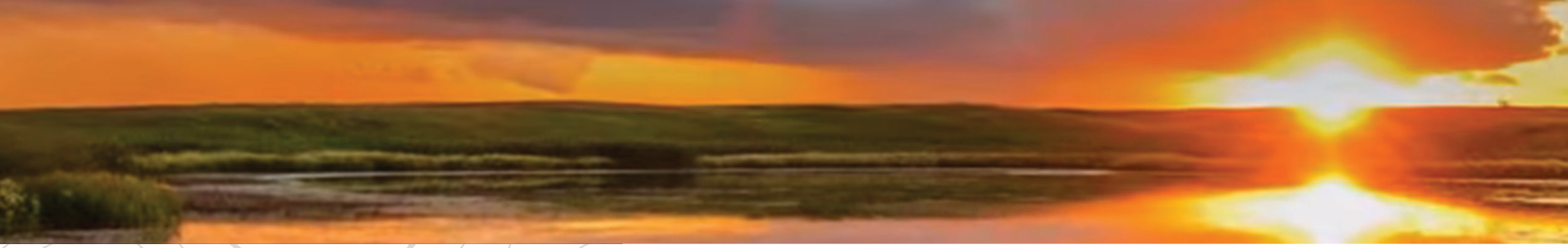
LESSON OVERVIEW:

Students will learn the ways birds are physically adapted to their habitats. Students will learn about different types of physical adaptations that birds have. At each of four stations the students will spin a paper spinner that will assign them one type of physical feature. They will then use the information provided to learn about their feature and what type of bird behavior it is adapted for. Students will "collect" all four physical features and then draw their own bird using those features. Once completed, they will explain their bird's behaviors based on its physical adaptations.

EDUCATOR PREP:

Print paper spinner templates for each station on card stock. Make spinners by poking a metal brad through a paperclip and inserting it into the middle of each spinner wheel. Print information sheets and *"Build a Bird"* worksheets. Have hummingbird video clip ready:

https://www.allaboutbirds.org/guide/Broad-billed_Hummingbird/media-browser-overview/402908



LESSON 6

Im-peck-able Adaptations

Sandhill cranes have long wings for soaring.

FOR VIRTUAL LEARNING:

Instead of having students spin for each trait, the teacher can randomly assign traits to students. Go through each type of trait together and split the class into the same number of groups as there are traits. For example, discuss the four types of feet and then randomly place students into four groups that correspond to the four types. Repeat this process for each of the categories. This could also be accomplished using breakout rooms. The students in each breakout room would be told which feature their birds would have and then would read the information sheet and discuss that adaptation as a group.

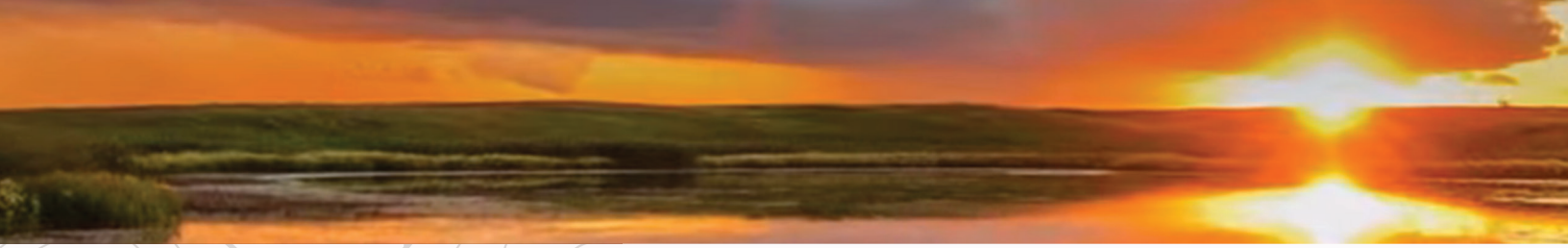
EDUCATOR GUIDE:

1. In the film *Wings Over Water,* we saw several types of birds that all have adaptations that help them survive in their environment.

2. Give students time to discuss the following questions with a partner or group before discussing as a class.

What is an adaptation?

An adaptation is a physical or behavioral feature that helps an organism survive in a particular habitat and produce offspring.



NOTES:

Ask students to think about the different animals from the film, what are some physical adaptations they saw that helped those animals survive and reproduce?

Answers will vary. Examples could include muscles helping migratory birds fly long distances, special organs in birds' eyes helping them find their way when they migrate, and bright colors that help the birds find mates.

3. Tell students that today they will be learning about the wide variety of physical adaptations that can be seen on different birds. Ask them to think about some physical features that are unique to certain species. Call on students to share and write their answers on the board to generate a list of bird features.

4. Explain that although most birds share common characteristics, like wings or beaks, each species has adapted to use these features differently.

5. Show the video of a hummingbird.

What adaptations do you see on this hummingbird?

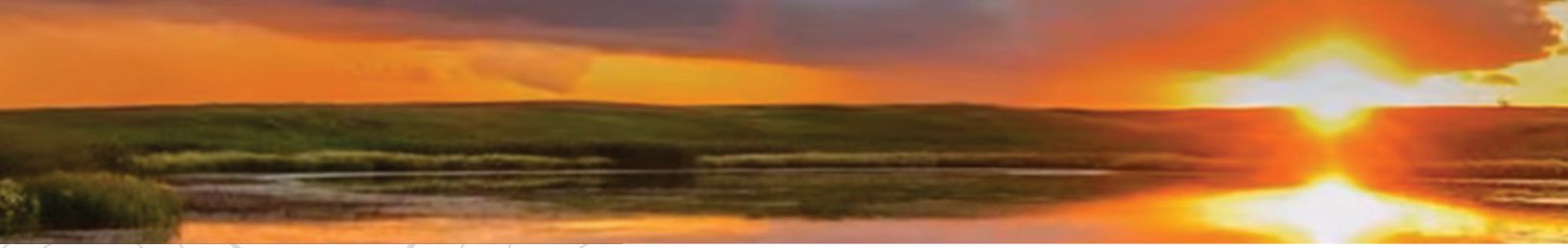
Answers will vary. Examples could include it has a long, thin beak and short wings.

What do you think it uses these adaptations for?

Its long beak and tongue help it collect nectar from flowers, its short wings move very fast and allow it to move quickly and hover in front of flowers.

What kinds of habitats would this hummingbird be adapted to living in?

It would need to live somewhere with lots of flowers and trees so it can hide from predators and will have plenty of food.



Aquatic ambystomatid salamanders also call the prairie wetlands home.

5. Tell students that they will be building their own birds that will each have a different set of physical adaptations.

6. Give each student a *"Build a Bird"* worksheet. Tell them that as they move through the four stations they should each fill out their *"Build a Bird"* sheet by spinning each of the four spinners and then matching that adaptation to the information sheet found at the station.

7. STATIONS:

Types of Feet
- *Swimming*
- *Perching*
- *Wading*
- *Catching prey*

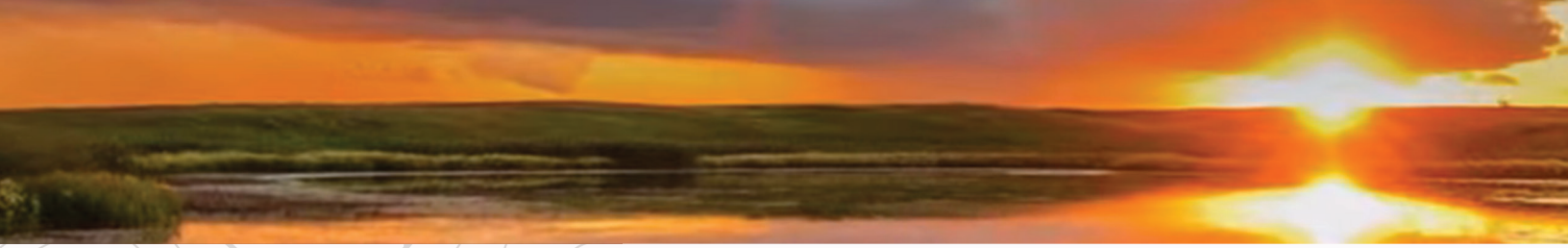
Types of Wings
- *Active soaring*
- *Elliptical*
- *Passive soaring*
- *High speed*

Types of Beaks
- *Probing*
- *Cracking*
- *Striking*
- *Straining*
- *Picking*
- *Tearing*

Types of Plumage

At this station, students will choose 2-3 colors and design their bird based on whether it would use its colors primarily for camouflaging in its environment or for communicating with other birds.
- *Colorful*
- *Camouflaged*

Note: Monitor and time students as they move through the stations giving them 5-10 minutes at each one.



NOTES:

8. When students have finished all four stations have them draw their bird on the other side of their worksheet. Tell them to brainstorm what kind of habitat their bird might live in and draw their bird in that habitat. Remind them to think about the kind of food they might eat, how they fly, where they would need to land, how they might find a mate, and how they avoid predators.

9. Give students time to brainstorm and draw their birds. Circulate around the room and check for understanding as they work.

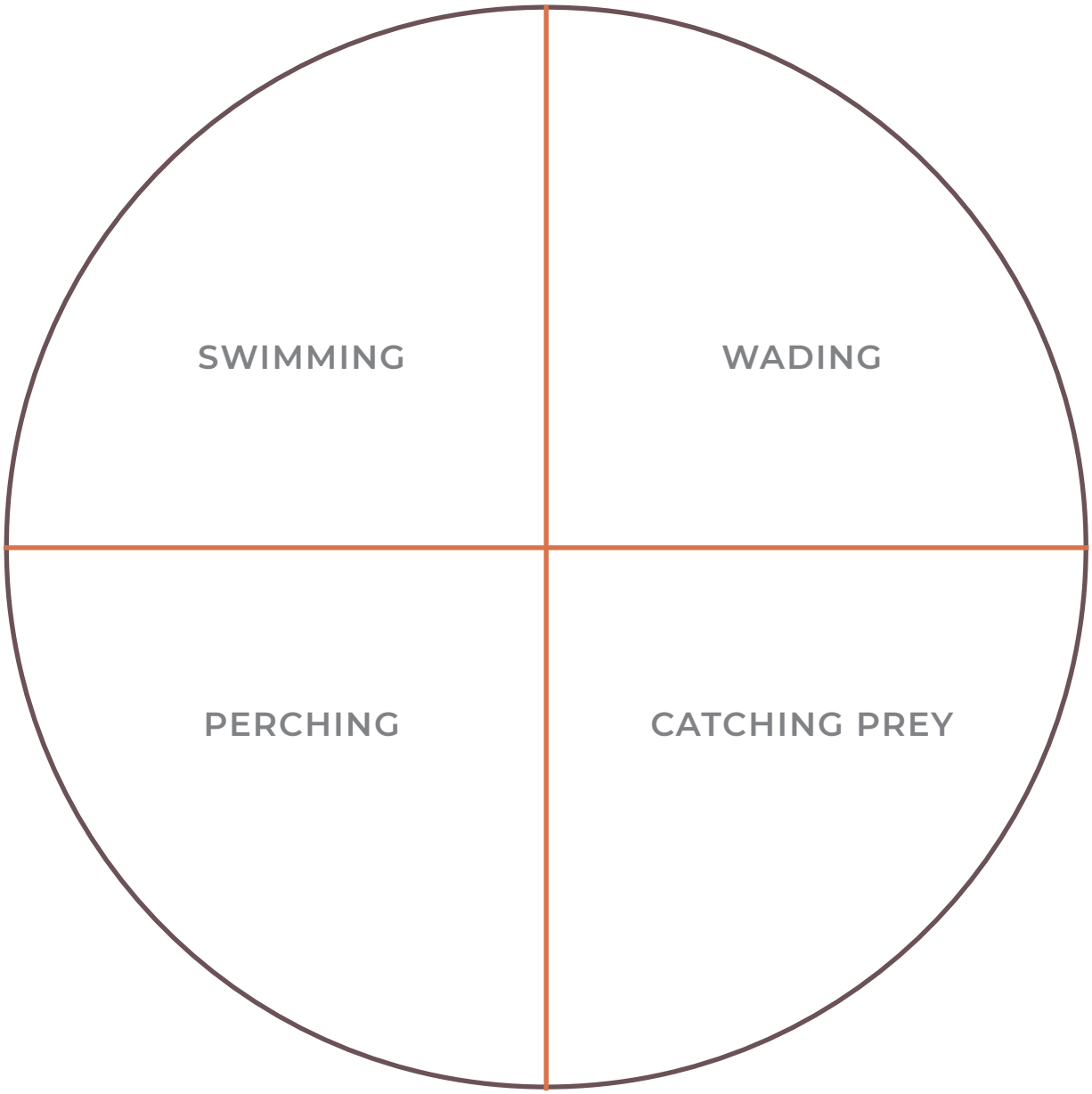
Note: Remind students that since they were randomly assigned each feature, it's unlikely that all their birds would survive well in any particular habitat. Let them know that this is not about getting the right answer because none of these are real birds that exist in the wild.

10. Give students time to share their birds with the class. As they share, ask them if their bird's physical features seem realistic or not and have them elaborate on what challenges they had when deciding what kind of habitat to put their bird in.

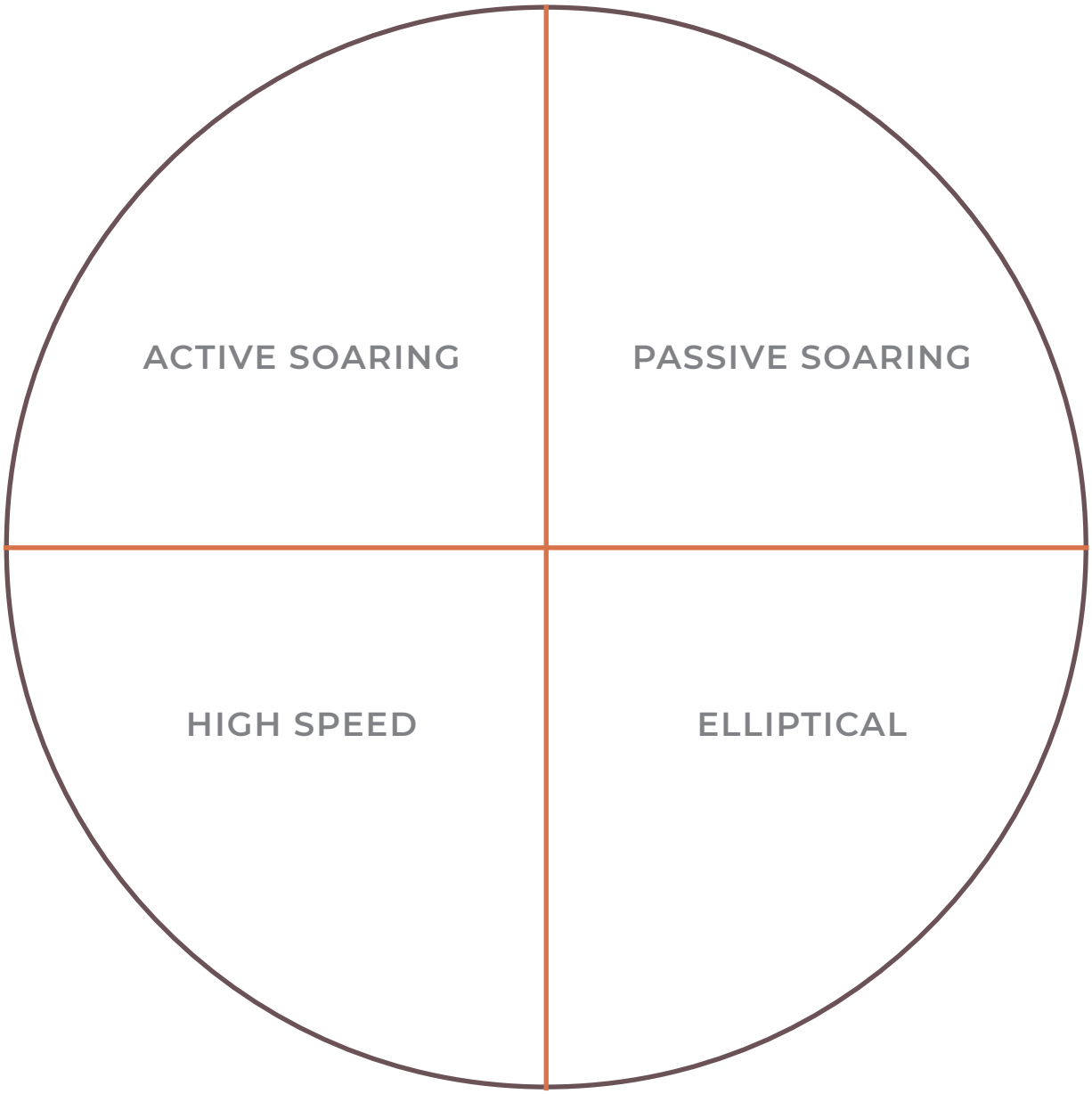
Students will probably find it difficult if their bird has features that would be adapted for very different behaviors.

For example: Feet for catching prey paired with a straining beak. This would be an opportunity to engage the students in a discussion as to why these features would probably not be found together in the wild.

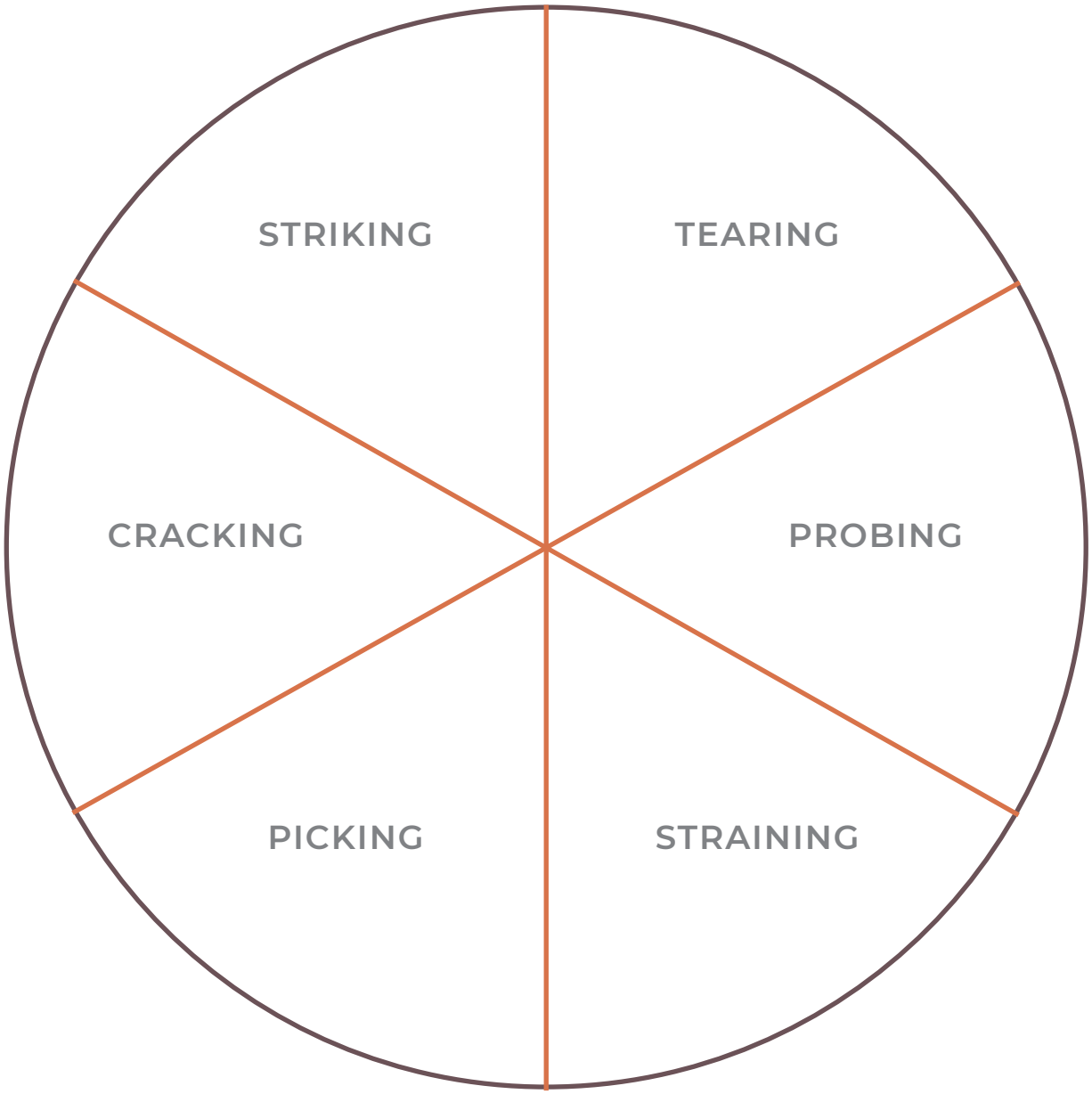
TYPES OF FEET



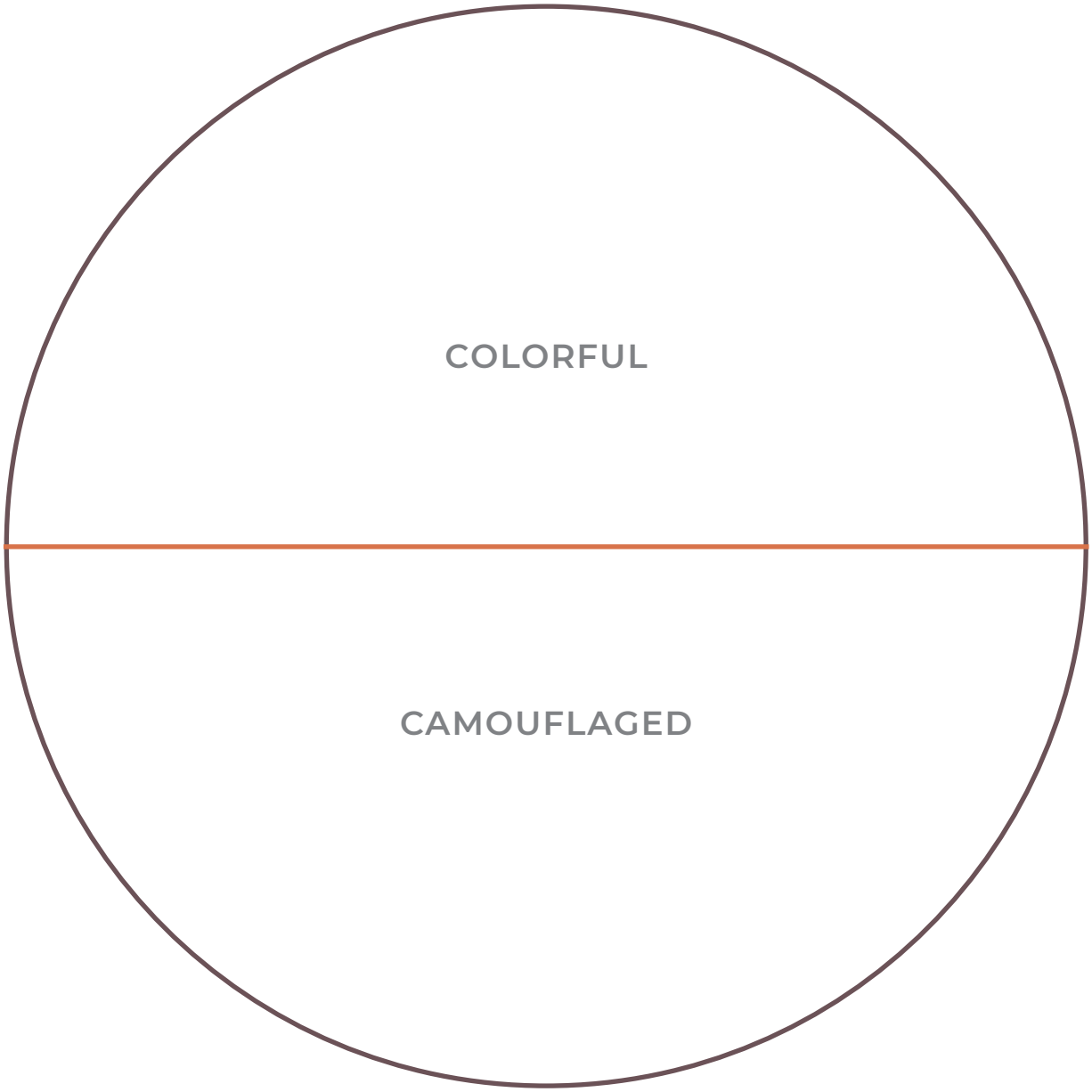
TYPES OF WINGS



TYPES OF BEAKS



TYPES OF PLUMMAGE



BUILD A BIRD / FEATURES

My bird's physical features:

Type of beak?

What kind of food does my bird eat?

How does my bird get its food?

Draw a sketch of your bird's beak.

Type of wings?

What kind of flight is my bird adapted for?

Draw a sketch of your bird's wings.

My bird's physical features:

Type of feet?

What does my bird use its feet for?

Where does my bird likely spend most of its time?

Draw a sketch of your bird's feet.

Description of plumage?

Does my bird have camouflaged or colorful plumage?

Choose 2-3 colors and sketch your bird's plumage.

On a separate sheet, draw a picture of your bird in the habitat you think it would be most successful.

Grade Level 6-8

LESSON 7

Leaders in the Field

WINGS OVER WATER

LESSON 7

Leaders in the Field

Standards (NGSS): MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services

Grade Levels 6-8: (2) 60 minute lessons

MATERIALS LIST

- *Access to research materials (Internet, computers)*
- *Various materials to build farm model*
- *Student resource sheet (one per student)*

FROM THE FILM:

In the film, *Wings Over Water,* farmers embrace sustainable practices to protect and promote the importance of the prairie wetland ecosystem. These practices allow farmers to live in harmony with the environment and maintain profitable farms.

LESSON OVERVIEW:

Students will take on the role of farmers competing for a sustainability grant. After researching farming methods used around their area and sustainable alternatives, students will build a model of their farm highlighting the sustainability practices and the advantages these practices provide to the environment and the farmer. Students will then present their models to the class "board" and debate the pros and cons of each design before the "board" votes on the most sustainable design.

EDUCATOR PREP:

Decide on project specifics to best fit needs and restrictions of class. Determine sources available for research and set proper time limits for debate. Print copies of Student Resources (one per student).

LESSON 7

Leaders in the Field

By incorporating sustainability practices, farmers can increase their productivity.

FOR VIRTUAL LEARNING:

This lesson is easily converted for virtual learning. Teachers will lead the introductory discussion during online class time and allow students asynchronous time to research and create their farm maps and models. Students will come back together to share and debate in their online classroom similar to how they would during in person instruction.

EDUCATOR GUIDE:

1. This project is going to explore sustainable farming, agriculture, and the impacts these practices can have on the environment.

Assess students' existing knowledge and ideas by asking if they are familiar with farming or agriculture. Allow time for students to share ideas and discuss them before expanding on their knowledge.

Agriculture is the science of cultivating soil, producing crops, and raising livestock. It is responsible for feeding, clothing, and powering the world. Agriculture is at the forefront of numerous global issues, including hunger and climate change. It is one of the leading industries in the world, encompassing hundreds of different career paths, and employing millions of people. Agriculture careers include environmental engineers, veterinarians, conservationists, and farmers, just to name a few.

Do students know what it means to be sustainable?

For something to be sustainable, it must meet our current needs while maintaining the ability for future generations to meet their needs.

NOTES:

What makes agriculture sustainable? Why is sustainability important?

Traditional and commercial farming and agriculture tend to focus on practices that will result in the most yield (sellable product) and profit. These farming practices may produce the largest profits in the short term, but have damaging affects on the environment that will result in lower yields in the future.

Think about the coffee industry where growing coffee was hugely profitable and farmers were cutting down large areas of rainforest to make room for coffee plants. This resulted in habitat destruction and threatened many animal species including the yellow warbler from the film ***Wings Over Water****. Now it has been found that shade grown coffee is better for the coffee and the environment. This sustainable practice has allowed farmers to continue to grow coffee and protect the environment.*

By incorporating sustainability practices farmers can increase their productivity and set their farms up for future success all while helping the environment. These practices help to ensure that farms are not only profitable, but able to support growing populations without damaging the natural environment.

The fishing industry is another example of how simple changes can have a huge impact on sustainability. For example, limiting when certain types of fish can be caught, ensures the fish are able to lay their eggs and maintain their population.

In this project students will take on the role of corn farmers in the upper Midwest, US, who are competing for a prestigious sustainability grant focused on improving the prairie pothole ecosystem and maintaining biodiversity by increasing the sustainability of local farms.

Yellow warbler perched in a tree.

2. Ask students the following question:

Have you ever heard of the prairie pothole region? Do you have any ideas about why this ecosystem is important?

The prairie pothole ecosystem is located in parts of five states in the upper Midwest region of the United States (North Dakota, South Dakota, Iowa, Minnesota, and Montana) and several Canadian provinces including Alberta and Saskatchewan.

This ecosystem contains millions of freshwater marshes and is one of the most important wetland regions in the world. The prairie potholes are a critical feeding and breeding habitat for migratory waterfowl. These wetlands benefit humans by protecting water quality, reducing flooding, and acting as a carbon sink.

3. The challenge students face is that farming in its very nature alters the natural world to allow for crop growth and raising livestock. Industrial farming focuses on making the most profits and skews toward mono-cropping (growing a single crop), but research is finding that it is better to develop a farm as a whole system.

4. Students will research ways to increase the sustainability and profitability of their farms and how those practices will positively impact the prairie wetlands. Students should utilize the *"Student Resources Sheet"* to find suggested websites and sustainability practices.

5. Remind students to keep in mind the requirements of the sustainability grant *(teachers can modify requirements as needed):*

- Farmers must integrate at least 2 sustainability practices.
- Farmers must highlight how these practices will benefit the prairie wetlands and increase biodiversity.
- Farmers must explain how their sustainability practices will increase/maintain the profitability of their farms.

NOTES:

6. Once students have completed their research, they will create a farm map to illustrate their changes. Maps should be drawn to scale and include all components of the farm including houses, pastures, fields, natural features, etc. Maps should also highlight added sustainability practices when applicable.

Optional extension activity: have students build a model of their farm utilizing recycled or household materials; students could also use an online modeling platform to create their farm model.

7. Students will present their farm proposals to the board (class). The proposals should highlight the impact of sustainability practices on the profitability of the farm and improvements to the prairie wetland ecosystem.

8. The board (class) will debate the pros and cons of each of the designs and then vote on which design will get the grant.

9. After all the presentations, allow the class time to debate which solutions they think will work the best to embrace sustainability and profitability.

10. Hold a class vote to decide which plan will receive the grant.

Student Resources & Planning Sheet

Leaders in the Field

FARM FACTS:

- Size: 800 acres
- Main crop: corn
- Usage for crop: 50% being sold to be made into biofuel; 40% being sold to be used as animal feed; 10% being sold to be turned into high fructose corn syrup
- All sales involve shipping product at least 100 miles
- Current land usage: 600 acres in crop land
  - 100 acres in pasture
  - 50 acres for homestead and buildings

REQUIRED FOR SUSTAINABILITY GRANT:

- *Farmers must integrate at least 2 sustainability practices*
- *Farmers must highlight how these practices will benefit the prairie wetlands and increase biodiversity*
- *Farmers must explain how their sustainability practices will increase/maintain the profitability of their farm*

SUSTAINABLE AGRICULTURE PRACTICES:

1. **Crop Rotation**
   - *This practice includes techniques like intercropping (growing different crops in the same area) and multi-year crop rotations among fields. Crop rotation can improve soil health and reduce the need for pest control.*

2. **Plant Cover Crops**
   - *This is the practice of planting "cover crops", such as clover, in fields during the time that the field's main crop is not growing, and the field would normally be bare. Cover crops increase soil health, prevent erosion, replenish soil nutrients, and keep weed populations down, which reduces the need for herbicides.*
   - *Cover Crops / SARE -* https://www.sare.org/resources/cover-crops/
   - *What Is a Cover Crop? -* https://www.worldatlas.com/articles/what-is-a-cover-crop.html

3. **Reduce or Eliminate Tillage (plowing)**
   - *Historically, fields have been plowed to prepare the soil for planting. Plowing loosens the soil and results in soil loss and erosion. No till planting involves putting the seeds directly into the soil and can reduce soil erosion and improve the overall health of the soil.*

RESOURCES:

USDA - National Agricultural Statistics Service - Statistics by State - *https://www.nass.usda.gov/Statistics_by_State/*

Crop Production | USDA - *https://www.usda.gov/topics/farming/crop-production*

Soil erosion: An agricultural production challenge | iastate.edu - *https://crops.extension.iastate.edu/encyclopedia/soil-erosion-agricultural-production-challenge*

It's Time to Rethink America's Corn System - Scientific American - *https://www.scientificamerican.com/article/time-to-rethink-corn/*

4. **Utilize Integrated Pest Management (IPM)**

- *Integrate Pest Management (IPM) is a long-term practice that is designed specifically for your farm's needs. By learning about the pests most likely to threaten your farm you can create a better plan to eradicate them using less chemicals. IPM wants to control and prevent pest populations.*

5. **Integrating Livestock and Crops**

- *Industrial agriculture is almost exclusively a monocropping industry, meaning each farm grows or raises one thing. This means farms growing animal food are far from farms raising animals resulting in high shipping costs and requirements.*

6. **Adopting Agroforestry Practices**

- *This is a newer term for a technique that integrates growing trees and shrubs along with crops and livestock. This technique improves conditions for native animal and plant species, can provide shade and shelter for cultivated crops, along with many other benefits to the natural biodiversity of an area. There is also a potential for additional income from the trees*
- *https://www.fs.usda.gov/nac/resources/publications/index.php*

7. **Managing Whole Systems and Landscapes**

- *This idea looks at balancing land usage between natural resources and agricultural needs*
- *Designing a Whole Farm System | OSU Extension Service - https://extension.oregonstate.edu/business-economics/management/designing-whole-farm-system*
- *Whole Farm Systems | Alternative Farming Systems Information Center | NAL | USDA - https://www.nal.usda.gov/afsic#:~:text=The%20Alternative%20Farming%20Systems%20Information,for%20agriculture%20and%20farmers%20worldwide.*

8. **Restoring or Rebuilding Wetlands**

- *Historically wetlands were seen as wasted space and it was common practice to fill in wetlands to turn them into farmland. As seen in* ***Wings Over Water,*** *farmers are rebuilding and restoring their former wetlands.*
- *Restoring and rebuilding wetlands doesn't just benefit the native wildlife, but also provides humans with natural water filtering, reduced flooding, and a carbon sink for rising emissions*
- *https://www.epa.gov/wetlands*

Grade Level 6-8

LESSON 8

May I Have This Dance?

WINGS OVER WATER

LESSON 8

May I Have This Dance?

Standards (NGSS): MS-LS2-5 Use argument based on empirical evidence and scientific reasoning to explain how animal behaviors and specialized plant structures affect the probability of successful reproduction.

Grade Levels 6-8: 75 minute lesson

MATERIALS LIST

- Video clips of Courtship Behaviors

Male Peacocks:
https://www.youtube.com/watch?v=ritxmTpKayY&t=2s

Male Satin Bowerbird:
https://www.youtube.com/watch?v=QkZQlaZUM38

- Online articles & videos on courtship behaviors:
https://www.audubon.org/news/10-outrageous-ways-birds-dance-impress-their-mates

- Additional Clips (Optional)

Sandhill Crane:
https://macaulaylibrary.org/asset/201109271#_ga=2.146240189.883411742.1616614729-2036490956.1616614729

Duck:
https://www.youtube.com/watch?v=bmp8e9_Fa50

- Worksheet
- Pencil
- Blank paper
- Devices for students to access videos and articles

FROM THE FILM:

The film *Wings Over Water* highlights the sometimes musical, often showy, and always fascinating courtship behaviors of birds. In particular, it focuses on the songs and displays of the sandhill crane, yellow warbler and various duck species including mallards.

LESSON OVERVIEW:

Students will discuss possible reasons for animal courtship behaviors, then split into groups to analyze the mating display of one of the film's primary bird species. They will evaluate which survival and parenting skills might be represented by each facet and how these skills will help offspring survive.

Students will then come up with three movements a bird living in a different ecosystem, such as an arctic, tropical, or desert ecosystem, might use in their courtship behaviors. Once each group has their new behaviors, they will explain them to the rest of the class, who will guess in which ecosystem these behaviors might belong.

EDUCATOR PREP:

Have both the peacock video and footage ready to play on a projection device. Print enough worksheets for each group to have one.

LESSON 8

May I Have This Dance?

A flock of sandhill cranes.

FOR VIRTUAL LEARNING:

When doing this lesson virtually, teachers should provide the handout digitally to students prior to the lesson. Then, they can utilize virtual breakout rooms to have students complete the activity in groups, then return to the main room for whole group sharing and discussion.

EDUCATOR GUIDE:

1. Begin by letting students know that today, we will study the intricate courtship behaviors of birds. Explain that the survival of a species is dependent on the ability of individuals to produce offspring. These courtship behaviors are an important biological mechanism.

Ask students what they know about courtship behavior.

Students may be able to tell you that courtship behaviors are performed by birds and many other animals either while attempting to attract a mate or once a mate has been found in order to bond. They may offer some examples that they may already know about.

2. Explain that we are going to be focusing in particular on the courtship behavior of male birds attempting to attract mates. We will begin by watching the courtship behavior of a peacock, then break down the behavior and what in the world it has to do with the survival of the peacock species.

NOTES:

3. Watch the video of a peacock performing his mating display, then discuss the following questions with students.

What about this display might be interesting to a possible mate? Do peahens (female peacocks) just really like the color blue?

Students should begin considering that courtship behavior goes deeper than bright colors and impressive dance moves.

By showing that he has these bright, beautiful feathers, what else is he showing to the female? What survival skills must he have in order to produce these feathers?

Students could respond here with the ideas of health, food-finding abilities, and genes that predisposed the male to survive in the surrounding environment. He also must be quick to avoid predators when he is unable to camouflage.

Let's talk about his "shivers," where he shakes his feathers back and forth very quickly. What do these demonstrate? Do those feathers look like they are easy to hold up?

This will prompt responses about strong muscles. Students should again connect here food-finding abilities and genes predisposed for survival.

What do the peacock's food-finding skills and strong muscles have to do with the female? Why would these traits matter to her?

Here, students should dig deeper, relating the traits discussed to the male's ability to provide, protect, and pass on genes that have been shown to result in healthy and successful traits.

4. Let students know that not all courtship behaviors are this type of large display. For example the Satin Bowerbird attracts a mate by showing off its building and decorating skills. It builds a bower, not for nesting purposes, but only to attract a female bird. Show students the video of the bowerbird "hosting" a female visitor.

Bowerbirds build and decorate elaborate nests to attract a mate.

How is this courtship behavior different from the peacock display we watched?

Student answers should explain that while the peacock was showing off its plumes and its appearance to impress the female, the bowerbird built this structure, decorated it, and thereby showing off his skills, instead of his appearance.

How is it similar?

Both birds are trying to gain the approval or favor of the female by displaying their particular strengths to her consideration.

What does the female bowerbird learn about the male through this display?

The female bowerbird is able to assess the ability of the male for good scavenging behaviour, which is useful for food foraging, evading predators, and building a good nest will be important for the female to lay her eggs and raise her chicks in.

5. It is important to note here that a connection between courtship behaviors and survival skills has not been definitively proven—after all, researchers are not able to ask a peahen for confirmation.

Ask students to form their own opinions. Do they think a connection is likely? Why or why not?

Answers to this question are open to student interpretation. You can steer them to consider the amount of time, energy, and resources female birds especially put into producing eggs and raising young and therefore what importance females might place on choosing a mate.

6. Split students up into groups of 2–3. Ask them to choose which bird's courtship behavior they would like to break down, the sandhill crane's or the mallard's? Use the provided resources to explore courtship behaviors of the two species.

NOTES:

7. Hand out the worksheet, found on Page 93, and direct students to Part 1. Here, groups will break down and analyze the courtship habits of the bird they chose, relating them to traits and abilities that have been proven successful in the prairie wetlands.

Give the groups 5 minutes to complete Part 1. As they work, walk around and observe, offering suggestions where needed.

8. Review the students' findings together by asking groups to share their analyses.

9. Next, explain that the groups will be combining their new knowledge in Part 2 to create their own birds. For a breakdown of instructions, see below. Give groups about 30 minutes to complete Part 2.

A. Students will work backward by first choosing an environment where their bird will be most successful: arctic, jungle, or desert.

B. Students will invent three tailored traits or abilities a bird would need in order to survive and be successful in this environment. For example, these could include fluffy plumage for keeping warm, long legs for evading predators, and demonstrating nest-building using thick brush.

C. Students will explain how this trait will be showcased in the bird's courtship behaviors, either by just the male bird or the male and female together.

D. Last, each group will create a comic strip (or series of pictures) of their bird demonstrating its unique courtship behavior, and in a paragraph, explain how this behavior aids in the animal's survival in their environment.

E. Optional – if the group is interested, they may choreograph a dance to showcase the courtship behavior.

Male peacocks use their colorful feathers to attract a mate.

10. Once groups are finished with their responses, explain that we're now going to listen to each group's three behaviors without revealing which environment they chose. If the group choreographed their courtship behavior, then they can share the dance and the picture. The rest of the class will guess in which environment each bird belongs.

11. To close the lesson, before turning in their papers, ask the groups to write down a fact they learned today that surprised them and why it was surprising.

Student responses will vary, but should include reflections of expectations about animals and courtship behaviors.

MAY I HAVE THIS DANCE / RESEARCH WORKSHEET

Part 1 - RESEARCH

Choose either the sandhill crane or the mallard duck, then analyze that species' courtship behaviors using these resources:

Sandhill Crane Links:

https://www.audubon.org/news/10-outrageous-ways-birds-dance-impress-their-mates
https://macaulaylibrary.org/asset/201109271

Mallard Duck Links:

https://www.allaboutbirds.org/news/what-to-watch-for-duck-courtship-video/

Sandhill Crane

Sandhill cranes mate for life, with mated pairs working together to build nests and raise their young. They can be seen dancing together throughout the year, especially during mating season.

1. ***Behavior:*** *The male uses his bill to pick at reeds and sticks, then throw them into the air.*

What trait or ability do you believe this behavior might exhibit?

Why would a mate in the prairie wetlands find this trait or ability attractive?

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2. ***Behavior:*** *The male spreads his wings and shows off his tail feathers.*

What trait or ability do you believe this behavior might exhibit?

Why would a mate in the prairie wetlands find this trait or ability attractive?

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3. ***Behavior:*** *Together, the courting couple twirl, bow, and jump with one another.*

What trait or ability do you believe this behavior might exhibit?

Why would a mate in the prairie wetlands find this trait or ability attractive?

Mallard duck

Mallard duck pairs mate for one season. Because there are more male than female mallards, the males must compete to get the females' attention. The female then nests and incubates her eggs on her own.

1. ***Behavior:*** *In head-up-tail-up, a male lifts his wings and displays the colorful feathers underneath while raising his tail.*

What trait or ability do you believe this behavior might exhibit?

Why would a mate in the prairie wetlands find this trait or ability attractive?

2. ***Behavior:*** *Both males and females rush across the water with their bills gliding along the surface.*

What trait or ability do you believe this behavior might exhibit?

Why would a mate in the prairie wetlands find this trait or ability attractive?

3. ***Behavior:*** *The male pushes up out of the water, extends his neck, and whistles loudly.*

What trait or ability do you believe this behavior might exhibit?

Why would a mate in the prairie wetlands find this trait or ability attractive?

Part 2 - CREATE

Create your new species of bird and its courtship behaviors.

What environment does your bird call home? Arctic, jungle, or desert?

Invent 3 traits or skills a bird would need in order to survive or raise its young in the environment you chose. Then, give an explanation of how each one would help the animal. Last, describe how this trait or skill might be showcased in courtship behavior. An example is shown below.

A. Trait or skill: *Thick, fluffy feathers*

How would this help the bird or its offspring survive? *The bird will keep himself and his babies warm in the cold weather.*

How will this trait or skill be showcased in courtship behaviors? *The male will puff out his feathers and spread his wings in his display.*

A. Trait or skill:

How would this help the bird or its offspring survive?

How will this trait or skill be showcased in courtship behaviors?

B. Trait or skill:

How would this help the bird or its offspring survive?

How will this trait or skill be showcased in courtship behaviors?

C. Trait or skill:

How would this help the bird or its offspring survive?

How will this trait or skill be showcased in courtship behaviors?

Part 2 - CREATE

Draw a series of pictures of your bird performing one of its courtship behaviors.

In a paragraph, explain how this courtship behavior aids in the animal's survival in their environment.

Grade Level 6-8
LESSON 9

Watch That Bird

WINGS
OVER WATER

LESSON 9

Watch That Bird

Standards (NGSS): MS-ESS23-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Grade Levels 6-8: 75 minute lesson

MATERIALS LIST

- Clipboard
- Field Datasheet *(one per student)*
- Classroom Datasheet *(one per student)*
- Binoculars
- Notepad
- Pencil and Pen
- Calculator
- eBird Account
- Computer or iPad
- Pedometer or step tracker to keep track of how far students travel while birding.
- Bird Field Guide *(Digital or Printed)*

Application resources:

Merlin Bird ID and the Audubon Bird Guide are free apps that works in conjunction with eBird

Online resources:

All About Birds
https://www.allaboutbirds.org/guide/

Printed resources:

The Sibley Guide to Birds (East or West) and Peterson Guide

- Watch That Bird

Data Analysis Exercise–Student Copy

FROM THE FILM:

In the film *Wings Over Water,* Marshall Johnson, the Executive Director of Audubon Dakota, talks about the importance of citizen science. Everyday people can capture significant data that scientists and researchers can use.

LESSON OVERVIEW:

Students will participate in the process of citizen science, the collaborative partnership with scientists where the public contributes to scientific research. Students will use bird watching to collect data on their local birds and share their findings. Students will also visualize sample birding data with a graph and calculate measures of central tendency.

EDUCATOR PREP:

Download the eBird Essentials for Educators Guide (*https://dl.allaboutbirds.org/ebird-kids-0*) and read through it. This resource will help you learn to recognize birds, deal with identification uncertainty, and set up a classroom eBird account.

If you are new to birding, watch these videos to prepare.

Inside Birding:

- Size & Shape- *https://www.youtube.com/watch?v=ridajl8uic0*
- Color Pattern- *https://www.youtube.com/watch?v=2rT7he15Js0*
- Habitat- *https://www.youtube.com/watch?v=UmPXtsJeu5M*
- Behavior- *https://www.youtube.com/watch?v=owZ6bonrOjA*

How to Use Binoculars: *https://www.youtube.com/watch?v=pkPzl-VPmo4*

LESSON 9

Watch That Bird

Ducks have an oil gland that is activated as they splash water over their backs.

EDUCATOR PREP CONTINUED:

- Determine where you plan to conduct the activity with your students and make sure that the area is safe and ready to move around in.

- Prepare the birding materials for your students.

  Determine what field guide or app to recommend or provide for your students.

  Download any apps that you will be using to school devices or prepare links for students to download apps.

  Print datasheets and attach to clipboards.

  Print the follow up data analysis exercise
  Watch That Bird Data Analysis Exercise- Student Copy

FOR VIRTUAL LEARNING:

If using this lesson for virtual learning, emphasize that birding can be conducted anywhere and set students up to look for birds from home. Consider the need for safety when birding and remind students to consider going with a parent or guardian, and not to go out alone or in areas where they would be at risk. To make sure that students are set up for success, provide access to resources like field guides, printed datasheets, and binoculars whenever possible.

If students report a variety of habitat types from their home birding experiences, consider comparing the birds encountered in each habitat and look for associations between certain species and habitat types.

NOTES:

LESSON 9

Watch That Bird

EDUCATOR GUIDE:

1. In the film, *Wings Over Water,* Marshall Johnson, the Executive Director of Audubon Dakota, introduces us to the concept of citizen science. Today, students will have the opportunity to learn about the research process, collect data, and contribute to one of the largest existing online biodiversity databases.

2. Prompt students to think about their personal experiences with science, the research process, and what they learned about the role of citizen science from *Wings Over Water*.

3. With students working together in small groups or individually, ask the following questions and start a discussion:

What are some traits of a good scientist?

There are lots of answers to this question, but some student answers that you should highlight are that scientists are curious, observant, patient, creative, and detail oriented. These are all qualities that students can and should work to demonstrate during this activity.

What is citizen science?

Citizen science is a collaborative partnership between the public and scientists that lets the public contribute to scientific research.

The sun sets on the prairie wetlands.

How can citizen science help scientists and researchers?

Citizen science programs allow scientists to have access to a large amount of data. Research projects are limited by the time and resources that scientists have. By outsourcing data collection to volunteer citizens across the country and the world, scientists can access far more data with minimal costs. This allows scientists to spend their time and resources on more complex parts of their work that require advanced knowledge and personal attention.

Citizen science also helps scientists investigate problems that are too big to tackle independently. Citizen scientists can capture more widely spread data together than an individual scientist or lab would be able to alone.

Citizen scientists can also help scientists review data through open-source projects, combing through large amounts of collected data to find important information. We will be focusing on birds today, but citizen science projects have also led to advances in a variety of different fields.

4. Show students the following video on eBird from the Cornell Lab of Ornithology to introduce the community and research project they will be joining.

https://www.youtube.com/watch?v=-t-0xAjxakw

5. Inform students that today they will become citizen scientists and help ornithologists by collecting data on birds. They will submit their data to eBird.org where it will be available to the ornithology community. Remember that students will be collecting data to help researchers and scientists worldwide. Continue your discussion with the following questions.

Are birds important? Why should we care about birds?

Birds play important roles in their ecosystems. They can be both predator (i.e. raptors or owls) and prey (i.e. ducks and pigeons). Birds serve as both seed dispersers and pollinators. They also help to control pest populations by feeding on insects and rodents.

NOTES:

Birds are a source of awe and inspiration for people. Engineers and inventors of the past looked at birds and tried to obtain their ability to fly. Birds have also inspired numerous works of art over time. Bird watching remains one of the most popular outdoor activities for people across the world and is a major part of ecotourism in some areas.

Have you ever observed birds at your home or in the outdoors?

Have students share observations they have made of birds in their own lives.

What are some characteristics or traits that are similar in all birds?

All birds have feathers, a beak, two legs, and wings.

What are some traits that are different between birds?

You will likely get lots of answers but these four categories are helpful to focus on.

- ***Bird size and shape:*** *the size and shape of a duck is very different from that of an owl. Learning the shape of different birds can help with identifying them.*

- ***Coloration:*** *coloration varies greatly among birds and it is an excellent trait to make note of when trying to identify a species, gender, or age of bird.*

- ***Location:*** *birds also live in different habitats, so making note of where you see the bird is a helpful clue to identify it. Certain birds only live in certain areas of the country as well. For species like Black-capped and Carolina Chickadees, your location will help you make the distinction.*

- ***Bird calls:*** *while difficult to learn, bird calls can be one of the best tools to determine what a bird is. Most bird species have unique calls. If you can hear, record, or remember a bird call you can often get a positive identification.*

A birdwatcher observes from high above on a cliff.

Where can you go to see birds?

This question has many answers because birds are everywhere! You can find birds in cities, suburban areas, and in the rural countryside (the earlier in the day, the better). You should be able to observe birds no matter where you are. If you are in an urban area, you can spot birds near buildings, parks, or gardens. Rock pigeons, European starlings, and House sparrows are commonly found in urban environments.

What time of day can you find birds?

While birds are around all day in most areas, many birds are more active in the morning or evening. This is especially true during summer months when hotter temperatures keep birds from being active. If you can only bird in the middle of the day you may have better luck in shaded areas or areas with water.

Birds will also be less active during severe weather like storms and strong winds. Some birds, like owls, only come out at night.

It is important to consider how your location, the time of day, and factors like weather, affect the birds that you will encounter. When scientists collect bird data, they often control the time of day they go out and keep careful records of the weather to account for variation in their data. If you are interested in seeing specific types of birds, research the best locations and times to see them to increase your chances.

6. Give your students time and resources to familiarize themselves with common and local birds. If you have the time, it may help to let your students familiarize themselves with birds overnight.

Here are 20 common birds that the *Audubon Society* recommends you familiarize yourself with:

https://www.audubon.org/news/get-know-these-20-common-birds

This is not a comprehensive list, and includes species common in both the eastern and western United States, but knowing the birds on this list may enable you to better identify other similar birds.

NOTES:

If you are using the *Audubon* or *Merlin Bird ID App,* encourage students to look through the *Explore Birds* list in the app. This will provide students a list of birds spotted or known to occur in their geographic area with names and pictures. Ask students to look through the list and see if any pictures look like birds they have seen before.

For teachers, to find a complete list of birds in your area you can click the following link and locate your area down to the state level on the checklist. Be aware that is list is of all species, sorted by family in the specified area. This is not a very student friendly resource but will provide you with a list of possible species.

- *Avibase - Bird Checklists of the World*

https://avibase.bsc-eoc.org/avibase.jsp

7. Before heading outside, it is a good idea to review the basics of bird watching. You can ask students the following:

What supplies will you need to be a successful bird watcher?

- ***Binoculars****– Birds are sometimes shy and fly away before you can get close enough to see detail. Binoculars allow you to see birds that may be high in the treetops or ones that are far away.*

- ***Paper or sketchbook****– You will want to write down where you saw a bird and make any notes about it that may be interesting or useful. When you are birding to collect data, this information should be recorded in pen on a datasheet. Sketching birds can be another fun part of birding and a way to develop your sketching skills.*

- ***Field Guide****– Field guides, digital or otherwise, are useful for quick identification of birds you may be unfamiliar with.*

Sandhill crane in flight from ***Wings Over Water.***

What do good birdwatchers or wildlife observers do?

Good birdwatchers are always respectful of nature. They are patient, quiet, and do not try to harass or scare any animals that they may see.

Always give birds and other wildlife plenty of space and never try to touch a wild animal.

Do not go in restricted or hazardous areas to observe birds. As with all things, safety is of the utmost importance.

What should you do if you see a bird that you do not recognize?

If you cannot identify a bird while in the field, you should take notes, sketches, or photos so that it can be identified later.

Because you will be collecting data for a research database, it is important to emphasize that you want to be as certain as possible of the the species and counts that you are recording.

You will not be able to identify every bird that you see and there is nothing wrong with that. Part of the fun of birding is learning as you go and gaining familiarity with the birds in your area. Although you will only submit data on the birds that you are confident of, keep good notes on everything.

8. Go through the field datasheet with your students and explain how to fill it out.

A. Reiterate the importance of collecting quality data and explain that data sheets are crucial documents for the scientific process. They are usually completed in pen with errors crossed out and initialed. This helps to make sure that the recorded information does not change. This may seem intimidating but emphasize that it is still okay to make mistakes or changes, you just want to keep track of them!

B. Walk through the data sheet with students and address how to fill in each field.

NOTES:

Before you begin birding, fill in the names of all the people in your birding group, the date you are birding, your location and start time.

- **Birdwatching Location-** Fill in your city, state, and country. Also specify where you are in the city under specific location (school, home, city park)

- **Start time- What time did you begin birding?**

While birding, record the common name of each species that you encounter, the number of birds, the habitat where you observed the bird and any notes. Use tally marks to make it easier to count birds while you are birding. If you run into a bird species that you cannot identify, record it as *Unknown* and number it if you have multiple unknown species. Take notes, sketches, or pictures for unknown birds so that they can be identified once inside.

- **Habitat-** Habitat refers to the type of habitat or structure where the bird was seen. Pick the best fitting option from the list (On the ground, sitting on fence, flying, in a tree or shrub, at a bird feeder, in the water)

- **Notes-** This should be filled in thoroughly when identifications are uncertain and should indicate color, size, and other details like bird calls if possible. Other notes can include interesting behaviors, species associations, observations about diet, and anything you find interesting. Be curious and creative!

*The **Wings Over Water** crew filming birds in flight along the banks.*

After you are done birding, circle the type of observations you made, record the time you stopped birding, how long you spent birding, and how far you traveled if you moved around.

- **Stationary, Traveling, or Incidental Observation-**

  - Stationary observations are made from a single location where you wait to see what birds are coming to you.

  - Traveling observations are made when you walk a path or travel a distance looking for birds.

  - Incidental observations are made when you happen to see a bird while doing other things.

  Circle only one type of observation. If a different type of observation is made for a species, it should be indicated in the notes.

- End time and duration- **What time did you stop birding, and how long did you spend in total?**

- Distance traveled- Record the distance you moved while birding. If you followed the same route in and out, only count the distance once.

9. Once the class has reviewed safety, good bird watching practices, and how to use the data sheet, it is time to head out to look for birds! Students can look for birds as a team or individually. Grouping students in twos or threes with rotating roles for spotting and counting birds, using binoculars, and recording data on the datasheet can help keep everyone involved and improve the quality of data collection.

If students are not able to identify a bird while in the field, remind them that they should take notes, sketches, or pictures so that it can be identified once inside.

NOTES:

10. After spending around 30 minutes birding, come back inside and have the students regroup to discuss their experience, share what birds they found, and look up any birds that they may not have been able to identify. Giving students time to indulge their curiosity and identify mystery birds is just as important as the time spent birding outside.

11. Once students have shared their experiences, have them review their datasheets, and note uncertain identifications that should not be added to eBird. If your students are birding in the same area you may also need to examine the data to make sure entries are not duplicated. Multiple students may have seen the same two hawks flying by. Discuss common species that you found and any observations that your students made.

12. Combine the data from all the student data sheets onto the classroom data sheet, tallying birds and combining the data into a single list for each birding location, enter the data, and submit it on eBird. Share the screen so that students can see the data entry process in case they want to make their own account and submit their own data later.

After submitting your bird data, guide students in completing the data analysis portion of the activity. This can also be assigned as homework or completed at a later date.

- Calculate the mean, median, and mode for each of the two listed species (e.g. the average number of birds observed per species).

- Visualize the bird data by graphing the average number of observed birds from each species on a bar graph.

Birdwatchers using binoculars in the field.

- Answer what the data shows scientists about bird populations. This question can be used as a discussion point.

  - For this data you can start to make hypotheses about the ability of the wetland to support each bird species, whether the wetland is better suited to one of the species, or even the relative size of flocks for each species.

  - Share that data and calculations like this can be used to compare the population level of birds at different locations or different times. By monitoring bird communities or populations of individual species you can track the effects of conservation efforts or pinpoint the impact of habitat alterations.

13. After the initial class birding experience and data analysis, students should take time to try birding on their own time. In most cases you can find birds right outside your door, but students can also go to a local park to do some birding. Equip students to bird at home with a new datasheet. Students will ideally be given time to compare their at-home observations to the observations they made at school.

14. To conclude, reflect on the citizen science process and discuss ways to get involved in citizen science individually or as a class. To get discussion going ask the following questions?

What did you enjoy about birding? What did you find challenging?

- Hopefully, students will enjoy interacting with nature and learning about the species they see. Students may also enjoy the artistic component of drawing or photographing birds.

- Students may be challenged by getting close enough to identify birds or frustrated by the differences in colors and small details that differentiate species. *Regardless, be sure to remind your class that they can continue birding outside of class and that it is okay if it is challenging. Birding can take practice.*

NOTES:

Are you excited about your data adding to the scientific process? What sort of projects do you think your data could be used on?

Students may not have a good idea of where their data will be used. There are many possible projects but here are a few.

- *Projects examining associations between birds or habitat areas.*

- *What birds will you find or not find in different habitats like in the woods, fields, next to highways, or in the city? Do certain species interact with each other?*

- *Projects tracking the impact of climate change on birds.*

- *What birds are associated with different seasons? Are some species present year-round or do some only appear in the spring or fall? Are those patterns changing?*

- *What time do migratory populations arrive? Is it the same each year? Is it changing?*

- *Check out some of eBirds published reports and be sure to emphasize that as you collect more data you can try to answer some of these questions in your area too.*

How has this experience changed the way you think about science?

Students may indicate that science seems more attainable.

Are you interested in doing more birding for eBird or contributing to a different citizen science project?

Student answers may vary.

Flock of birds flying over the prairie pothole region.

15. If your class is interested in birding or additional citizen science projects, check out these links.

For more birding opportunities -

https://www.birds.cornell.edu/k12/citizen-science-for-educators

Database of projects with filters for location, topic, age group, and project type.

https://scistarter.org/finder

If you are looking for projects to contribute to remotely check out *Zooniverse.* This site has many ongoing projects ranging from the arts to all types of science, history, language, and literature.

Projects are constantly changing. Some projects may take minutes, others hours, and all can be completed remotely.

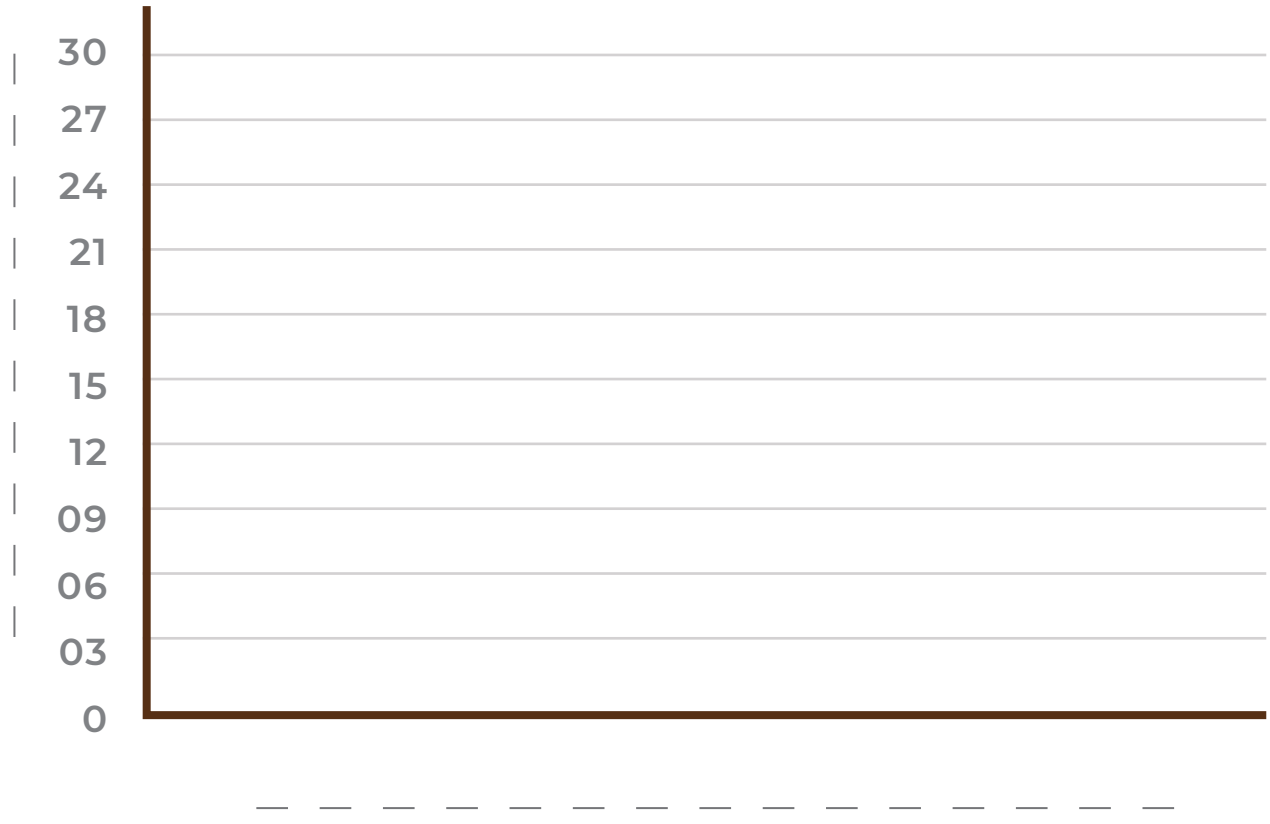
https://www.zooniverse.org/

ANALYSIS OF EXAMPLE BIRD DATA

Two species were observed at a wetland on each of five trips. Each trip was conducted at the same time of day and the weather was similar on each trip. Calculate mean, median, and mode using the values in the table below.

Species	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	MEAN	MEDIAN	MODE
MALLARD DUCK	27	32	34	26	26			
YELLOW WARBLER	14	10	10	9	17			

Compare the average number of birds from each species by graphing them below. Give your graph a title and label the x and y axes.



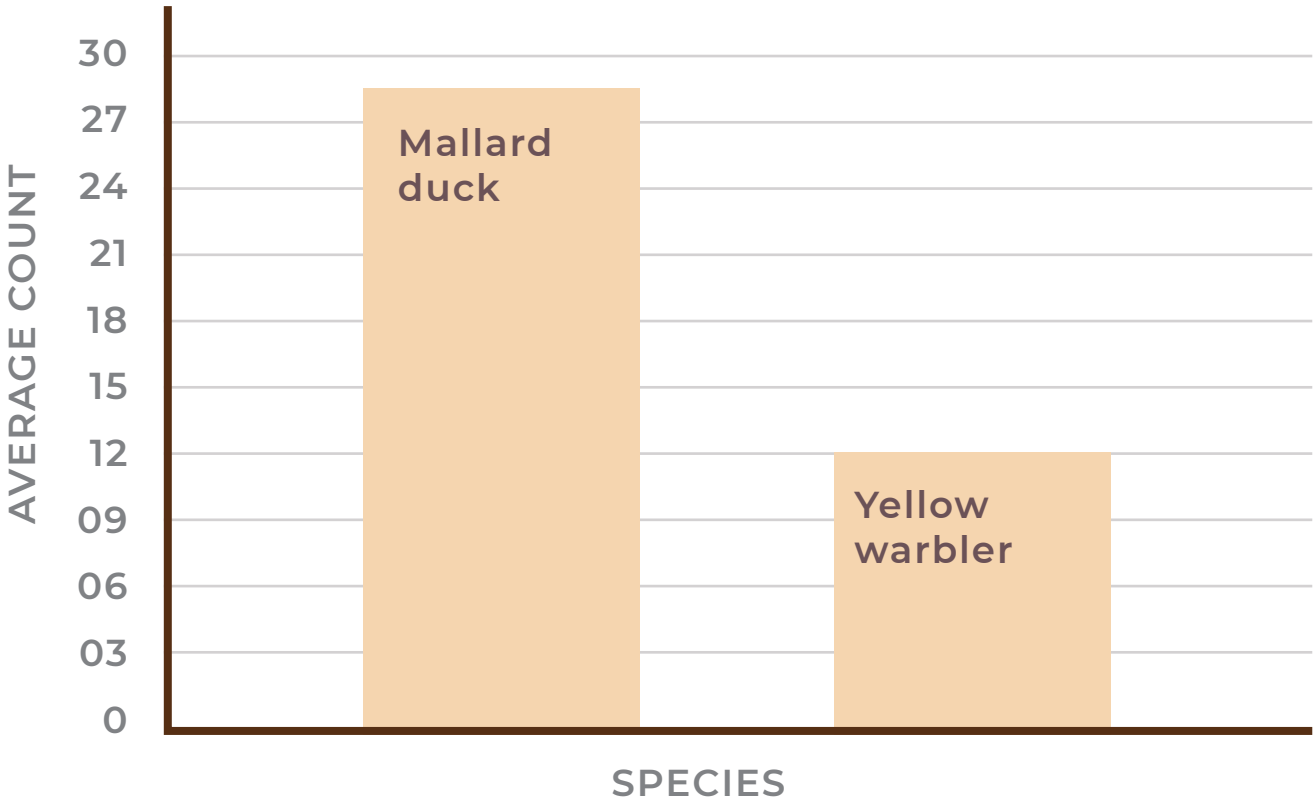
What does this data show about the mallard and warbler populations at the wetland?

ANALYSIS OF EXAMPLE BIRD DATA / ANSWER KEY

Two species were observed at a wetland on each of five trips. Each trip was conducted at the same time of day and the weather was similar on each trip. Calculate mean, median, and mode using the values in the table below.

Species	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	MEAN	MEDIAN	MODE
MALLARD DUCK	27	32	34	26	26	29	27	26
YELLOW WARBLER	14	10	10	9	17	12	10	10

Compare the average number of birds from each species by graphing them below. Give your graph a title and label the x and y axes.



What does this data show about the mallard and warbler populations at the wetland? *This data may indicate that the wetland is better suited for mallards than warblers.*

It may also indicate that mallard ducks live in larger groups than warblers or that warblers need more space than mallards.

WATCH THAT BIRD / CLASSROOM DATASHEET

Transfer all bird data from the classes field datasheets that you are confident is correct and not repeated between observers onto this datasheet to enter into *eBird*.

Birdwatching Location

City: State/Province: Country:

Start time: End time: Duration:

How did you observe the birds *(Check One)*?

○ STATIONARY ○ MOVING ○ INCIDENTAL OBSERVATIONS

Did you move at all? If so, how far did you travel?

Aggregate Data *- Working with your class, combine your observations into one table:*

Species	Tallies from each species	Total Count	Notes
Rock Pigeon	𝍸 𝍸 |	*13*	*Four student groups observed rock pigeons in different areas around the school.*

WATCH THAT BIRD / FIELD DATASHEET

Use this sheet to record your birding data. Before you begin, record your location and start time. If you are moving, be sure to track how far you travel, and the time you stop counting birds. Use tally marks to make it easier to count birds quickly. If you cannot identify a species, record it as *Unknown.* Record by number if you have multiple unknown species. Note habitat, appearance and calls, for identification.

Specific Location:

City: State/Province: Country:

Start time: End time: Duration:

How did you observe the birds *(Check One)*?

◯ STATIONARY ◯ MOVING ◯ INCIDENTAL OBSERVATIONS

Did you move at all? If so, how far did you travel?

Species	Tallies from each species	Habitat	Notes
Rock Pigeon	𝍸	*On the ground*	*Group of 4 seen pecking at ground. Gray body and wings, shiny greenish throat.*

Grade Level 6-8
LESSON 10

Wetland Web

WINGS
OVER WATER

LESSON 10

Wetland Web

Standards (NGSS): MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affecting populations.

Grade Levels 6-8: 40 minute lesson

MATERIALS LIST

- *Access to research materials (internet, computers)*
- *Species cards (one per student)*
- *Red and green yarn*
- *Posterboard*
- *Markers or colored pencils*

FROM THE FILM:

In the film, *Wings Over Water,* we learn that migrating birds depend on the food, shelter, and safe breeding grounds provided by prairie wetland ecosystems for survival. Migratory birds also contribute seeds and nutrients to the soil through their droppings and keep insect populations under control. Every plant and animal species in the prairie wetland is important to maintaining the balance of life in these ecosystems.

LESSON OVERVIEW:

Students will work together to show how each component of a wetland ecosystem is linked through symbiotic relationships of producers, consumers, and decomposers. They will create an ecosystem web using yarn to link the different components together. The teacher will introduce changes to the ecosystem to show how the changes affect all components over time. Afterwards, students will work in groups to create ecosystem web drawings on posterboard with each group choosing and researching a different ecosystem.

EDUCATOR PREP:

Print and cut out the species cards. Tape off four *potholes* around the room, large enough for 8–10 students to fit in or around. Label the potholes POND 1,2,3, and 4 (If modifying for smaller classes, use species cards for 2 or 3 ponds). Cut the red and green yarn into pieces, roughly 2–3 feet long, and place 8–10 pieces at each pothole (additional yarn can be added as needed).

LESSON 10

Wetland Web

Herd of bison grazing on the prairie.

FOR VIRTUAL LEARNING:

The teacher can send each student a virtual version of their species card and create a breakout room that corresponds to each pothole. The students will discuss their species and make connections in the breakout rooms. They can either draw their connections on paper or create a shared document to keep track of the different species and connections that they make. It may be beneficial to assign a leader who can keep track of the connections that are made. The teacher should go to breakout rooms to help facilitate the discussion.

After students have made their initial connections, read one of the threat cards to the whole group and then return students to their groups to discuss how these changes would affect their pothole. If the threat involves losing an entire pothole, discuss this change as a class and rearrange student groups as needed. After some discussion, the students can come back together as a class and review changes they had to make and how this would affect the ecosystem. Utilize a team leader who can speak for each group and explain what changes they had to make.

EDUCATOR GUIDE:

1. Tell students that in the film, *Wings Over Water,* we saw how important the prairie wetlands are for the survival of many different species, especially migratory waterfowl. Discuss the following questions with the class:

Why are the prairie wetlands so important?

They provide a nesting habitat for many species of migratory birds during the spring and summer. They also help maintain the health of the land by filtering groundwater and trapping carbon dioxide.

NOTES:

Why is it important that birds return to the wetlands each year?

It is where they breed and hatch their young. They also provide nutrients to the wetlands and help keep them healthy.

What is an ecosystem?

An ecosystem is a community of living organisms that interact within a particular environment. All the components of an ecosystem, living and nonliving, are interconnected through the cycle of energy and nutrients.

What is an ecological niche?

An ecological niche is the role an organism plays in its environment. Every species affects and is affected by different factors in its environment. Discuss how an ecosystem is influenced by more than simple food chains.

How is a food chain different than a food web?

*A food **chain** demonstrates who eats whom in a single line, for example, a mouse eats seeds, a snake eats the mouse, and an eagle eats the snake.*

*A food **web**, on the other hand, is made up of many food chains and involves all the different ways energy and nutrients are passed through the ecosystem through different chains of connection. A food web involves things like predators eating prey, plants absorbing energy from the sun and passing it on to herbivores, and insects breaking down decaying material and returning nutrients to the soil allowing new plants to grow.*

Ask students if they think a food chain or a food web is a better representation of an ecosystem?

Students should be able to explain that a food web better represents the many different relationships and connections between different species in an ecosystem.

2. Explain that in order to see how everything in an ecosystem is interconnected students will create their own wetland ecosystem in the classroom.

Birds take to the air.

3. What is one of the main features of the prairie wetlands?

Share with students that there will be four prairie pothole ponds around the room and that the whole room will represent the wetland ecosystem. Show them the four potholes taped off and labeled on the floor. Tell them that each of them will have the role of a different producer, consumer, or decomposer.

4. Students may have heard the terms producer, consumer, and decomposer before. Give them time to discuss these terms before checking their understanding.

What is a producer?

A producer is an organism that makes its own food from inorganic material. Plants are producers, they use the energy from the sun and nutrients from the soil.

What is a consumer?

A consumer is something that cannot make its own food. Consumers get energy and nutrients by eating producers and other consumers. Animals are consumers, they can be primary, secondary, or tertiary consumers.

Primary consumers are herbivores, or animals that eat only plants. They are the first level of consumers that transfer energy from producers up to higher level consumers.

Secondary consumers are carnivores, or meat eating animals, that eat the primary consumers. Some secondary consumers are omnivores, meaning they eat plants and animals.

Tertiary consumers are also known as apex predators. They are carnivores that eat both primary and secondary consumers.

What is a decomposer?

A decomposer is something that breaks down dead plants and animals and returns those nutrients back to the soil. Decomposers include bacteria, fungi, and some plants and animals including many invertebrates.

NOTES:

5. Instruct students that they will each get a card telling them their role in the wetland ecosystem. The card will tell them what pothole to go to, what their organism gets from the ecosystem, and what they produce.

Example: Sandhill Crane-gets nutrients from seeds, insects, small reptiles and amphibians. Produces nutritious poop to fertilize plants and eggs that can serve as food for predators.

6. Once students have received their cards and moved to the appropriate potholes, tell them that they should now use the yarn to make connections between the various species at their pothole based on what they eat, what they need from their environment, and what they produce *(I.e. poop, larvae).* Tell them to use the red yarn to connect food sources and the green yarn to make connections based on other needs *(at this stage students should be making connections only within their potholes).* Each student should use as many pieces of yarn as they need to make connections based on their species card (provide additional yarn as needed).

Give students 10-15 minutes to make their connections. Walk around and check for understanding while they are working. Once they have made their connections explain that the classroom now represents a balanced wetland ecosystem

What would happen if something changed to make our ecosystem unbalanced, for example, what if all the earthworms disappeared?

Answers will vary but may include there would be less food for the animals that eat earthworms or the soil wouldn't be as healthy. Make sure students understand that any change to the ecosystem will have a ripple effect and goes beyond just losing a food source.

Earthworms are important for keeping soil healthy, which allows for the growth of new producers. Without earthworms and other soil-dwelling invertebrates we would lose many plant species. Discuss how the loss of fertile soil would affect the ecosystem as a whole.

*Filming **Wings Over Water** from inside a blind.*

7. Read the first of the ecosystem threat cards and help the whole class work together to adjust the ecosystem. *For example, a farmer drains the wetlands from his field, which eliminates one of the potholes from the ecosystem.*

Help students understand how this would affect the various species in that pothole. Students who are animals can "migrate" to other potholes but plants that are rooted would die if the pothole was drained. Show how there is now a higher concentration of animals with fewer food sources. This would also mean more animal byproducts like poop with fewer decomposers to break it down.

How did the changes affect the ecosystem as a whole?

Answers will vary but should demonstrate that students understand the ripple effects that any changes would have on the ecosystem.

8. Depending on class size and teacher preference, either reset to the original positions before reading additional threat cards or add additional threats on top of the first. The threat cards do not need to be used in numerical order but can be mixed up and used in whatever order the teacher would prefer. Discuss the effects of each threat together after changes are made.

9. On the second day, put the students in groups of 3-4 and tell them that they will now get the chance to research another ecosystem and draw an ecosystem web. Show them the example wetland ecosystem web. Tell them that their ecosystem web should include at least 3 producers, consumers, and decomposers. The teacher may want to assign each group an ecosystem or allow the students to choose their own.

***Possible ecosystems to research:** Rainforest, coastal wetlands, temperate forest, desert, tundra.*

10. Each group will then present their ecosystem web to the class along with a potential scenario that would change the balance of that ecosystem.

Great Horned Owl
Pond 1

Consumer
Eats reptiles, amphibians, young migratory birds

Other needs:
Trees and shrubs for nesting

Provides:
Keeps prey populations down

Dragonfly
Pond 2

Consumer
Eats smaller insects, larvae

Provides:
Larvae

Great Horned Owl
Pond 3

Consumer
Eats reptiles, amphibians, young migratory birds

Other needs:
Trees and shrubs for nesting

Provides:
Keeps prey populations down

Dragonfly
Pond 4

Consumer
Eats smaller insects, larvae

Provides:
Larvae

Sandhill Crane
Pond 4

Consumer
Eats crustaceans, small reptiles, and amphibians

Other needs:
Aquatic plants for nesting

Provides:
Nutritious poop, eggs, offspring

Mallard
Pond 1

Consumer
Eats insect larvae and aquatic plants

Other needs:
Grasses for nesting

Provides:
Nutritious poop, eggs, offspring

Yellow Warbler
Pond 2

Consumer
Eats insects

Other needs: *Trees and shrubs for nesting*

Provides:
Nutritious poop, eggs, offspring

Sandhill Crane
Pond 3

Consumer
Eats crustaceans, small reptiles, and amphibians

Other needs:
Aquatic plants for nesting

Mallard
Pond 4

Consumer
Eats insect larvae and aquatic plants

Other needs:
Grasses for nesting

Provides:
Nutritious poop, eggs, offspring

Yellow Warbler
Pond 1

Consumer
Eats insects

Other needs:
Trees and shrubs for nesting

Provides:
Nutritious poop, eggs, offspring

Sandhill Crane
Pond 1

Consumer
Eats crustaceans, small reptiles, and amphibians

Other needs:
Aquatic plants for nesting

Mallard
Pond 2

Consumer
Eats insect larvae and aquatic plants

Other needs:
Grasses for nesting

Provides:
Nutritious poop, eggs, offspring

Yellow Warbler
Pond 3

Consumer
Eats insects

Other needs:
Trees and shrubs for nesting

Provides:
Nutritious poop, eggs, offspring

Northern Leopard Frog
Pond 1

Consumer
Adults eat insects, tadpoles eat algae and aquatic plants.

Other needs:
Ponds for breeding

Provides:
Eggs, tadpoles

Garter Snake
Pond 2

Consumer
Eats amphibians, Insects, eggs, crustaceans

Other needs:
Grasses

Provides:
Keeps prey populations down

Franklin's Gull
Pond 3

Consumer
Eats aquatic invertebrates, earthworms, grubs

Other needs:
Aquatic plants for nesting

Provides:
Nutritious poop, eggs, offspring

Northern Leopard Frog
Pond 4

Consumer
Adults eat insects, tadpoles eat algae and aquatic plants.

Other needs:
Ponds for breeding

Provides:
Eggs, tadpoles

Garter Snake
Pond 1

Consumer
Eats amphibians, Insects, eggs, crustaceans

Other needs:
Grasses

Provides:
Keeps prey populations down

Franklin's Gull
Pond 2

Consumer
Eats aquatic invertebrates, earthworms, grubs

Other needs:
Aquatic plants for nesting

Provides:
Nutritious poop, eggs, offspring

Northern Leopard Frog
Pond 3

Consumer
Adults eat insects, tadpoles eat algae and aquatic plants.

Other needs:
Ponds for breeding

Provides:
Eggs, tadpoles

Garter Snake
Pond 4

Consumer
Eats amphibians, Insects, eggs, crustaceans

Other needs:
Grasses

Provides:
Keeps prey populations down

Franklin's Gull
Pond 1

Consumer
Eats aquatic invertebrates, earthworms, grubs

Other needs:
Aquatic plants for nesting

Provides:
Nutritious poop, eggs, offspring

Aquatic Plants
Pond 1

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Grasses
Pond 1

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Algae
Pond 1

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Aquatic Plants
Pond 2

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Grasses
Pond 2

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Algae
Pond 2

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Aquatic Plants
Pond 3

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Grasses
Pond 3

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Algae
Pond 3

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Aquatic Plants
Pond 4

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Grasses
Pond 4

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Algae
Pond 4

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Trees and Shrubs
Pond 1

Producer

Needs:
Sunlight, nutrients from consumers and decomposers

Provides:
Shelter, food, nesting space

Zooplankton
Pond 1

Decomposer
Eats algae and decaying aquatic plants

Provides:
Clean water by removing decaying material

Aquatic crustaceans

Amphipods

Pond 1

Decomposer

Eats dead and decaying plant and animal material

Provides:
Larvae, eggs, keeps water sources clean.

Earthworms

Pond 1

Decomposer

Eats dead and decaying plant and animal material

Provides:
Nutrient-rich soil

Midges (Invertebrate)

Pond 1

Decomposer

Eats dead and decaying plant and animal material

Provides:

Larvae

Aquatic crustaceans

Amphipods

Pond 2

Decomposer

Eats dead and decaying plant and animal material

Provides:
Larvae, eggs, keeps water sources clean.

Earthworms

Pond 2

Decomposer

Eats dead and decaying plant and animal material

Provides:
Nutrient-rich soil

Midges (Invertebrate)

Pond 2

Decomposer

Eats dead and decaying plant and animal material

Provides:

Larvae

Aquatic crustaceans

Amphipods

Pond 3

Decomposer

Eats dead and decaying plant and animal material

Provides:
Larvae, eggs, keeps water sources clean.

Earthworms

Pond 3

Decomposer

Eats dead and decaying plant and animal material

Provides:
Nutrient-rich soil

Midges (Invertebrate)

Pond 3

Decomposer

Eats dead and decaying plant and animal material

Provides:

Larvae

Aquatic crustaceans

Amphipods

Pond 4

Decomposer

Eats dead and decaying plant and animal material

Provides:
Larvae, eggs, keeps water sources clean.

Earthworms

Pond 4

Decomposer

Eats dead and decaying plant and animal material

Provides:
Nutrient-rich soil

Midges (Invertebrate)

Pond 4

Decomposer

Eats dead and decaying plant and animal material

Provides:

Larvae

THREAT CARDS / EDUCATOR SHEET

Threat 1:

One pond is drained to create more farmland.

Notes:
When a pond is drained, the plants in and around that pond will disappear. Species that are fully aquatic, such as amphipods and water fleas will also not survive. Other species can join nearby ponds and try to share resources with the inhabitants already living there. The teacher can extend this by draining more ponds as the activity continues.

Threat 2:

Pesticides from nearby farms leach into the wetlands harming or killing some aquatic invertebrates, larvae, and amphibians.

Notes:
This can affect one or several ponds.

Threat 3:

An invasive species of reptile is introduced to the area by humans. The reptile species has no natural predators, breeds quickly, and consumes large numbers of migratory bird eggs.

Notes:
The teacher should help students think about the long-term effects of this new predator on migratory bird populations and the ecosystem as a whole.

Threat 4:

Urban sprawl–A pond is drained and filled to make room for a new highway.

Threat 5:

Minnows are introduced to one of the ponds.

Notes:
The introduction of minnows can be harmful because they eat the aquatic invertebrates that many native species rely on. Minnows and other fish can be introduced to new habitats when people release pets into local waterways. This practice has led to the introduction of invasive species around the world and can be devastating for native species and ecosystems.

EDUCATOR GUIDE

Wings Over Water

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WINGS
OVER WATER