

Youth Guide

Federal Junior Duck Stamp Program

Connecting Children with Nature Through Science and Art!

For young people grades K through 12

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

WELCOME

Introduction: The Call of the Wild Duck 7

Are you curious? Do you like to discover new things? Do you like to draw or write? Do you like to make a difference? Then give these activities a try! And try to solve the mystery of the Labrador Duck.

UNIT 1: What is . . . a Waterfowl? 25

Figure out how you can tell the differences among ducks, geese, and swans. Investigate why waterfowl have special feet and bills. Find out what inspired famous writers and artists to think about waterfowl, and make your first drawings of these unique birds.

UNIT 2: A Day in the Life 59

Learn about amazing behaviors that help waterfowl survive. Explore the kinds of things that birds do. Investigate how behavior can help you tell the difference between one type of bird and another. Build a blind to help you watch waterfowl without being seen.

UNIT 3: Raising a Family in a Wetland 87

Explore how a duck finds a mate. Investigate where a goose could make a home and not be disturbed. Describe in art or words how waterfowl parents protect their young from predators and weather.

UNIT 4: Going the Distance 121

Investigate some of the mysteries of migration. Explore migration routes and imagine yourself on a migration journey. Investigate the impact of climate change on Mallard migration along with a team of scientists. Create artwork illustrating a migration journey.

UNIT 5: Learning from the Past; Taking Action for the Future . . . 153

Learn why our government decided to make laws about hunting migratory birds, starting early in the 20th Century. Explore survival challenges for waterfowl. Make a difference for waterfowl in your community. And maybe you'll solve the mystery of the Labrador Duck.

Vocabulary 205

Acknowledgments

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Thank you to our many biologists and our U.S. Fish and Wildlife Service colleagues who were interviewed for this effort. Their valuable contributions enabled us to stay focused on conservation sciences and helped us illustrate to young people the importance of wildlife stewardship and staying connected to the natural world.

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Give it a try!

Have you ever wondered what makes you look up whenever you hear or see a V-shaped flock of geese going north or south? Is it just the sight or sound, or is it a deeper feeling about the changing seasons? Why do people like to watch ducks or swans swimming in city parks? Is it their graceful swimming and diving, or just the kaleidoscope of color and movement? And why do people ooh and aah when they see the little duckling fuzzballs following their mothers?

There is something magnetic about waterfowl that draws the attention and the imagination of both city dwellers and people who live in the country. With this guide you can explore many questions about ducks, geese, and swans. You'll have fun and use what you learn to make your neighborhood and community a great place to live for ducks, geese, and swans.

And a BONUS... You will also practice the skills you'll need to create an entry for the Junior Duck Stamp art competition. Whether or not you think you are good at science and math or writing and art, give it a try. Everyone is a winner!

ARE YOU CURIOUS? Then explore:

- Were there ducks when the dinosaurs were alive?
- Why did the Labrador Duck go extinct? Are other ducks endangered?
- Do all ducks look alike?
- Do all ducks quack?
- What do these names mean to you: *Ugly Duckling*, *Daffy Duck*, *Swan Lake*?
- What does a duck's name tell you: Northern Pintail, Redhead, Bufflehead, Harlequin Duck, Wood Duck, Goldeneye, Blue-winged Teal?

DO YOU LIKE TO DISCOVER NEW THINGS? Then investigate:

- How many duck decoys are needed to attract ducks?
- Do the same ducks live in your community all the time, or does the duck population change with the seasons?
- Do changes in our climate affect duck migration?

DO YOU LIKE TO DRAW OR WRITE? Then give it a try:

- Perfect your skills by trying some of the activities in this guide.
- Enter the Junior Duck Stamp art competition.

DO YOU LIKE TO MAKE A DIFFERENCE? Then share:

- Talk about what you are learning.
- Try a conservation project in your community.

INTRODUCTION

The Call of the Wild Duck



Northern Pintails
USFWS photo by Gary Kramer

Waterfowl Challenge Question

Q: How did a duck help Columbus discover America?
Look for the answer at the end of this unit

Meet the “Waterfowl Friends”

This group of middle-schoolers found each other online on one of the social network sites because they shared a common interest in waterfowl. Follow their conversations throughout the pages of this guide as they explore, investigate, express, and share curious facts and information about ducks, geese, and swans.



Anthony

[Links](#) [Info](#) [Photos](#) [Notes](#)

Home: Near Baltimore, Maryland

School: 6th grade

Interests: Video games, birding, hiking, texting



Selena

[Links](#) [Info](#) [Photos](#) [Notes](#)

Home: Bangor, Maine

School: 6th grade

Interests: Online social media, computer programming, camping, reading



Jacob

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Home: Knoxville, Tennessee

School: 7th grade

Interests: Fishing, NASCAR racing, chemistry set, texting, TV



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[Links](#) [Info](#) [Photos](#) [Notes](#)

Home: Saginaw, Michigan

School: 8th grade

Interests: Kayaking, birding, volleyball



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[Links](#) [Info](#) [Photos](#) [Notes](#)

Home: Stuttgart, Arkansas

School: 6th grade

Interests: Fishing, canoeing, camping, hiking, online chatting, TV

Jasmine



- Links
- Info
- Photos
- Notes

Home: Lincoln, Nebraska
School: 7th grade
Interests: Shopping, flying, chess club, texting

Carlos



- Links
- Info
- Photos
- Notes

Home: Corpus Christi, Texas
School: 6th grade
Interests: Video games, football, baseball, social media, TV

Hannah



- Links
- Info
- Photos
- Notes

Home: Redding, California
School: 6th grade
Interests: Soccer, volleyball, reading, social media, TV

Michael



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- Info
- Photos
- Notes

Home: McGregor, Minnesota
School: 7th grade
Interests: Boating, fishing, swimming, snowmobiling, skateboarding

Emily



- Links
- Info
- Photos
- Notes

Home: Near Juneau, Alaska
School: 6th grade
Interests: Hiking, video games, social media, TV, dogsledding





In the Introduction...

What will you learn?

- How to use this *Youth Guide*
- The mystery behind the disappearance of the Labrador Duck
- Ducks, geese, and swans are very interesting
- You can use science, art, and writing skills to show how important waterfowl and wetlands are to you, your family, and your community

What will you do?

- Investigate mysteries about waterfowl along with the scientists working to solve them and the artists who want to tell their story
- Make a plan for doing the activities in this guide
- Start a Nature Notebook
- Get started on making observations about ducks, geese, and swans and their habitats

What will you need?

- An educator or adult leader
- A sketchbook or materials to make a sketchbook, such as cardboard or tagboard for the cover, unlined white construction paper, a 3-hole punch, and string
- A place nearby where you can look at waterfowl in their habitat. It could be a natural area, city park, zoo, an empty lot, or your own backyard



Why waterfowl?

If you wanted to paint a duck, goose, or swan and have the painting be as realistic as possible, what would you need to know? What questions would you ask? Would you be surprised to find that your questions are the same as those asked by wetland and waterfowl scientists? There are many fascinating stories about ducks, geese, and swans, and even some unsolved mysteries waiting for you in this guide.

Ducks, geese, and swans, collectively known as “waterfowl,” have captured the imaginations of people in many cultures for hundreds of years. What is it about these birds of wet places that caused them to be celebrated in dance, song, stories, poetry, and art? Why have they been and why do they continue to be of such great interest to waterfowl biologists, wetland ecologists, ornithologists, and other scientists?

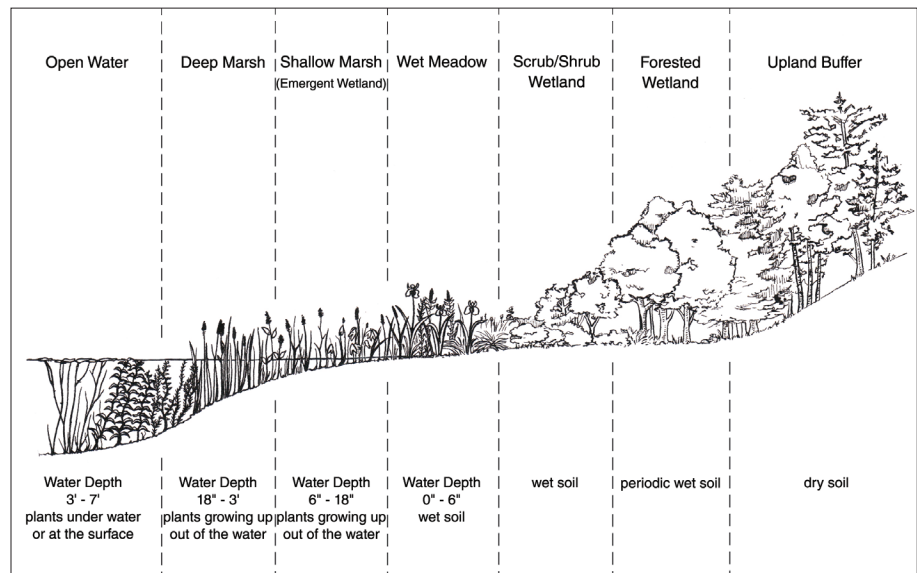
Waterfowl are usually found in wetlands or along the sea coast. You might see waterfowl in ponds, streams, lakes, reservoirs; low spots that are filled with water; places where rain water collects; drainage ditches; places with wetland vegetation (like cattails or marsh grasses); ocean coasts; or tidal zones. Even if you don't see a duck, a goose, or a swan when you visit one of these areas, you will see the habitat (food, water, and shelter) that is important to their survival.

Did you know that there has been more research done on waterfowl than nearly any other type of animal in the world? Find

out why they are so important, why studying them could help us learn about ourselves, and why helping them survive could be linked to our own survival. This guide provides you with an opportunity to investigate what is fun, unique, and mysterious about waterfowl in North



USFWS photo by Dr. Thomas G. Barnes



Wetlands generally occur between uplands (dry land) and deep or open water.

America and in your community. And every unit includes a story about a scientist who is working with the U.S. Fish and Wildlife Service to learn about waterfowl and how they survive. Perhaps you would like a job like this one day. Learning about waterfowl helps us to guard the welfare of plants and animals that live in wetlands, and it helps us to understand how our environment is changing and what we can do to help conserve these fascinating animals.

Laura Maloney, DJ Case & Associates

What about you? How do you fit in?

The activities in this guide will help you learn more about yourself and look at things from different points of view. There are lots of questions to think about, and in many cases there is no right answer!

What do you really like to do? What kinds of things are you good at? In each section, you can choose among the activities and find those that interest you the most.

Are you good at science? Art? Math? Writing? Technology? You may not think of yourself as being particularly good at any of these, but don't judge yourself too soon!

The activities in this guide will help you express thoughts, feelings, and experiences about waterfowl and conservation. As you participate in unit activities, you might find out that you are more of a scientist than you think! You may also find out that you enjoy taking an active role in conservation efforts to preserve waterfowl habitat in your community.



© California Waterfowl

GETTING STARTED: Explore, Investigate, Express, Share

Choose your own path.

There are lots of things to try. Each unit provides important clues and skills. Where do you want to begin?



USFWS photo by Steve Noyes



© California Waterfowl



© California Waterfowl



© James Baumgartner

Watch for landmarks

How do you get started? In each unit, you will get a chance to explore an important question, investigate possible answers, express what you learn in art or writing, and share with others. Try the activities in this *Introduction* to learn how each unit will work and to make sure that you are ready to complete the activities.



Pencil-to-paper warm-up: Each unit starts with a warm-up exercise that involves making a simple line drawing of a duck, goose, or swan using geometric shapes. This will be called your *geo-duck*, *geo-goose* or *geo-swan*. The purpose of these exercises is to warm up the “why?” part of your brain. Asking “why?” is the basis of scientific thinking; figuring out how to answer “why?” is the beginning of the scientific process.



Explore: Explore the kinds of places where waterfowl live, observe waterfowl and other creatures that share their habitats, and learn about some of the challenges to their survival. Explore science and math as you try activities.



Investigate: Learn about questions that scientists are asking about waterfowl and see how they are trying to answer these questions. You will have a chance to ask your own questions and try to find the answers.



Express: See how artists have expressed the beauty and uniqueness of waterfowl. You will write, draw, paint, and perhaps use theater and other forms of art to express your thoughts and feelings about what you learn.



Share: With the help of your classmates, share what you’ve learned through artwork and writing, talking about your scientific findings, and taking action to improve waterfowl habitat.



Pencil-to-paper wrap-up: At the end of each unit, you will briefly reconsider your *geo-duck*, *geo-goose*, or *geo-swan*. This is an opportunity to apply what you learned in the unit to make your drawing more life-like.

Vocabulary

Starting on page 205 is an index of words and definitions you may find useful while using this guide. These words appear in **bold** the first time they are used in each unit.

Helpful facts

North American Waterfowl Species

Waterfowl live all around the world. However, in this guide, we will focus mainly on the waterfowl of the **western hemisphere**. Waterfowl includes all ducks, geese, and swans. It does not include other **shorebirds** and **waterbirds** such as herons, cranes, gulls, and plovers. Many of these other species have similar habitat needs and **behaviors**, so your studies may include them. See page 23 for a list of North American waterfowl.

Get help from an expert

You may want to ask an expert for help to get the most out of some of the activities in this guide. An expert could be a science educator, a parent with a special interest in waterfowl, or a conservation professional such as a wildlife expert. Ask your teacher or leader to help you figure out whom to ask. This guide will refer to this expert as your conservation partner.

Tips for working with an expert:

- Prepare before you call, write, or meet. Be as specific as possible about how you think he or she can help.
- Be polite and respectful, even when you disagree or don't get what you want.
- Always give your name and the name of your group.
- Write all names, phone numbers, and addresses in your Nature Notebook.
- Say thank you. Send thank you notes. Invite partners to a project celebration.
- Only one person from your group should call. Don't confuse your partners.
- Call back after a couple of days if someone hasn't returned your call.
- Make sure you have a complete list of all your questions before you call your conservation partner, so that you don't have to keep calling back each time something comes up.

EXPLORE



Start a Nature Notebook. Buy a sketchbook or make one. Use cardboard or tagboard for the cover, use white construction paper or other suitable paper, and bind together by using a 3-hole punch and tying it together with string. Decorate the cover if you like. Throughout this guide are ideas for using your Nature Notebook. They are marked with this icon.

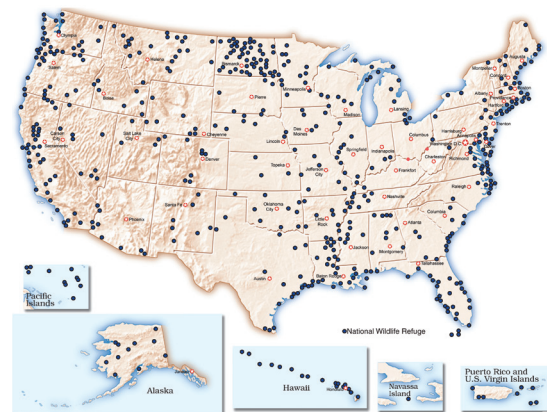


Make A Plan: Flip through this guide and make a plan for what you will record in your Nature Notebook. You can change your plan as you go along, but this will get you started.

Get Your Ducks in a Row	
Unit activities	Action & estimated starting date
Introduction: The Call of the Wild Duck	
What is . . . a Waterfowl?	
A Day In the Life	
Raising a Family in a Wetland	
Going the Distance	
Learning from the Past; Taking Action for the Future	

Find Waterfowl Where You Live: Learn where ducks, geese, or swans live in your area. It's best if you can visit a natural habitat that you can visit. If it's not possible for you to get to a natural area, you can do many of the suggested activities by observing waterfowl in a zoo or city park. For some ideas, contact:

- U.S. Fish and Wildlife Service: **national wildlife refuges**; waterfowl production areas
- City, town, or county parks department
- State natural resource agency
- State parks office
- National Audubon Society, local Audubon Society chapters or other birding groups
- Many states have waterfowl associations (such as the Missouri Waterfowl Association)
- Local hunting and fishing clubs
- Waterfowl conservation organizations (such as Ducks Unlimited and local chapters of Ducks Unlimited, Waterfowl USA, Delta Waterfowl, Trumpeter Swan Society)
- The Cornell Lab of Ornithology provides resources on local birding; look for special projects such as "Project FeederWatch"



There are over 550 refuges across the country. Visit one near you.



INVESTIGATE

Observe a Duck, a Goose, and a Swan. Look at the photo of each of these birds. How can you tell the difference? Do they seem to have different actions or movements? Are they similar in size?

Duck



USFWS photo by Donna Dewhurst

Goose



USFWS photo by Tim Bowman

Swan



USFWS photo by George Gentry



USFWS photo by Edward Wagner



USFWS photo by Tim Moser



USFWS photo by Donna Dewhurst

List a few questions about ducks, geese, and swans in your Nature Notebook: _____



Visit a natural area, park, or zoo and make nature observations: Visit a natural area at least once. Then try to get outside once a week for at least 15 minutes. If you can get to a wetland or other waterfowl habitat, great! If not, just go to a city park, empty lot, or your backyard and observe birds, mammals, reptiles and amphibians, or even insects. The observation and recording skills you use will help you become a better scientist and artist. Here are some things to observe and record in your Nature Notebook each time you go out.

My Nature Notebook: Weekly Observations

An illustration of an open, spiral-bound notebook with a light blue grid pattern on the pages. A pencil is tucked into the top of the notebook. The notebook is divided into two columns by a central binding. The left page contains the following text: "Date and location:", "Weather conditions:", "Time of day:", and "Plants (name or draw):". The right page contains the following text: "Animals, including insects, birds, mammals (name or draw):", "Sounds, smells:", "Sketch of any plants or animals you find interesting:", and "Written description of any plant or animal you find interesting:". The notebook is shown from a slightly elevated perspective, with a soft shadow underneath.

Date and location:

Animals, including insects, birds, mammals (name or draw):

Weather conditions:

Sounds, smells:

Time of day:

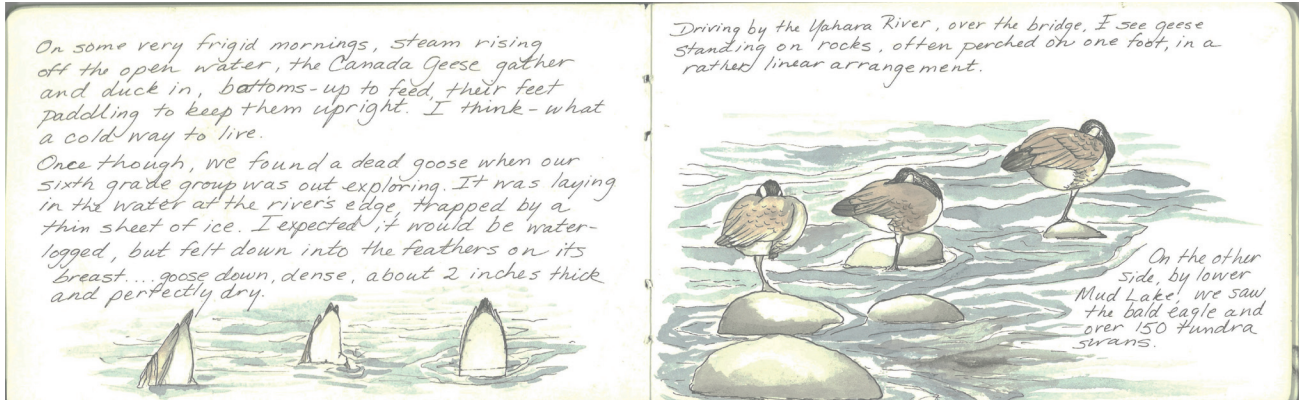
Sketch of any plants or animals you find interesting:

Plants (name or draw):

Written description of any plant or animal you find interesting:

EXPRESS

Use your Nature Notebook: Record your observations during activities in this guide when you go outside and when you visit a natural area.



Sample Nature Notebook pages. © Janet Moore

SHARE



Tell someone: Tell a friend or parent which activities in this guide you want to try and why.

Show someone: Show your nature notes and drawings to a friend, parent, or group leader.

Take a friend with you: Visit a natural area with a friend. Ask your friend to help you add information and ideas to your Nature Notebook. Maybe your friend would like to start a Nature Notebook, too.

Waterfowl Challenge Question

Q. How did a duck help Columbus discover America?

A. Apparently on October 8, 1492, crewmen aboard one of Columbus's ships, the Pinta, observed ducks flying southwest and altered course to investigate. On October 12, they sighted land in the Bahamas.



Featured Scientist & The Mystery of the Labrador Duck

Glen Chilton



Photo courtesy of Glen Chilton

[Links](#)

[Info](#)

[Photos](#)

[Notes](#)

Meet the Labrador Duck

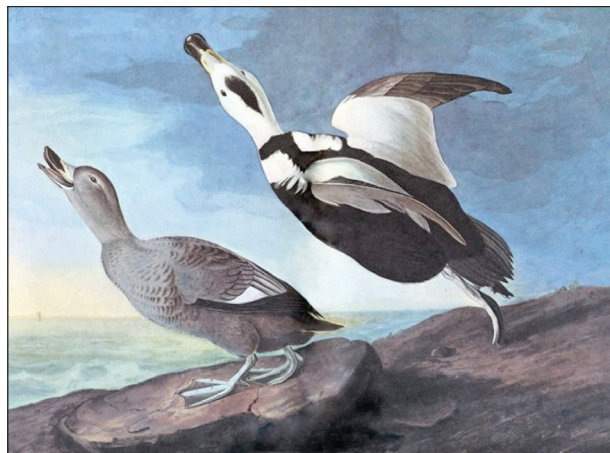
Glen Chilton and the **Mystery** of the Labrador Duck

There is only one waterfowl species known to have become **extinct** in North America – the Labrador Duck. **The last Labrador Duck ever seen was in 1875 in Long Island, NY!** What did the Labrador Duck look like? Where did it live? How did it behave? Why did it disappear? No one knows for sure what caused the **extinction**, but scientists have a few **clues** to answer these questions. Since Labrador Ducks are similar to Eider Ducks, sea ducks that exist today, Eider Duck biology may be important to understanding what happened. Each unit will add clues to help you think about a possible solution.

Clues to help you think about the mystery of the Labrador Duck:

- Unit 1 – Labrador Duck body shape and appearance
- Unit 2 – Labrador Duck behavior
- Unit 3 – Labrador Duck reproduction
- Unit 4 – Labrador Duck migration
- Unit 5 – Labrador Duck and people

Clues to the mystery come mostly from observation by naturalists, such as John James Audubon. But the only Labrador Ducks left to study today are stuffed specimens in museums. Glen Chilton, an **ornithologist** from Canada, traveled around the world to examine each specimen. He also studied the journals of naturalists from the 1800s to examine any records of Labrador Duck sightings. He learned some important information from nature journals. Maybe 100 years from now someone will make important discoveries from the Nature Notebook you create for the activities in this guide.



Labrador Ducks, John James Audubon

Featured Scientist

Jena Moon

[Links](#)[Info](#)[Photos](#)[Notes](#)

USFWS photo by
Steve Hillebrand

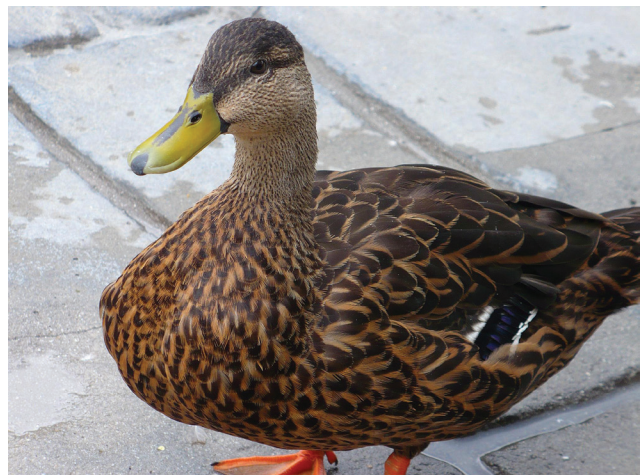
Meet Jena Moon, Wildlife Biologist, U.S. Fish and Wildlife Service

Jena and her co-workers at the McFaddin/Texas Point National Wildlife Refuges are trying to understand how the Mottled Duck lives in its habitat and how it moves between habitats. **Biologists** want to learn as much as they can about the Mottled Duck because its ability to survive will tell them whether the marshes where it lives are healthy. The Mottled Duck is an **indicator species**. An indicator species is a specific plant or animal that can help biologists to notice changes in the environment.

The Mottled Duck is becoming less and less common along the Texas Gulf Coast. Currently, biologists have a relatively poor understanding of the Mottled Duck's use of its habitat, its response to biologists' efforts to **manage** its habitat, and its **movements** between refuges and other properties. Jena and her colleagues track the movement of Mottled Duck **hens** (females) on the refuge using radios, and are now gathering more detailed information by attaching solar-powered satellite radios to the ducks. The satellite radios are used to document where the ducks go, in particular when hens depart the refuge property. This information helps biologists to improve **habitat management** in response to changes in habitat across the Mottled Duck range. Habitat management practices include burning, grazing, changing water levels, and applying herbicides.



© Eve Fraser-Corp



© Wes Bryant

Jena's project involves an important partnership with local school districts and other **conservation** organizations. Students in elementary and intermediate classes in schools near the refuges will be able to follow the progress of the project online and through class visits to the refuges. Students are able to:

1. Learn how **radio telemetry** works and actually track wildlife like biologists do.
2. Play interactive games to help them learn the basics of wildlife ecology.
3. Get up-close with wildlife in an exhibit and touch tanks.
4. Seine (net) for fish with McFaddin/Texas Point Wildlife Refuges coastal fisheries biologists and technicians.
5. See marsh research equipment at work (airboats, marsh masters, amphibious excavators, etc.).

National wildlife refuges are a national network of lands and waters set aside for the conservation and management of natural resources. The U.S. Fish and Wildlife Service may also **restore** fish, wildlife, and plant resources and their habitats at these refuges.

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North American Waterfowl

Okay, so exactly which ducks, geese, and swans are we talking about?

Waterfowl live all around the world. However, in this guide we will focus mainly on the waterfowl of the western hemisphere. Waterfowl includes all ducks, geese, and swans. It does not include other shorebirds and waterbirds such as herons, cranes, gulls, and plovers. Many of these other species have similar habitat needs and behaviors, so your studies may include them.

These are the species that are eligible for inclusion in the Junior Duck Stamp art competition and will be the focus of this guide and the activities in this guide:

Whistling Ducks

Fulvous Whistling-Duck

(*Dendrocygna bicolor*)

Black-bellied Whistling-Duck

(*Dendrocygna autumnalis*)

Swans

Trumpeter Swan (*Cygnus buccinator*,
formerly *Olor buccinator*)

Tundra Swan (*Cygnus columbianus*,
formerly *Olor columbianus*)

Geese and Brant

Greater White-fronted Goose

(*Anser albifrons*)

Snow Goose, including blue phase

(*Chen caerulescens*)

Ross's Goose (*Chen rossii*)

Emperor Goose (*Chen canagica*)

Canada Goose (*Branta canadensis*)

Brant (*Branta bernicla*)

Dabbling Ducks

Wood Duck (*Aix sponsa*)

American Wigeon, formerly American
Widgeon (*Anas americana*)

Gadwall (*Anas strepera*)

Green-winged Teal (*Anas crecca*)

Mallard (*Anas platyrhynchos*)

Mottled Duck (*Anas fulvigula*)

American Black Duck (*Anas rubripes*)

Northern Pintail (*Anas acuta*)

Blue-winged Teal (*Anas discors*)

Cinnamon Teal (*Anas cyanoptera*)

Northern Shoveler (*Anas clypeata*)

Diving Ducks

Canvasback (*Aythya valisineria*)

Redhead (*Aythya americana*)

Ring-necked Duck (*Aythya collaris*)

Greater Scaup (*Aythya marila*)

Lesser Scaup (*Aythya affinis*)

Sea Ducks

Common Eider (*Somateria mollissima*)

King Eider (*Somateria spectabilis*)

Spectacled Eider (*Somateria fisheri*)

Steller's Eider (*Polysticta stelleri*)

Harlequin Duck (*Histrionicus
histrionicus*)

Long-tailed Duck (*Clangula hyemalis*)

Black Scoter (*Melanitta nigra*)

Surf Scoter (*Melanitta perspicillata*)

White-winged Scoter (*Melanitta fusca*)

Bufflehead (*Bucephala albeola*)

Barrow's Goldeneye (*Bucephala islandica*)

Common Goldeneye (*Bucephala clangula*)

Mergansers

Hooded Merganser (*Lophodytes cucullatus*)

Red-breasted Merganser (*Mergus serrator*)

Common Merganser (*Mergus merganser*)

Stiff Tails

Ruddy Duck (*Oxyura jamaicensis*)

Masked Duck (*Oxyura dominica*)

Hawaiian Species

Koloa (*Anas wyvilliana*)

Laysan Duck (*Anas laysanensis*)

Nene (*Branta sandvicensis*)

Doodle space:

UNIT 1

What is... a Waterfowl?



Trumpeter Swans
© Rick Harris

Waterfowl Challenge Question

Q: Which of the following groups of birds are waterfowl?
Hérons, Ducks, Loons, Snipe, Geese, Swans, Gulls.

Look for the answer at the end of this unit.



Jacob

[Links](#)

[Info](#)

[Photos](#)

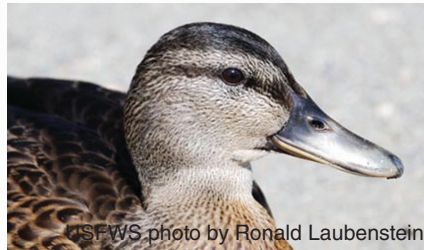
[Notes](#)

JACOB

We just talked about some birds in class called “**waterfowl**.” What is a waterfowl, anyway?

JASMINE

I think waterfowl is ducks and stuff. They’ve got those funny bills that aren’t like the beaks of other birds. What else is different between them and other birds? Here is a picture of a Mallard Duck’s bill.



USEWS photo by Ronald Laubenstein



MATTHEW

They’ve all got webbed feet, right? My Dad is a duck hunter, and he says geese and swans are also waterfowl—not just ducks.

EMILY

I love swans, but I didn’t know they were waterfowl. The largest swan in North America is the Trumpeter Swan. They’re so beautiful!



USEWS photo by Donna Dewhurst



In Unit 1...

What will you learn?

- What we mean by the term “waterfowl”
- How waterfowl are alike and different from other birds
- What special **characteristics** help waterfowl survive
- What the first duck looked like

What will you do?

- Investigate how waterfowl keep their feathers dry
- Investigate how waterfowl feet and the shape of their bills help their survival
- Draw a shape that is clearly a duck, goose, or swan and not some other type of bird
- Show others what makes a duck, goose, or swan unique

What will you need?

- A teacher or adult leader
- Pencil or pen
- Nature Notebook
- Outline of waterfowl skeletons
- Glue or tape
- Diagram of a feather
- A feather from a chicken, an art store, an old pillow, a quilt, or a down jacket (Note: do not use a feather found outdoors. Leave feathers found in a natural area where you found them.)
- Magnifying glass or microscope
- Good light source
- An eye-dropper
- A cup of water
- Clay or paper mache for sculpting
- Camera
- Printer to print your photo
- A natural area to visit (within walking distance or transportation will be needed)
- A library to visit
- Access to a computer with an Internet connection
- Access to a computer with image editing software, like Photoshop
- Collection of materials that could be used to dress someone up like a duck or goose

Featured Artist

Joseph Hautman



USFWS photo

[Links](#) [Info](#) [Photos](#) [Notes](#)

Meet Joseph Hautman, physicist and artist

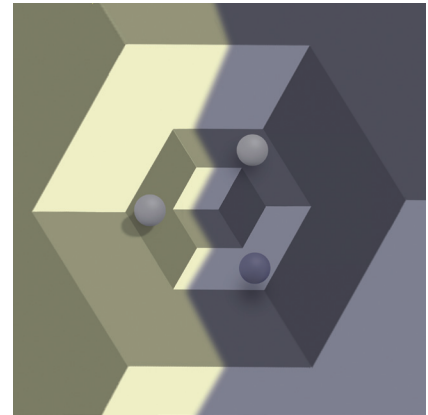
From an early age, Joe Hautman loved to draw and paint, but he was fascinated by science, as well. He studied physics and astronomy at the University of Minnesota and eventually earned a Ph.D. in Physics from the University of Michigan. Joe was working as a scientist when he began to enter the Federal Duck Stamp art contest as a way to exercise his artistic skills. In 2007, Joe won the Federal Duck Stamp Contest for the third time with a painting of a pair of Pintails.

Joe thinks like a scientist, and that influences his art. Scientists need to be keen observers of detail. They need to be problem solvers and experiment with new ways of doing things to figure out “how the world works.” Joe uses his science skills while painting. He is intrigued by the way color and light interact to create a certain effect in a painting and how the same color can look completely different depending on what color is next to it. He can paint a straight line, but because of other things in the background, it may not look straight. Discovering this led him to experiment with optical illusions (this took him on a tangent from the painting he was working on, which he says is a danger of thinking too much!).

Joe says there is another thing that scientists and artists have in common: they are both searching for the truth. He quotes from Yeats, a famous poet, “Beauty is truth, truth beauty—that is all ye know on earth, and all ye need to know.” What do you think this means to him? What does it mean to you?

Joe feels that painting ducks is “way more complicated” than anything he ever did in the physics lab. He thinks about all the elements of light and color and the details of duck anatomy. He also thinks about how people will react to the painting and how different painting techniques will make them feel (perhaps how they will see the truth as Yeats described?).

Thinking like a scientist also leads Joe to a great deal of research to learn about the animals he paints and the important elements of the habitats they need to survive. He has traveled to India and Asia to paint tigers and other wildlife. In Joe’s studio are shoeboxes crammed with his wildlife photos. When he was preparing to paint a Spectacled Eider, Joe also traveled to Ottawa, Canada,



Here is an optical illusion that Joe painted. Two of the three balls in this painting are actually the same color. Can you tell which ones? Notice how the different backgrounds make them look like they are different colors. © Joseph Hautman

to examine rare stuffed specimens in a museum. To learn more about what he found, see the “Mystery of the Labrador Duck” in Unit 3 on page 116. Eider Ducks are related to the Labrador Duck and might provide some clues to their disappearance.

Joe’s two younger brothers are also professional painters. James has won the Federal Duck Stamp Contest four times (the first time, in 1989, he was the youngest person ever to win). Robert is a two-time winner. The brothers also have won a total of 16 state duck and pheasant stamp competitions. Joe wants to continue to improve, so he likes to hear constructive criticism about his work. He asks his brothers to critique his paintings and he says they are always brutally honest. Joe thinks that to be a good artist, you have to be open to others’ ideas.

As you draw and paint waterfowl and their habitats, try to think like a scientist and use some of the techniques that Joe uses to improve your work. After all, he’s won the Federal Duck Stamp Contest three times!



Joe Hautman’s painting of Pintail Ducks that won the 2008 Federal Duck Stamp Contest. © Joseph Hautman

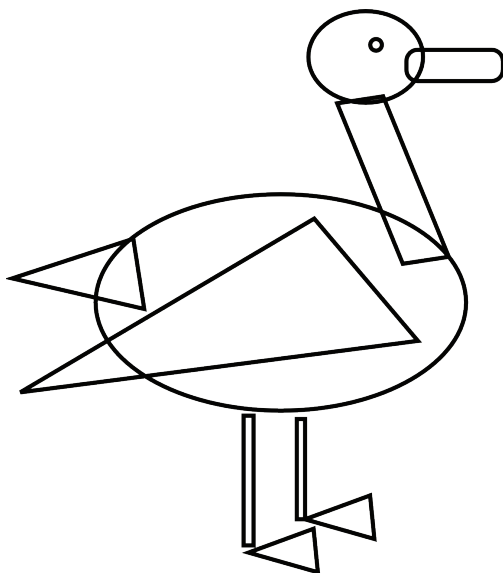
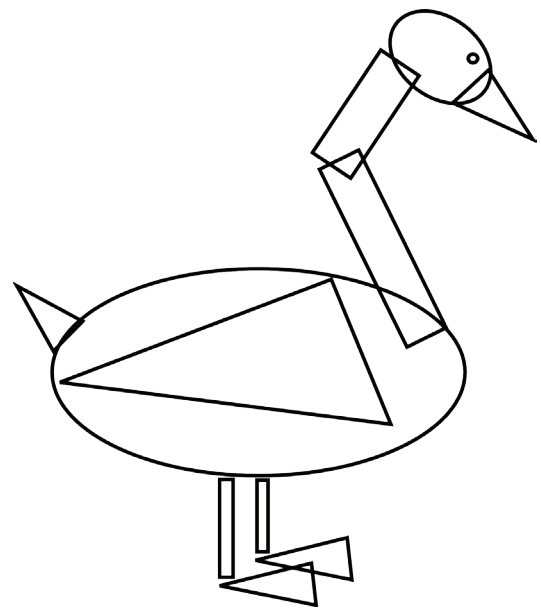
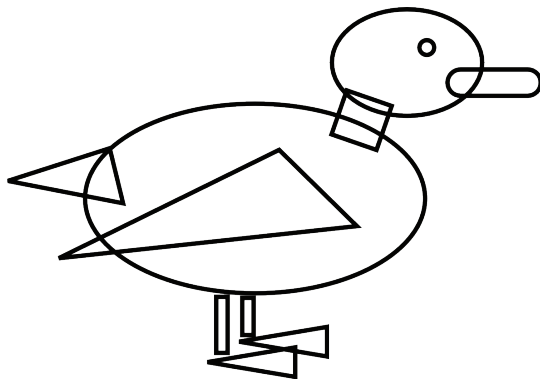
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PENCIL-TO-PAPER WARM-UP

What *are* waterfowl? Ducks, geese, and swans. What *are not* waterfowl? Coots, cormorants, gulls, and cranes.

Working in a small group, brainstorm a number of words that describes the shape of ducks, geese, and swans. Ask someone in the group to record all the words. Think about how these types of waterfowl are alike and different from other birds. Think of the different large body parts (head, neck, body, and feet) and describe them in **geometric** terms (circle, oval, cylinder, etc.). Working on your own, create a quick drawing in your Nature Notebook using only geometric shapes. This is your *geo-duck*, *geo-geese*, or *geo-swan*.



Dan Wolfe, DJ Case & Associates

GETTING STARTED

We write books about waterfowl; we see waterfowl in art; we even use cartoons of waterfowl to explain a point or to make a joke. We name clothing using terms like *duck boots* or a hair style like *duck tails*. There are children’s games like *duck, duck, goose*, and a graceful dive called a *swan dive*. But why? What is it about waterfowl that captures our imagination and our interest?

In Unit 1, we will begin to explore these questions by getting “up close” to ducks, geese, and swans. When you look at photos of these birds in this guide or on the Internet, what differences do you notice about their size, coloring, nesting habitats, food habits, and ways of getting food (**dabblers** vs. **divers**)?

Begin with the *Explore* section and read through the activities. Choose at least one and carefully follow all of the directions. When you are satisfied that you have a good start on understanding the main ideas for Unit 1, move on to the other sections: *Investigate*, *Express*, *Share*. Plan to do at least one activity in each of the sections. Don’t forget the pencil-to-paper wrap-up at the end of the unit!

EXPLORE



What traits do birds share? Ducks, geese, and swans are waterfowl, and waterfowl are birds. What do all birds have in common?

ACTIVITY: Some of the birds below are **waterfowl**, and some are **waterbirds** (crossed out by a circle with a bar through it). What differences do you see between waterfowl and waterbirds?

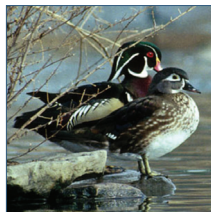


ACTIVITY: In your Nature Notebook, make a list of all the characteristics of birds that you can think of. Clues are provided throughout this unit.

BONUS: Name each bird in the photos below. Check your answers at the bottom of the page.



a: USFWS photo by Steve Farrell



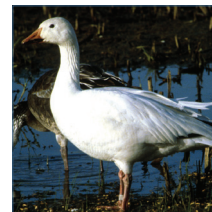
b: USFWS photo by Tim McCabe



c: USFWS photo



d: USFWS photo by Wyman Meinzer



e: USFWS photo by Dave Menke

a: Black-crowned Night Heron b: Wood Duck c: Common Loon d: Sandhill Crane e: Snow Goose

Explore & Curious Facts



SELENA

What makes something a bird? They all have feathers, beaks, and they lay eggs.

MATTHEW

The beaks of waterfowl and some other birds are sometimes called “bills.” All birds also have two legs, and the legs or toes of their feet have scales—like a lizard!



ANTHONY

That’s cool. Most birds also have hollow bones, to make them lighter. But I think some birds like penguins and ostriches have solid bones, like we do. But they are not waterfowl.

CARLOS

The hollow bones make birds lighter, so they can fly. Ostriches and penguins don’t fly, so I guess they don’t need hollow bones. Solid bones are probably stronger for life on land.



EMILY

I saw on TV where birds have a gland in their brain that has some magnetic stuff in it. Birds can use it like a compass to help them find their way in the dark or bad **weather!** The show said that humans have the same gland, but not sure yet if we can use it like a compass. That sure would be helpful!



What shape is a waterfowl? Waterfowl have very distinctive shapes. If you were asked to describe the shape of a duck, for instance, could you say it was apple shaped, or pear shaped, or round? The shape of waterfowl is an important characteristic that allows it to live successfully in wetland habitats.

ACTIVITY: Talk with a friend or in a small group about these photos. Which of these photos are pictures of waterfowl? Which are photos of birds that might be a part of a different group? How did you decide?



EXPLORE



1 - Glaucous-winged Gull, 2 - Flamingo, 3 - Horned Grebe, 4 - Canada Geese, 5 - Gadwall, 6 - Sandhill Cranes
7 - Black-crowned Night Heron

Explore & Curious Facts



SELENA

Matthew said that ducks, geese, and swans are all waterfowl. I looked it up online and he's right. They all belong in a family with the scientific name *anatidae* ("uh-NAH-tih-dee"). Other birds might be similar in some ways, but only ducks, geese, and swans are waterfowl.

Unit 1. What is... a Waterfowl?

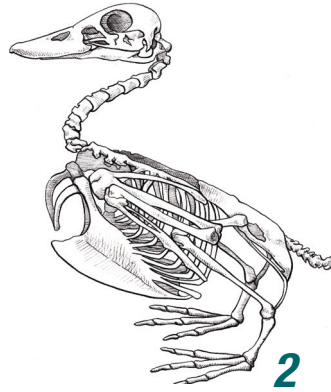
Telling the difference by shape. Glue or tape these three skeleton outlines into your Nature Notebook, and then draw an outline around the skeleton to make the shape of the bird. Your instructor will provide you with a paper that shows the outlines of three waterfowl.



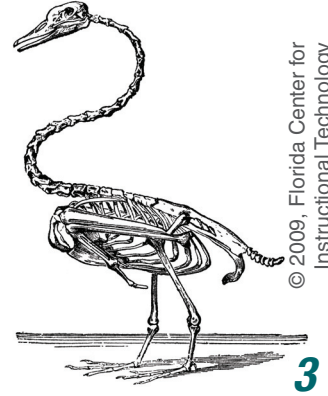
ACTIVITY: Which is the duck? Which is the goose and which is the swan? What do you notice about the skeletons? What are the differences among them? The main difference in the skeletons is the number of neck bones. Which has the most? The least? Make a note in your Nature Notebook.



Laura Maloney, DJ Case & Associates



Laura Maloney, DJ Case & Associates



© 2009, Florida Center for Instructional Technology

Which of these feet belong to a duck, goose, or swan?



ACTIVITY: Look at these illustrations. Which feet are likely to belong to waterfowl? In your Nature Notebook, draw a foot that you think you would see on waterfowl. What makes this foot special? Describe the characteristics you notice.



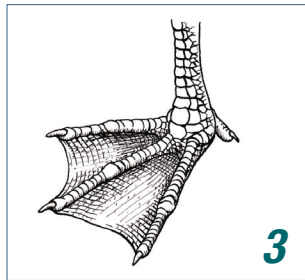
EXPLORE



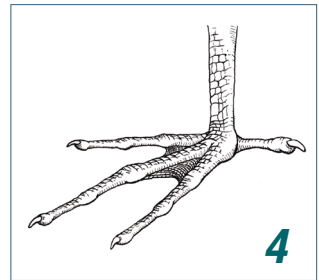
1



2



3



4

Laura Maloney, DJ Case & Associates

Bird songs. Each bird has a distinctive call or song. Find a recording of waterfowl calls that are common in your area by searching online or checking out a CD from the library.

ACTIVITY: Work with a partner. Close your eyes and ask your partner to play 2 or 3 duck or goose calls. Can you tell the difference? Which call is for which bird?



EXPLORE

A duck dinosaur? Research by paleontologist Dr. Julia A. Clarke, an assistant professor in the marine, earth and atmospheric sciences department at North Carolina State University, provides unprecedented fossil proof that some close cousins to living waterfowl species coexisted with dinosaurs more than 65 million years ago. *This was the same time that many dinosaurs still roamed the earth!* The fossils were identified as a new bird species named *Vegavis*, which somehow survived the mass **extinction** that wiped out all the dinosaurs.

ACTIVITY: Why do you think the *Vegavis* bird might have survived when the dinosaurs did not? What physical characteristics may have helped this species survive? What makes a bird a bird, and what makes a waterfowl different than other birds? Investigate the **evidence** yourself by doing a search for “Vegavis fossil” online. When was the fossil discovered? Where was it discovered? What did the fossil look like when it was discovered (find a photo online)? How did scientists know that the fossilized bones that were found were a bird? Where is the fossil evidence now?

Collect as much evidence as you can, keeping notes in your Nature Notebook. Present your results to a friend or a class group, and propose ideas for what helped this ancient species to survive at the time of the dinosaurs.

Doodle space:

Explore & Curious Facts



ANTHONY

There sure are lots of different kinds of birds. Waterfowl are a good example. We have a book about ducks at home, and there are some really wild looking ones!

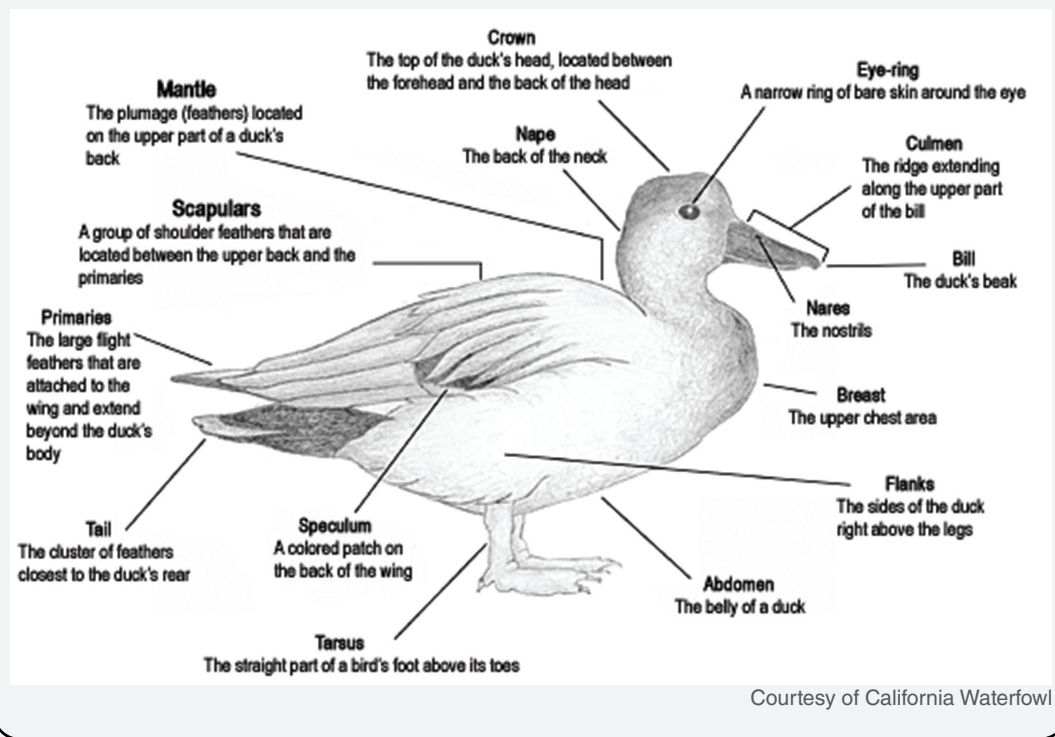
EMILY

Yeah, it's hard to believe those brightly colored ones could survive. Seems like the **predators** would see them and scarf them up.



SELENA

lol. But we've been studying **adaptations** at our school. Every part of any animal alive today has a function that helps the species survive and have babies. I want to learn more about how those crazy colors and other weird traits have helped these critters survive. Check out this drawing that describes different parts of a duck.





INVESTIGATE

We've looked at overall body shape and skeletons of waterfowl. Now we'll focus on some unique features that help ducks, geese, and swans survive: feathers, bills, feet, and color. Waterfowl **appendages** are uniquely **adapted** to life in the water, and help them survive.

Feathers: Not all feathers are the same, because not all feathers have the same structure and function. In this activity, you'll describe the structure of a feather in detail and compare a waterfowl feather to other birds' feathers.



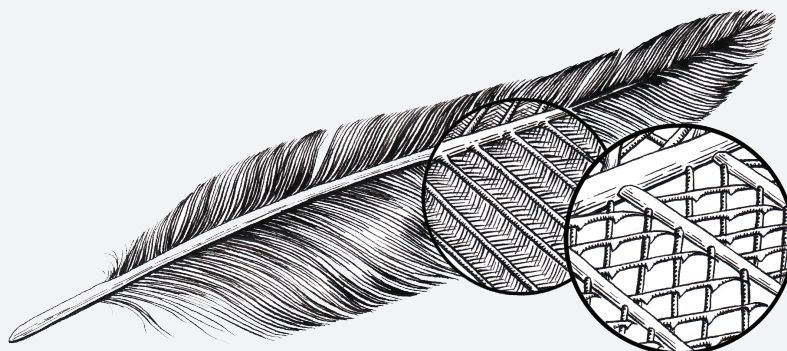
ACTIVITY: Get a feather from a chicken, from an art store, or from an old jacket, quilt or pillow (with your parents' permission). Look at it under a microscope or a hand lens. What do you see? In your Nature Notebook, draw all the details you see in the feather. Try to find different types of feathers from the same bird (for example, a wing feather and a down feather from a chicken). Do they all have the same pattern? Make a note in your Nature Notebook. Do not pick up feathers that you find outside.

Explore & Curious Facts



ASHLEY

Did you guys know that not all feathers are the same? All birds have several different types of feathers—each designed for a specific purpose. The most common are the **flight feathers** found on the wings and tail. These are the longest and strongest feathers, and they have little barbs on them. Check out this drawing.



Laura Maloney, DJ Case & Associates

HANNAH

Yeah, my grandma has a feather bed made of goose down feathers, and I knew those were different from the flight feathers you showed us.





ANTHONY

My book says those down feathers are soft and fluffy to trap air and keep the bird warm. Down feathers are part of a larger group of feathers called **contour feathers**, which are found everywhere except the bill, legs, and feet. Most contour feathers are barbed, but not near the base. The base is downy.

SELENA

I looked up feathers online and found that there is a third category called **filoplume** (“file-uh-PLOOM”) **feathers**. Most feather shafts are attached to muscles for **movement**, but these feathers are attached to nerve endings. Scientists think these feathers send messages to the brain to help the bird arrange its feathers to keep it dry, warm and to help it fly. Here’s a drawing I found on the Web.



Laura Maloney, DJ Case & Associates

Water off a duck’s back? Ducks, geese, and swans live most of their lives in water, yet they are warm blooded and need to maintain a constant body temperature. How do they stay warm and dry in the water — especially when it’s cold? These birds have oil glands or preen glands near the base of their tail. The more scientific name for this gland is the **uropygial** (“your-oh-PIE-je-uhl”) **gland**. They rub their beaks on the gland, and then rub their feathers to spread the oil over their feathers and bodies.



INVESTIGATE



© deeneg, Creative Commons

ACTIVITY: Drop water on a feather that you get from an art store or old pillow — drop by drop. Notice if the water soaks in or beads up on the top of the feather. Describe what you’ve observed in your Nature Notebook. (Remember to leave any feather you find in a natural area, where you found it.)



Investigate & Curious Facts



CARLOS

I understand how feathers keep a duck dry, but come on, in the fall and winter they're sitting in freezing cold water most of the time, or walking around on ice! How do they keep their feet warm? My feet get cold just watching them. 😊

ASHLEY

I've seen them standing on one foot before, like the Mallard in this photo. Maybe they are warming the other foot up next to their body.



© Rhett Maxwell



EMILY

Yep, they do that, and when they are floating they can pull both feet up close to their bodies for warmth. The feathers are great insulators.



INVESTIGATE

The Right Bill for the Job.



ACTIVITY: Look at all these different types of bills! Try to match the bill to the type of food each species might eat. What were your reasons for making each match? Write your conclusions in your Nature Notebook.



INVESTIGATE

Which bill eats which food?

BIRD BILL

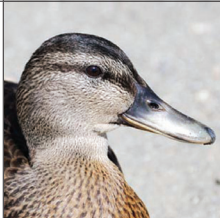
a. Northern Shoveler's "spoonbill"

USFWS photo by Dr. Thomas G. Barnes



b. Mallard

USFWS photo by Ronald Laubenstein



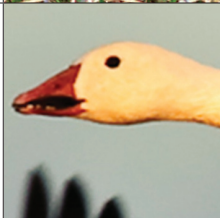
c. Common Eider

USFWS photo by Tim Bowman



d. Snow Goose

© Howard Ignatius



FOOD POSSIBILITIES

1. Small clams, shrimp, sea urchins, insects

2. Stems and roots of short grasses, rice, and wheat

3. Aquatic plants, seeds, insects, small swimming **invertebrates**

4. Aquatic plants, seeds, insects

The Winner by a Foot: All ducks, geese, and swans have webbed feet, but some are more webbed than others. Those that spend the most time in the water have more webbing than those that spend some time on land.



ACTIVITY: Look at these feet and decide which species spend more time on land and which spend more time in the water. How did you decide? Jot down your ideas in your Nature Notebook. You'll find clues on page 47.



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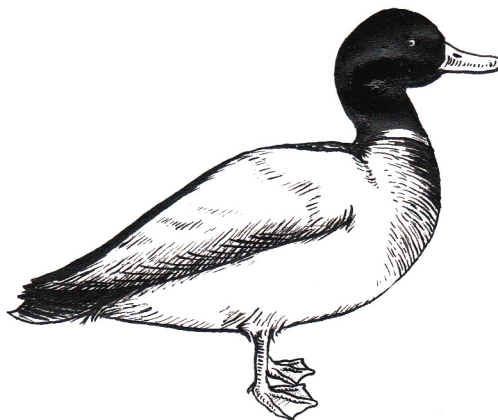
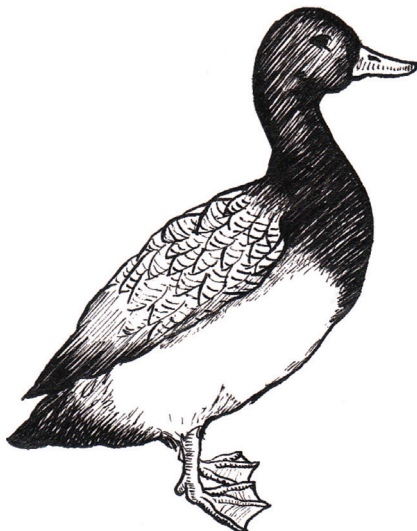


© Rob Pearce

ACTIVITY: Which of these two ducks would be better at swimming? Which one would be better at walking on land? Write your **opinion** in your Nature Notebook. How did you decide?



INVESTIGATE



Laura Maloney, DJ Case & Associates

True Colors. Waterfowl have some of the brightest and most interesting colors and patterns in the animal world. Why are some ducks so colorful when other ducks just fade into the background?



ACTIVITY: Visit a wetland habitat in your community, or find a photograph or painting of a wetland like a pond or marsh. Look at the colors, textures, and general atmosphere of the habitat.

- What words come to mind?
- What does the bird need to do in that habitat? Does it need to sit on a nest, attract a mate, or hide from predators?
- In your Nature Notebook, draw a duck, goose, or swan (or tape or glue a photo or drawing), then shade in the colors of the habitat for that bird around the drawing. (Hint: find an online or library resource to help you make sure you match the habitat with the bird correctly.)
- Try to answer this question: Why are some ducks so colorful when other ducks just fade into the background? (You can learn more about how to answer this question in Unit 3.)

ACTIVITY: Most waterfowl undergo a seasonal change in color. Look at these photos of a male (**drake**) Wood Duck. Which duck is in its summer **plumage**; which in its winter plumage? How could the plumage help the Wood Duck to survive?



USFWS photo by George Gentry



© Rick Leche

Investigate & Curious Facts



HANNAH

My Mom was reading *The Ugly Duckling* to my little sister last night. Remember that story? A baby swan was raised by ducks. At first, the little swan didn't fit in, because he didn't look like the other ducklings. But then he transformed into a beautiful swan. I wonder if that is true for all waterfowl.

JASMINE

I LOVE that story! And yes, it's true that all waterfowl begin life looking very different than they look as adults. Ducklings, **goslings**, and **cygnets** all hatch out looking drab brown and "fuzzy." I guess they're brown so they're harder for predators to see.



Cygnet

USFWS photo by Steve Hillebrand



Adult swan

USFWS photo by John & Karen Hollingsworth



CARLOS

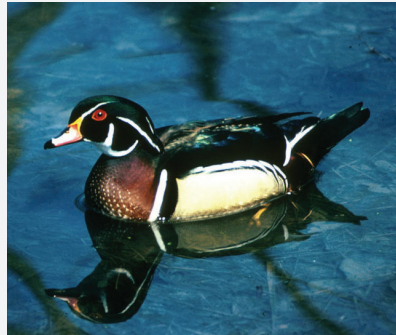
Yeah, they can't fly, so they have to blend in with the background. But the drab brown is slowly replaced with adult colors. For most species, this all happens before they are one year old.

MICHAEL

And remember that most waterfowl replace their feathers or "molt" every year, so they don't always look the same from month to month. Check out these photos of an adult Wood Duck in two different seasons.



Wood Duck drake winter plumage
© Phil Johnson



Wood Duck drake summer plumage
USFWS photo by Edward Wagner



More Exploring and Investigating! Looking for more things to explore and investigate on your own? Check with your teacher for places where you can find more information and activities, or to get involved. Here are some ideas for how to find related resources online.

INVESTIGATE

ACTIVITY: On the Internet, search for:

- Flyways
- Duck identification resources
- Duck identification for photos and information on every species of waterfowl
- *Ducks-at-a-distance*. This booklet is useful for anyone who needs to identify ducks at a distance at all times of year and in all stages of their lives. It is especially useful for hunters, who need to correctly identify waterfowl on the wing
- The Cornell Lab of Ornithology website to find any species, photos, sound recordings, and for many species, videos.
- California Waterfowl Association
- All about Birds organization
- Delta Waterfowl organization
- Project Greenwing
- The Ducks Unlimited organization for general information about ducks and **conservation** efforts

Record some of your findings. Bookmark some of the sites you found that you would like to go to again. What surprised you? What was the coolest site you found?

Doodle space:

Investigate Your Question. Coming up with a good question is the most important part of science. How can you come up with a good question? The best science questions are ones you can answer by comparing, measuring, observing and recording observations, experimenting, etc. But it is very difficult to answer *why* questions. All questions are good questions, but if you decide to take the next step and investigate your question, you will need to think how to compare one characteristic with another (such as comparing the feeding habits of birds that have long bills with the feeding habits of birds that have short bills).



INVESTIGATE



ACTIVITY: Practice thinking of questions. What questions did you have while studying Unit 1? Read the “Types of questions” column in this table. Think of at least one descriptive question, one comparative question, and one **correlative question** and write it in your Nature Notebook. Here are some examples of good science questions for Unit 1:

- How are the feet of water birds different from other birds?
- How does the webbing of duck feet help ducks to swim?

TYPES OF QUESTIONS	YOUR QUESTION
Descriptive question: How many? How frequently? When did... happen?	
Comparative questions (comparing two situations): Is there a difference between Groups? Conditions? Times? Locations?	
Correlative questions (considering how two things are related or connected): Is there a relationship between <i>[shape of a bird bill and the kind of food the bird eats]</i> ?	

Telling the difference. Now that you know all about different physical adaptations of waterfowl, you can start to develop the skills to identify different species of waterfowl.



ACTIVITY: Go to a wetland or city park and observe waterfowl. Look at each bird's size, bill, legs, feathers (plumage), habitat, and what the bird is doing. Memorize the following six tips to help you to identify birds. With practice, these tips will come to mind automatically when you look at a new bird and will help you to remember its important features. If possible, write what you have seen in your Nature Notebook at the time of sighting. Often the details of a bird's structure, plumage, or **behavior** are soon forgotten, and the observer may spend much time trying to recall them. If these six points are remembered or noted at the time of the observation, an analysis can be made later.



INVESTIGATE

Six Simple Tips for Quick Bird Identification

1. What is the bird's relative size? Compare the bird with other birds that are well known to you. Is it larger or smaller than a SPARROW? If larger, is it larger or smaller than a PIGEON? If larger, is it larger or smaller than a HAWK?
2. What is the shape and color of the bird's bill? The shape of its bill is a guide to what it eats, classifying the type of bird it is. Is the bill short and round like that of a songbird, or powerful and hooked like that of a hawk? What color is it? Many birds have blackish bills, but some are brightly colored.
3. What length and color are the bird's legs? Does the bird have unusually long wading legs, short perching legs, etc.? Are its legs a distinctive color?
4. What plumage colors or markings do you notice? Bold markings, colors, or bars on the bird's wings, tail, breast, or above the eyes should be noted. Also note that in some bird species the males are brightly colored and the females tend to be camouflaged.
5. In what habitat do you see the bird? The habitat in which the bird is seen is another important clue to the kind of bird it is. Is it in a garden, in water, in grassland, in the forest, etc.?
6. What is the bird doing? Is it walking, hopping, wading, or swimming? Does it peck at the ground, probe in mud, or feed in a tree? Try to detail its behavior as closely as possible.

Investigate & Curious Facts



EMILY

I read an article that said that **diving ducks** rarely go onto land because they don't have very good balance. I wonder why?

MICHAEL

Diving ducks have feet mounted way far back on the body, which is great for swimming and diving. But it's not good at all for walking on the land. I saw a nature show where some diving ducks actually had the front of their bodies sitting on the ground, and were pushing themselves around like bobsleds. They never strayed far from the water's edge.



JACOB

Yep, they're awkward on land, but they sure can swim! I heard that a group of long-tailed ducks were caught in a fishing net in Lake Ontario at a depth of 240 feet! That's almost the length of three basketball courts! Here is a photo I found of a duck swimming underwater.



© Jans Canon

EXPRESS

Now you'll have an opportunity to use your skills as an artist, writer, or investigator to create something interesting about what you've learned so far.

Simple Shapes. Earlier in this unit, you drew outlines of a duck, goose, or swan based on their skeletons in your Nature Notebook. Now look at photographs of ducks, geese, and swans to make your outline more accurate. Don't draw in details at this point, just practice drawing outlines of the basic shape of the birds.

ACTIVITY: You can start by drawing an oval for the body, another oval for the neck and a circle for the head. From there draw contour lines to make the shape of a duck, goose, and swan. Make sure the proportions are the same as in the photographs. The oval shape of the body should be about four "head" sizes in length. Make sure the neck is the appropriate length (shortest for a duck, longest for a swan).

Step one



Step two



Step three



Northern Pintail
illustration by California Waterfowl

Step one



Step two



Step three



Canada Goose
illustration by California Waterfowl

Step one



Step two



Step three



Swan
illustration by California Waterfowl



EXPRESS

Shape Sculpture. Look at these photos. Now that you can draw the basic shape of a duck, goose, and swan, make a three-dimensional sculpture with clay or paper mache. Don't worry about legs and feet, just sculpt the basic body, neck, and head, and work on getting the proportions right. Take a photo of your sculpture, print it out, and add it to your Nature Notebook.



© Tim Cherry (Branson, MO)



© Dagny Scott



© grahamc99
Creative Commons

What's in a Name? Many ducks have very interesting names. Some describe physical characteristics of the bird.

ACTIVITY: Use your imagination and draw in your Nature Notebook what you think these species might look like. Then look at photos on one of the websites suggested in the *Investigate* section to see how close you were.

- Blue-winged Teal
- Green-winged Teal
- Canvasback
- Redhead Duck
- Northern Shoveler



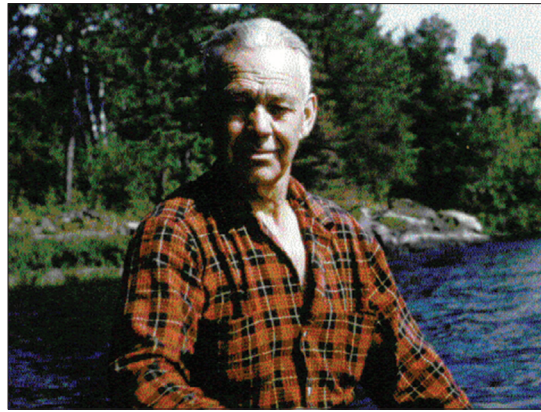
EXPRESS



Scientists or Artists or Writers? Many people we now remember as great artists or writers were also keenly interested in science and studied the subjects of their artwork in scientific detail.



ACTIVITY: Sigurd Olson was a writer who studied and wrote about nature. He lived in northern Minnesota. Read the passages written by Sigurd Olson. In your Nature Notebook, make a list of the words for each passage Olson uses to describe the physical characteristics of the waterfowl he observes.



Sigurd Olson
Courtesy of the Olson family

*There is a certain duck marsh close by where I have spent many hours during the past ten years. I have stood in my **blind** in the darkness watching the stars fade and the sun rise. I have stood there during many sunsets. Hours on end I have stood there and studied the opposite shoreline until I can truthfully say there is not a stub, nor a bush nor a single irregularity in the skyline that I do not recognize and know. I know also just what parts of that shoreline have exploded ducks. Over one clump of old dead **tamaracks** the mallards always come, and over another the bluebills. And when they come in, from long experience I know what they will do, and they proceed to do it with as much regularity as though they had rehearsed the act many times. I know just what little openings in the rice they are going to drop into and why. I have hunted in many other places where I have gotten many more ducks, but the fact that I know this lake, the fact that the old campsite has many pleasant associations tied up with it, makes a trip there doubly enjoyable.*

— “Familiarity,” December 1, 1933

(Unpublished manuscript, permission granted by David Backes on behalf of the Olson family)

This fall I was on the Island River. It was late October and the tamaracks were as golden as they would ever be. Before me was a stand of wild rice, yellow against the water, and because it was a bluebird day there was not a wing in the sky. I stood there just looking at the horizon. Suddenly the sun went under a cloud and it began to snow, softly at first, and then as the wind rose the serrated ranks of tamaracks across the bay almost disappeared in swirling flakes. A flock of northern bluebills tore out of the sky with that canvas-ripping sound that only bluebills make when they have been riding the tail of the wind and decide to come in. In a split second, an instant in which I was too startled even to move, there were a hundred wings where before there had been nothing but space. Then they were gone and in the same instant the sun came out.

— The Singing Wilderness (New York: Alfred A. Knopf, 1956), page 174

In the fall when the rice harvest is on, I think of canoes going through golden fields of it against the blue of the water, the flash of ducks above and the whisper of their wings, the redolent haze from parching fires over some encampment.

— Runes of the North (New York: Alfred A. Knopf, 1963), page 119

It had been a wild, blustery day with snow swirling constantly. Toward evening the sun broke through the gray clouds and, when it washed the rice beds, the fury was forgotten—the wet and frozen hands, the shivering in the teeth of the wind—and for a moment there was a sense of warmth and quiet in which I was no longer conscious of the storm. Silhouetted against the lowering sky that evening were flights of ducks and in the shaft of light they became drifting skeins, silver as they turned, gold as they flew into the west.

— Runes of the North (New York: Alfred A. Knopf, 1963), page 125



Mallard Duck
John James Audubon



ACTIVITY: John James Audubon was one of the first artists to focus on birds. At the time that Audubon lived, it was not illegal to kill any wildlife species. Scientists were just starting to discover many species. The most common way for them to study new species was to kill them, preserve them, and study the preserved specimens over time. Audubon worked from looking at stuffed and **mounted specimens**.

- Go to a library or look online to find copies of Audubon's art to look at. Do you like Audubon's paintings?
- In your Nature Notebook, write what you like best about Audubon's paintings. What don't you like about them?
- Note the species of waterfowl that Audubon painted and pick two of your favorite species. Then check current books or the Internet for photos of those two species. Critique Audubon's work. Do you think he portrayed the physical characteristics (shape, color, appendages) in a life-like way or the way you might have portrayed them? Does waterfowl art have to be realistic to be considered good art?



Benjamin Bunny by Beatrix Potter

ACTIVITY: Beatrix Potter wrote and illustrated many famous children’s books, including *Peter Rabbit*. When Beatrix was a child, she and her brother would study animals they found on their farm in England’s Lake District.

- Look at a story written by Beatrix Potter. Do the animal illustrations look life-like or imaginary?
- When you draw or paint, do you prefer to make birds look life-like or do you prefer another shape, such as a design or cartoon? Draw an example of your preferred style for representing animals in your Nature Notebook.



EXPRESS

Artist’s techniques and you: Practice makes perfect. Artists need to practice drawing things over and over again. Particularly in the early years of natural history study, artists had to draw individual parts of plants and animals very precisely to make sure to distinguish one species from another.



ACTIVITY: In your Nature Notebook, practice drawing individual body parts of waterfowl, as in natural history illustrations — bills, feet, feathers. Try to make your drawings very detailed and life-like.

Draw some sample sketches here.

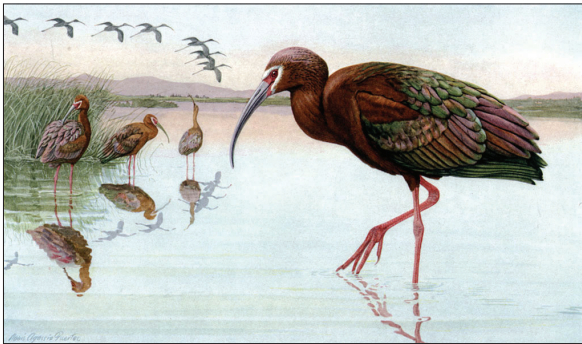
Waterfowl in the arts: Famous names in the world of paintings and drawings of birds and waterfowl include Louis Agassiz Fuertes, John James Audubon, John Gould, and Alexander Wilson. Recent artists include Charley Harper, Tony Angell, and Sherrie Russell Meline.



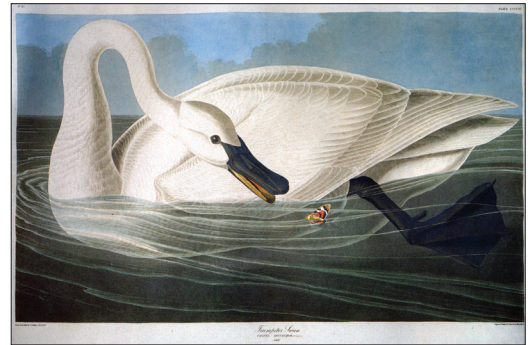
ACTIVITY: Go to the library or search online and find examples of the work of some of these artists. Notice specific characteristics of each waterfowl species depicted in the artwork. Describe what habitat, if any, the artist or writer described in the work. This time, use words to make your description of the habitat as life-like as possible. For instance, instead of describing something just as “green,” you might describe it as “the green of a new leaf in spring.” Make a note about what you learned in your Nature Notebook.



EXPRESS



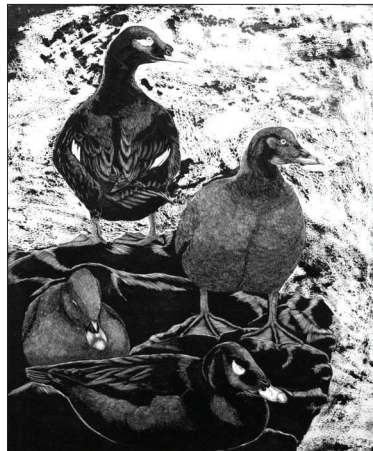
White-faced Ibis, *Plegadis chihi*, 1918
© Louis Agassiz Fuertes



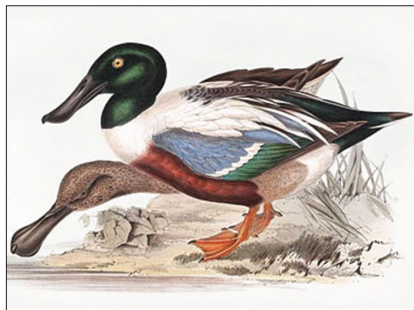
Trumpeter swan, *Cygnus buccinator*, 1838
© John James Audubon



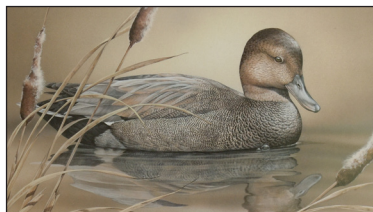
From American Ornithology Vol. 8
Alexander Wilson



White winged Scoters, 1982
© Tony Angell



Ducks and Waterfowl
© John Gould



Golden Moment - Gadwall
© Sherrie Russell Meline



Octoberama
© Estate of Charley Harper

SHARE

What did you learn about waterfowl in Unit 1 that you'd like to share with others? Something fun? Something mysterious? Something surprising? Think of something to share, who you would like to share it with, and how you want to share it. Here are just two suggestions that might spark your interest.

Biomimicry: Ducks are well adapted to living in water and to flight. Think of human technologies that “mimic” waterfowl adaptations: What do people wear on their feet to help them swim faster? What do we wear when it rains? How are airplanes designed so they can fly?



ACTIVITY: In your Nature Notebook, draw a cartoon that shows a human or human invention with a duck characteristic (an airplane with real duck wings) or a duck “wearing” a human invention (raincoat, etc.). Or use image editing software, like Photoshop, to create your invention. Explain your drawing or image to a friend or small group of classmates. Write a script for a skit or short play about the daily activities of the duck, goose, or swan. Perform the play in costume!

NOTE: Image editing software is not allowed in the production of artwork to be submitted to the Junior Duck Stamp art contest.

Dressed for work! Work in a group to put on a presentation for your classmates, families, or younger students in your school.



ACTIVITY: Have the group choose a subject: a duck, goose, or swan.

- Collect things that could be used to dress someone up like the bird you chose (such as swim fins, boa to represent feathers, etc.). These materials should mimic parts of the bird. Be creative. You might paint a swim cap the colors of your bird's head.
- When you gather your audience, ask one person in the audience to be your model. Ask the person to pull things out of the bag, one piece at a time, and put them on. Explain to the audience how each particular feature helps this particular waterfowl to function successfully in the wild. After your model has put on all the costume pieces, take a picture and put it in your Nature Notebook.



Labrador Duck
John James Audubon (1785–1851)

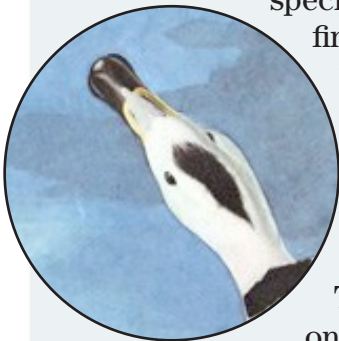
THE MYSTERY OF THE LABRADOR DUCK

Evidence about body shape and appearance

*In your Nature Notebook, keep a set of detective notes about the Labrador Duck. Can you find any clues about why the duck became **extinct** in this description about the shape of the duck's body?*

John James Audubon painted this Labrador Duck drake and **hen** while looking at a mounted specimen. A mounted specimen is an animal that has been killed, skinned, and stuffed for display. Audubon also saw Labrador Ducks in the wild, so we can assume this is accurate.

The Labrador Duck was a sea duck, similar to today's Eider Ducks and Scoters. One of the nicknames of this duck was "Skunk Duck" — (why do you think it had that name?) The Labrador Duck had an interesting bill. Notice the flaps near the end of the bill. This gives us clues about what it ate. Steller's Eider and the Blue Duck, which are similar species alive today, have the same type of bill flaps. They use them to find small shellfish in the sand in shallow water. This is a good clue that Labrador Ducks probably looked for food in shallow sandbars near the shore. This special bill indicates that Labrador Ducks had a very specialized diet and probably ate only shellfish and possibly some **aquatic** plants. Anything that would disrupt the shellfish population could endanger the duck's survival. Like other diving ducks, the legs of the Labrador Duck were farther back on its body. They were good swimmers and divers, but probably pretty awkward on land.



PENCIL-TO-PAPER WRAP-UP

Revisit your *geo*-bird. Is there anything you'd change now that you know a bit more about waterfowl? What would you change and why? Note your answers in your Nature Notebook and/or make changes to your *geo*-bird sketch.

Waterfowl Challenge Question

Q: Which of the following groups of birds are waterfowl?
herons, ducks, loons, snipe, geese, swans, gulls

A: Ducks, geese, and swans all belong to the waterfowl group. (See the *Introduction* for a list of all the birds that fit the definition of waterfowl.)

Challenge Extra – The Duck Test

“If it looks like a duck, swims like a duck, and quacks like a duck, *then it probably is a duck*” is a common phrase that refers to duck identity in a humorous way.

The *duck test* is a humorous term for a form of **reasoning**. The test implies that a person can identify an unknown subject by observing that subject’s behaviors. It is sometimes used to argue against a claim that something is not what it appears to be. For instance: Sarah told the teacher she didn’t eat Charlie’s Reese’s Pieces®, but her breath really smelled like peanut butter and chocolate. The teacher said, “Well, Sarah, that just doesn’t pass the duck test.”

What did you learn?

- What do we mean by the term “waterfowl”?
- How are waterfowl alike and different from other birds?
- What special characteristics help waterfowl to survive?
- What did the earliest known ducks look like?

Doodle space:

UNIT 2

A Day in the Life – Preening, Dabbling, and other Unusual Behaviors



Mallard preening
© Robert B. Schmunk

Waterfowl Challenge Question

Q: How did ducks help humans discover gold?
Look for the answer at the end of this unit.



Michael

Links

Info

Photos

Notes

MICHAEL

If you were a duck, what would you do all day long?



Northern Shovelers.
USFWS photo by Steve Hillebrand

MATTHEW

And how would you know what the other ducks were thinking? I mean, if I decide to go to the movies, I can text my friends and let them know. I wonder how **waterfowl** tell each other that it's time to feed, or roost, or migrate?



JASMINE

And however they do it, is it the same for all ducks? What about geese and swans?



Snow Geese
USFWS photo by Gary R. Zahm



In Unit 2...

What will you learn?

- What waterfowl do in their daily lives
- How you observe bird **behavior**
- What waterfowl behaviors are typical for some species

What will you do?

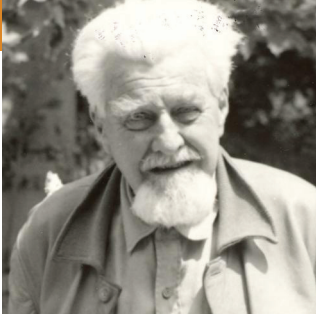
- Record and analyze waterfowl behaviors
- Make a duck decoy, use a duck call, and build a duck **blind**
- Read and talk about Native American stories about ducks
- Incorporate waterfowl behavior into your art or stories

What will you need?

- Pencil or pen
- Nature Notebook
- Clock or watch with a second hand, or a stopwatch
- Camera
- Printer to print your photos
- Tag board for making a collage
- Roll of shelf paper or craft paper
- Materials needed to build an outdoor duck blind or indoor model
- Colored markers, water colors, or water-soluble paints
- 3" x 5" index cards
- A natural area to visit (You may need to get permission from a parent and transportation)
- A library to visit
- Access to a computer with an Internet connection
- A **conservation professional** to help with duck blinds and duck calls

Featured Artist

Konrad Lorenz



© Eurobas, Creative Commons

Links	Info	Photos	Notes
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Meet Konrad Lorenz

Konrad Lorenz was a doctor who became well known for his studies of animal behavior in the 1930s. Dr. Lorenz wondered about how young birds learned. Here is how Lorenz did his research: he appeared before newly hatched ducklings and imitated a mother duck's quacking sounds. He discovered that soon after hatching, young ducklings and **goslings** learn to follow their parents. If someone took the place of the parents, the young birds would follow a "foster parent", which could be another type of animal or even a human! He called this behavior "**imprinting**." The sight and sound of the parent (or foster parent) was imprinted in the young bird's brain. How do you think this helps young birds survive?

Note: In 1973, Konrad Lorenz won a Nobel Prize, along with Karl Von Frisch and Niko Tinbergen, for their discoveries of behavior patterns. In his acceptance, Dr. Lorenz said, "*Nils Holgersson* (a popular child's book) was read to me—I could not yet read at that time. From then on, I yearned to become a wild goose and, on realizing that this was impossible, I desperately wanted to have one and, when this also proved impossible, I settled for having domestic ducks. In the process of getting some, I discovered imprinting and was imprinted myself. From a neighbor, I got a one-day-old duckling and found, to my intense joy, that it transferred its following response to my person. At the same time my interest became irreversibly fixated on water fowl, and I became an expert on their behavior even as a child."

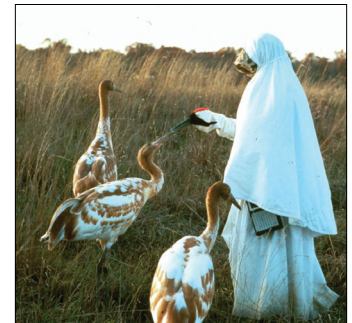


Illustration from *Nils Holgersson* by John Bauer

Dr. Lorenz's work has been an inspiration to scientists and they continue to study and work to understand waterfowl behavior.

Scientific Thinking Is an Evolving Process!

Scientific research is an ever-changing process. Scientists learn from and build on each other's research over time. Since Dr. Lorenz discovered that birds can **imprint** on non-bird species, wildlife scientists have changed their thinking about this process. They now recognize that it is not healthy for wild animals to imprint on humans. It becomes very difficult for the animals to return to the wild and thrive because they don't have a natural fear of humans. Instead, scientists who work with wildlife now try to disguise themselves as the animal they're working with. In this picture, you see a person, dressed like a crane, feeding a crane chick. This is so the chicks don't imprint on the person feeding them. This is a perfect example of scientists building on knowledge from the past to preserve wildlife for the future.



© International Crane Foundation, Baraboo, Wisconsin

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Explore & Curious Facts



HANNAH

Did you guys see that show on TV last night that showed geese following an ultralight airplane?

CARLOS

I did. That was awesome! Scientists figured out that birds learn how and where to migrate from their parents, so if they are orphans or raised in captivity, they may not migrate.



JACOB

That doesn't sound good. Those birds need to migrate to survive, right?

HANNAH

Yeah, a lot of them do, so this group called Operation Migration has figured out that geese and other birds will imprint on a human dressed up in a goose suit, and they will follow an ultralight airplane along a normal migration pathway! Then, after they make the trip and become adults, they get together with other wild geese and remember the way they migrated.



CARLOS

And now they are using this method to help endangered birds like the Whooping Crane learn how to migrate.

JACOB

That's cool. I know that a lot of endangered birds are raised in zoos, so teaching them to migrate like wild birds would be really important.



CARLOS

The show said this method developed by Operation Migration may be the only hope for re-establishing migrating flocks of several endangered species.





PENCIL-TO-PAPER WARM-UP

In Unit 2, you will focus on what waterfowl do. In a small group, brainstorm all the words you can think of to describe what waterfowl do (their behavior). Record all the words in your Nature Notebook. Next, think about where waterfowl do these things (their habitat), and describe that place next to each action word.

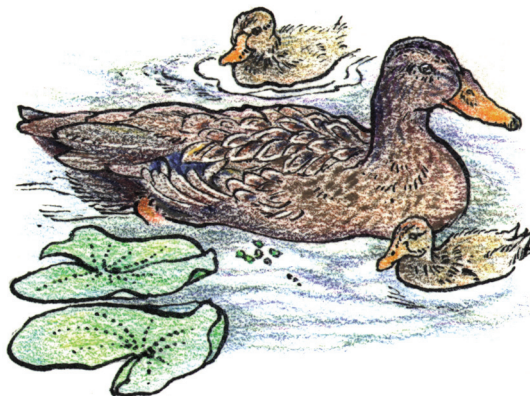
For example: a swan

What they do (behavior)	Where (habitat)	Habitat description
Swim	Pond	City park, pond, etc.
Lead baby swans	Near pond edge	Cattails, wild rice, concrete, etc.
Your idea ...		
Your idea ...		



Pick a behavior and habitat from the list (for example: swim/pond), and in your Nature Notebook, sketch a new *geo*-bird illustrating the behavior and habitat you've chosen.

Remember, the *geo*-bird is a simple drawing; only use lines and **geometric** shapes. After you've completed your drawing, describe to a classmate how your *geo*-bird's shape changed from the one you completed in Unit 1.



Water Resources Clip Art, University of Wisconsin-Extension Environmental Resources Center, 1999

GETTING STARTED

Waterfowl are probably the most studied animals in the world. There are many reasons for this. Some amazing behaviors may be one reason. In Unit 1 you learned about many of the amazing physical **adaptations** that help waterfowl survive. In this unit, you'll learn about some even more amazing behaviors!

Begin with the *Explore* section and read through the choices of activities. Choose at least one activity, and carefully follow all of the directions. When you are satisfied that you have a good start on understanding the main ideas for Unit 2, move on to the other sections: *Investigate*, *Express*, *Share*. Plan to do at least one activity in each of the sections. Don't forget the Pencil-to-Paper Wrap-Up at the end of the unit!



EXPLORE

Right out of the egg—Precocial Youngsters! Precocious (pre-ko-shus) is a term we use for children who are advanced for their age. So what do you think a **precocial** (pre-ko-shul) bird might be? It means a bird that is capable of moving around on its own soon after hatching. All ducks, geese, and swans are precocial—they can walk around within hours of hatching. The opposite of precocial is **altricial** (“al-trih-shul”)—not able to move around on its own, needing intense care and feeding by parents. Waterfowl parents lead their young to find food, but don't have to feed them.



Precocial chick © Corey Butler



Altricial chick © Matt Gravity

ACTIVITY: Can you think of an example of an animal that totally depends on its parents at birth (an altricial animal)? (Hint: when were you able to move around and find your own food?)



ACTIVITY: Suggest three benefits that precocial young (more independent at birth) may have in comparison to altricial young. (Hint: how do the **characteristics** of precocial young help the young to survive?) Keep track of your ideas in your Nature Notebook.



Konrad Lorenz and his imprinted goslings
© AJC1, Creative Commons

Parenting tricks? The number of eggs laid by different species of waterfowl may vary. For instance, on average, Mallards commonly lay 7–10 eggs, Canada Geese lay 5–6 eggs, and Trumpeter Swans lay 3–8 eggs. If all the eggs hatch successfully, there are a number of youngsters that need food, shelter, and protection from **predators**. How do waterfowl parents keep their young family together?

ACTIVITY: Look at the photo of Konrad Lorenz. Why do you think the goslings are following him? What is the word that describes the goslings' behavior? (Hint: check the description of Dr. Lorenz's work in the *Meet Konrad Lorenz* section on page 62 and the information in *Curious Facts* on page 63.) Write your ideas in your Nature Notebook. Dr. Lorenz studied human behavior also. He believed that humans could learn a great deal about their own behavior by studying animal behavior. What do you think?



Doodle space:

EXPLORE

INVESTIGATE

Identifying birds by their behavior: It can take years of practice to identify birds, but there are some tricks to make it easier, and one of those tricks is watching for behaviors:

- **Posture:** How do they hold themselves when sitting or standing or swimming?
- **Movement:** How are they moving? Swimming? Diving? Flapping wings? Quickly? Slowly?
- **Flight pattern:** Are they flying by themselves or in a group? Approximately how many in the group? Is the group organized in a line or shape?



ACTIVITY: Study these illustrations with a partner. Describe the behaviors you see in each picture. Be very specific in your descriptions: Are they just standing on the shoreline or are they standing but seem very alert? Are they **preening** while standing? Make a drawing of one example of a typical **posture**, a typical **movement**, and a typical flight pattern in your Nature Notebook, to help you remember.



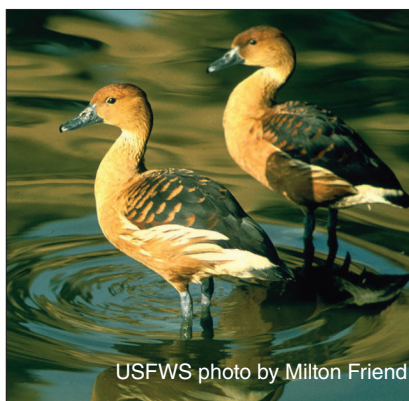
USFWS photo by Peter Mickelson



USFWS photo by Dave Menke



USFWS photo
by Donna Dewhurst



USFWS photo by Milton Friend



USFWS photo by Tim Bowman

Investigate & Curious Facts



CARLOS

One thing you guys can look for when you're studying duck **behavior** is watching how they feed. Some of them, like Scaup and Redheads, dive underwater to find shellfish and other food items. This group of ducks is called *divers*. They are usually found in deeper water.

ASHLEY

The other group is called *dabblers* or *puddle ducks*. These ducks, like Mallards and Northern Pintails, tip-up when they feed. You'll see their little duck butts sticking straight up, with the head and the rest of the body under water. They only feed in water shallow enough for them to reach the bottom or whatever they're eating.



SELENA

We've got Common Eiders near the shore by our house in Maine. They are divers. It's cool to watch them, because they dive headfirst into the water, and right before they hit the surface, they open their wings. My teacher says this is because they use their wings like paddles when they dive, and having them open as they hit the water allows them to get a strong first stroke to help them catch prey. They also use their wings and feet to steer underwater.

MATTHEW

Canvasbacks are divers, too, but they don't open their wings when they dive. My Dad says they mostly use their feet for propulsion, so they keep their wings tight to their bodies while underwater to make themselves more streamlined.



ANTHONY

My waterfowl book says another thing you can look for is how many waterfowl are together in a group. Some types are very social, and like being together in large flocks. Snow Geese, for instance, gather by the hundreds, thousands, and even millions. Others, like Harlequin Ducks, will only tolerate small groups. You can learn a lot about waterfowl by noticing their tendencies to flock.



Observing behavior of birds: To learn about bird behavior—and to learn about and enjoy birds—you need to watch them for a long time, as long as the bird will let you. Identifying what a bird looks like is certainly interesting to many people. But noticing what they do, what they eat, and how they interact with other birds can be really fascinating—and help you understand how they think!



ACTIVITY: With your parents, a friend, or class, observe waterfowl in the wild, at a **national wildlife refuge** or other natural area, city park, zoo, or wildlife rehabilitation center. What kinds of things do the birds do? In your Nature Notebook, describe at least three different kinds of behaviors that you observe. Give each a name, such as: eating, resting, or grooming.



INVESTIGATE

ACTIVITY: Make a chart in your Nature Notebook like the one on page 70. Choose a partner from your group. With your partner, decide who will be the timekeeper and who will be the recorder for this activity.

- The Timekeeper will keep track of the time using a stopwatch or watch with a second hand. The Timekeeper will announce *one minute* at the beginning of the new minute.
- The Recorder will use the checklist to note what types of behaviors the bird is performing. Put a check in the box for each behavior, each minute. If you can, make a new observation each minute.
- With your partner, watch *one bird* for 10 minutes.
- Now look at your data. What did the bird spend most of its time doing? Do you have more than one checkmark on any of the behaviors? Calculate what *percentage* of the 10 minutes was taken up by any specific behavior ($\% = \frac{\text{number of minutes spent on a behavior}}{\text{total minutes}} \times 100$). For example, if you saw a bird feeding for 6 minutes, the percentage of time feeding would equal $6/10 \times 100 = 60\%$.
- Use this information to create a picture of the behavior of your bird. Compare your 10-minute observation of your bird with observations by your friend or classmate. Did one bird spend more time resting than another? More time feeding than another? You could compare your bird with a different kind of bird, or the same bird under other circumstances.



INVESTIGATE

Observation checklist for behaviors										
Minute	1	2	3	4	5	6	7	8	9	
Aggression (fighting, chasing)										
Courtship (swimming together, displaying)										
Dabbling ("tipping up")										
Diving										
Drinking										
Feeding (on what?)										
Mating										
Preening										
Resting										
Swimming										
Walking										

Animal Behavior Research: After watching the bird, did you think of any questions about the behaviors you observed?



INVESTIGATE



ACTIVITY: Use the table below to brainstorm and refine your questions. Use your questions to help you conduct further observations.

Here are some ideas: Do the same kinds of birds behave differently in different habitats, different **weather** conditions, and different times of day? All of these differences are called **variables**. Analyzing differences among variables is one of the basic aspects of all scientific research.


Other possible variables: Compare behavior in different individuals—do all the ducks seem to have the same behaviors? Compare behaviors among different species of ducks or geese or from different species of birds. Keep track of all your observations in your Nature Notebook.

Type of question	Your questions
<p>Descriptive question: How many? How frequently? When did... happen?</p>	
<p>Comparative questions (comparing two situations): Is there a difference between Groups? Conditions? Times? Locations?</p>	
<p>Correlative questions: (considering how two things are related or connected): Is there a relationship between the weather conditions and the amount of time that the bird feeds?</p>	

Investigate your question. Coming up with a good question is the most important part of science. It is very difficult to answer “why” questions. The best science questions are ones that you can answer by comparing, measuring, observing and recording observations, and experimenting. Here are some examples of good science questions for Unit 2 that you could develop a way to answer:

- How does the behavior of waterfowl make it easy or hard for predators to catch them?
- Does the color of the bird’s feathers make it easier or harder to see the duck, goose, or swan in its natural habitat?

Scientific process



ACTIVITY: Choose one of your questions about waterfowl behavior. Use a chart like the one on page 73 to organize your investigation in your Nature Notebook. The chart describes a sample question and investigation project.

ACTIVITY: Propose a **hypothesis** that explains a possible answer to the question. This is the first step in developing an investigation.

ACTIVITY: Propose a way to test your hypothesis. Get help for testing your hypothesis. Ask your teacher or leader to help you find a natural resource professional, teacher, leader, or more experienced student who can help you think through each of the steps. Use the chart below as a guide to help you plan your investigation. Provide ideas specific to **your** question.

➔ **Sample question:**

Do ducks spend more time feeding at temperatures above 40°F or at temperatures below 40°F?

To test your hypothesis, answer questions like the ones in the sample on page 73.

Doodle space:

Testing your hypothesis

Sample questions	Sample investigations and observations
To find out whether my hypothesis is true or false, what do I want to do?	Make observations on at least two days when the temperature is above 40°F and on two days when the temperature is below 40°F. Take and record the temperature every time I make an observation.
Where would I do the study? <ul style="list-style-type: none"> • Where is the control group? • Where is the study group? 	Local park or natural area where I can observe waterfowl.
What information would I collect?	Minutes spent in feeding behavior. Temperature.
<ul style="list-style-type: none"> • What conditions are the <u>same</u> for each group? (control variables) 	Same type of bird. Same location. Same time of day. Period of observation (one or more 10-minute segments at any one visit.)
<ul style="list-style-type: none"> • What one condition would you <u>change</u> (independent variable)? 	Temperature.
<ul style="list-style-type: none"> • What would you measure (dependent variable)? 	Time spent feeding (time observed feeding during a 10-minute time period). Repeat.
What materials would I need?	Thermometer, binoculars, pencil, notebook, stopwatch or watch with a second hand.
How would I know if I found the answer? <ul style="list-style-type: none"> • What would I have to observe to prove my hypothesis correct? 	I would calculate the percent time that the bird spent feeding out of every 10-minute observation period. I would compare the percent time feeding at the temperatures below 40°F with those above 40°F. NOTE: A scientist doing this proposed study might need to make 100 observations to have enough examples to be able to prove or disprove the hypothesis.

When you work as a conservation scientist, the hypotheses you create are closely related to conservation problems you're trying to understand or solve for a particular species or resource. Does the hypothesis you posed in this activity have a waterfowl **management** or conservation implication for waterfowl? Not sure? Ask your natural resources partner for some ideas and jot them down in your Nature Notebook.



Investigate & Curious Facts



JASMINE

My science teacher says that asking good questions is one of the most important parts of science. She says the best questions are ones you can answer by using one or more of these science skills:

- Making observations
- Recording data
- Measuring
- Making connections
- Experimenting
- Making models
- Making comparisons
- Classifying
- Predicting

CARLOS

That makes sense to me. I mean, you couldn't really answer very many "why" questions, like "why do ducks rest so much?" There would be no way to answer them.



JASMINE

True. But with good observations, measurements, and careful recording, you can learn a lot about waterfowl!

Fact or Fantasy? There are many legends and fairy tales about ducks, geese, and swans.



ACTIVITY: Read one or more of the stories from the list below.

The Ugly Duckling, Hans Christian Andersen (elementary)

The Trumpet of the Swan, E. B. White (elementary and middle)

Nils Holgersson or The Wonderful Adventures of Nils, Selma Lagerlof (elementary)

Are You My Mother?, P. D. Eastman (K-3)

In your Nature Notebook, write down which story you read. Consider these questions about your story and include some answers:

- What elements of the story are based on natural history and real swan behavior? How do you know? Did you read about swan behavior? Did you see a video of swan behavior?
- Are waterfowl used as symbols or metaphors? Why? Can humans learn life lessons from waterfowl?



INVESTIGATE

Native American Stories about Waterfowl. Stories are very important in most Native American cultures. There is even a story about how stories came to be! That story provides insights about why stories are important and how to use stories.

[This story] “is about a great stone who gave stories to a young boy. The stone told stories to the boy all through the winter months. The boy went back home each day and shared the stories with his family. When winter was ending and spring was about to come, the stone spoke for the last time, ‘I have told you all of my stories. Now the stories are yours to keep for the people. You will pass these stories on to your children and other stories will be added to them as the years pass. Where there are stories, there will be more stories. I have spoken.’”

(from *Keepers of the Earth* by Michael J. Caduto and Joseph Bruchac)



INVESTIGATE

Stories help to explain things to children. Stories help people understand and interpret the world around them. Stories teach important lessons for how we should live in harmony with the earth and with other people. Stories in most Native American cultures were not written. They were told by elders and repeated many, many times. What time of year did the stone tell stories to the boy? When did the stone stop telling them? Stories were only told in winter months, when it was cold and there were more hours of darkness and time to sit around the fire to listen and learn. It was considered disrespectful and inappropriate to tell stories at other times of the year.

Every culture has its own stories and its own unique traditions about telling stories; however, there are some stories that are shared by many different cultures. As in almost every culture around the world, Native American stories include supernatural explanations of natural things (like stones telling stories). Can you think of other stories you’ve heard or read that explain nature in supernatural ways?

Several different Native American cultures have a very similar story about waterfowl. In some it is “Coyote and the Ducks,” in others it is “Nanabozho and the Ducks.” Nanabozho (in different cultures spelled Nanabush or Manabush) is a supernatural being who could take the form of a physical being, sometimes a human, sometimes an animal, sometimes a combination of the two. It is sometimes seen as inappropriate, disrespectful, or very bad luck to say the name of supernatural beings out loud — so be careful!



INVESTIGATE

ACTIVITY: Following are two different versions of the same story. Read the stories and talk about them with a friend or a small group of classmates. What similarities do you see? What differences do you see? What does this story tell you about the importance of waterfowl to Native Americans? In the Menominee story, “A Menominee Legend,” what species of bird kept his eyes open? Was it a duck or another type of bird?

A Menominee Legend

Menominee (Me-NOH-muh-nee) Tribe members were originally residents of northeastern Wisconsin and the upper peninsula of Michigan. Today, most Menominee are residents of northeastern Wisconsin. Ojibwe (oh-JIB-wah) is the name of a large group of Native Americans (a nation) that once spread across the northern U.S. from Montana to Michigan. “Ojibwe” also describes the native language spoken by these people.

Manabush was wandering along, stopping now and then to examine a flower, or to watch the flight of a bird or butterfly, when he suddenly saw at a little distance a number of water birds of different kinds. There were ducks, geese, and swans among them. They were dancing in a circle and were enjoying themselves.

As he drew near them he said to them, “My friends I have brought some songs with me. I will sing for you while you dance. You must all keep your eyes closed while you dance, if not, I will stop singing.” The birds consented and began to dance.



© Rabbett Strickland

As one of them came near to him he grasped its neck to prevent its crying out. In this way he killed a number of birds. One bird, a duck, not hearing the voices of its friends opened its eyes. It saw the dead dancers laying at the feet of Manabush. It flew into the air and cried out, “My brothers, Manabush is killing us. Fly, or we shall all be killed!” Instantly all of the birds opened their eyes and flew in all directions. All escaped. Manabush called to the duck that had sounded the warning, and said, “For this disobedience you shall always have red eyes.” To this day the rings around the eyes of this duck are red.



Coyote and the Ducks

Coyote was walking along a lake and saw a flock of ducks, which put him in the mood for a good duck dinner. So he stuffed a bag full of grass and walked past the ducks, stepping lively and singing a catchy tune. “Where are you going?” asked one of the ducks. “I am going to a circle,” replied Coyote. “What’s in the bag?” asked the duck.

“Songs that I am bringing to the circle,” replied Coyote. “Oh, please sing your songs for us,” the ducks all said. “I’m very busy,” said Coyote.

“Please, please, please, please...” said the ducks. “I’m running late,” said Coyote. “Please, please, please, please...” “Oh, alright.”

“I’ll sing a song for you, but I need your help. All of you stand in three lines. The fattest ones in the front, those in the middle who are neither fat nor thin, and the thin ones in back.

All of you close your eyes and dance and sing as loud as you can. Don’t anyone open your eyes or stop singing, because my songs are very powerful and if you do that you may go blind! Is everyone ready?” “We are!” replied the ducks, and they fell into lines and began dancing and singing along with Coyote’s tune.

Coyote moved up and down the line, thumping the ducks on the head and stuffing them into his bag. The ducks were singing and dancing so hard that no one could hear the thumps or know what was happening.

This would have gone on until none were left, if not for one scraggly duck in the back who opened his eyes and saw what was going on. “Hey, he’s going to get us all!” cried the scraggly one.

At this, the other surviving ducks opened their eyes and made their getaway. Coyote wasn’t too upset; he already had a lot of ducks in his bag. He went home and ate good for a good while.

The ducks went home and mourned their dead, and gave thanks to The Great Duck that one of them had been wise enough to open his eyes, and that the rest of them had been wise enough to listen to the one who gave warning.

***NOTE:** This story was described on the Internet as an Ojibwe Legend, but Coyote is only found in Native American legends in the Southwestern United States and is not found in Ojibwe culture. This error illustrates that you should not believe everything you find on the Internet! It is especially important with Native American stories to try to learn them from Native American people themselves. What Native American cultures are found or were found in the past in your area? Learn about them and find out if there are elders who might be willing to tell you some of their stories. Remember that these stories are sacred to them. Perhaps they can only tell them at certain times of the year. Perhaps some cannot be shared outside the tribe. Learn what you can and always be respectful of other cultures, even if they see the world in a different way than you do.*

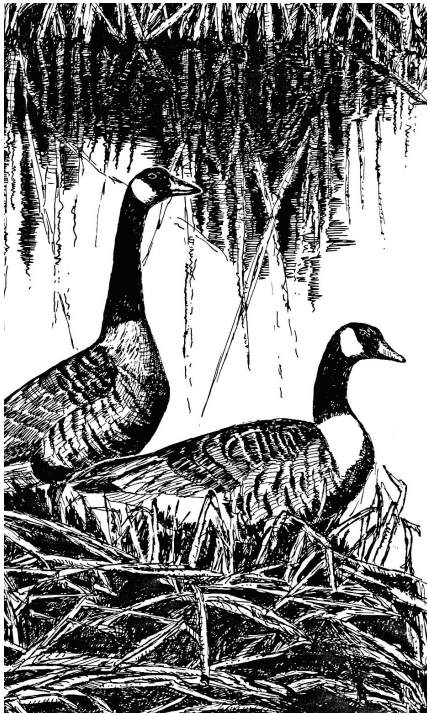
EXPRESS

What does behavior look like?

ACTIVITY: Look at this art and these photos. What behaviors are the waterfowl in these pieces exhibiting? What kinds of behaviors do you see in the photos? Where is the bird when it is performing these behaviors? Describe or draw the behaviors in your Nature Notebook.



© Abraham Hunter



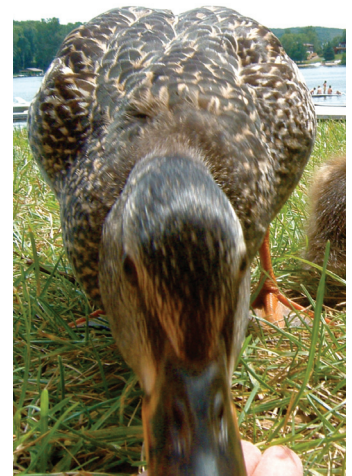
USFWS Art by Tom Kelley



USFWS photo by Karen Bollinger



Metalwork duck by Diccon Dadey © Tim Surman



© Jodie Wilson



© HarshLight, Creative Commons



© Bruce McAdam

Take your own photos:

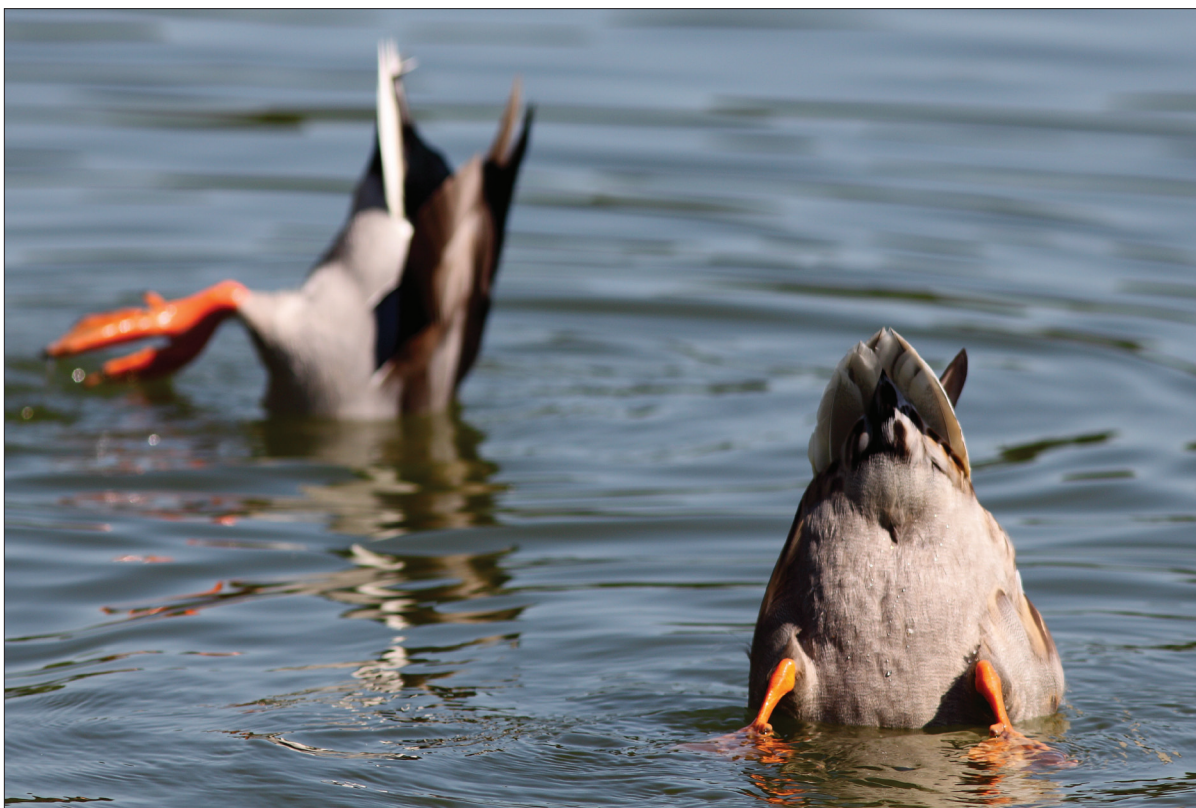
ACTIVITY: Take photographs of birds. Try to photograph birds exhibiting specific behaviors. Make a collage with your behavior photos and label the behaviors you identified.

The world from the point of view of a dabbling duck. You’ve seen examples of how **dabbling ducks** “dabble” in the water and how **diving ducks** dive. Now think of what the underwater world looks like to each of them.

ACTIVITY: Imagine you are a dabbling duck, tipping upside down, usually in shallow water to feed on water plants and small animals. What do you see? Now imagine that you are a diving duck. You actually dive underwater and swim around looking for small animals and fish. What do you see? Use watercolors to paint the underwater world that each duck may see.



EXPRESS



Dabbling ducks “tipping up.”

© Ted Nigrelli



Observe and study waterfowl—a blind to help you see: For hundreds of years, humans have developed strategies to find and attract ducks, geese, and swans—to watch them, hunt them, or photograph them. A blind is any kind of structure that blends in with the natural environment to hide a person who wants to get closer to the action. Vehicles also make excellent blinds to study or photograph waterfowl from an auto tour route or country road.

ACTIVITY: Look at these photos/drawings of different types of blinds. To be effective, a blind has to mimic the habitat very well. Draw a picture of a blind in your Nature Notebook. Then write a note about where you would like to put it. What time of year would you need it? How will that impact your design? What type of habitat will you mimic?





Students moving a duck blind
© Victoria Rydberg (Madison, WI)

ACTIVITY: With help from your conservation partner, build a blind and decide where to put it. Or, if there is no space or opportunity to build a real blind, build a small model of a blind. Make a display that illustrates a specific habitat and place your miniature blind in the best place to observe waterfowl.



EXPRESS

Express & Curious Facts



EMILY

You guys will like this—our school has an outdoor classroom on a wetland, and last week we built an observation blind right next to it. A blind is a structure where people can get close to wildlife without being seen. It makes it great for watching what they do.

JACOB

That sounds cool. Is the blind in the water?



EMILY

It's on a long strip of land that sticks out into the wetland, and we have a trail that leads down this strip to the door of the blind.

MATTHEW

When my Dad hunts geese he puts a temporary blind out in a cut cornfield. The geese like to land there to eat the leftover corn still in the field. Really anyplace where ducks and geese like to land is a good place for a blind.



ASHLEY

I've seen "pop-up" blinds like this that are like small tents for sale in a local sporting goods store. They are camouflage and easy to put up and don't cost that much.



© Jon Marshall, DJ Case & Associates

MATTHEW

Portable blinds are great. My family uses one at a wildlife area outside of town. My Dad says if you leave a blind on public land, you should put a tag on it that has your name, address, and phone number. I guess there's a law that says you have to. You could contact your state natural resources agency to find out for sure, and even to ask them for ideas about where to put a blind for watching waterfowl.



CARLOS

And don't forget to use decoys. Some ducks are very easy to attract with decoys and will land next to almost anything that looks sorta like a duck. Other species, like Mallards, are more wary and will only be attracted to a decoy that looks like a real duck.

MATTHEW

But you usually need more than one. You might need one or two dozen! In fact, the more the better. Some hunters my Dad knows use several hundred at a time for attracting snow geese, 'cause they like big groups. Also, you can't just throw them out in the pond or the field. In the water, each decoy has a string with an anchor attached, to keep it from drifting away. For diving ducks, put 'em in a line in deeper water. Dabbling ducks would be in more random small groups and in shallower water.



Observe and study waterfowl—make a decoy: Ducks and geese are attracted to groups of other ducks and geese. Hunters, photographers, and scientists use artificial ducks and geese, called decoys, usually placed near their blind, to attract waterfowl. These decoys can be very simple and basically just suggest the shape of a duck or goose. They can also be very realistic. Many people make and collect decoys as works of art in addition to making and using them to attract waterfowl.



© VH Hammer

EXPRESS



ACTIVITY: Try it. Draw a picture of your example of a decoy in your Nature Notebook, and then write a note about how you decided how to build your decoy.

ACTIVITY: Make your own decoy. Build a decoy out of paper mache or other materials. Or carve one out of soft wood with parental supervision. You can even make one out of recycled materials such as a milk jugs and 2-liter soft drink bottles.



© Joey Jobes

Observe and study waterfowl—duck calls: What noises do ducks make? Listen to a number of different species of duck calls. Describe how they are alike and how they are different. Hunters, photographers, and scientists use instruments called duck calls to attract ducks to their blinds. Are there different duck calls used for different species?

ACTIVITY: You can buy a duck call or make one. If you have woodworking skills, you can make a professional quality duck call. But there are many directions on the Internet for making duck and goose calls out of simple materials. Search for these or make up your own. Conduct an experiment to see which kinds of calls actually work.



Commercial duck calls
© Jon Marshall, DJ Case & Associates



SHARE

Create a mural with your group: A mural is a large drawing or painting that covers an entire wall or ceiling. These can be great in schools, showing off your work to other classes and helping them learn about waterfowl, too.

ACTIVITY: Using a large roll of shelf paper or craft paper, create a life-sized mural that depicts waterfowl in a variety of habitats, displaying a variety of different behaviors. Write a description of each behavior illustrated and create information cards to attach to the wall next to the mural. Students passing by can read the cards to learn about some of the interesting things that happen during a day in the life of a duck, goose, or swan. Discuss with your group—what do people do that might interfere with the behaviors you illustrated in the mural?

ACTIVITY: Play waterfowl charades. Get a handful of blank 3" x 5" index cards. On each card, write one waterfowl behavior that you studied in this unit. Mix up the cards, and have randomly selected students pick a card from the deck and try to mimic the behavior on his/her card. The rest of the class has to guess what the behavior is. For even more fun, divide the class up into teams and see which team has the best actors/guessers.

ACTIVITY: Make greeting cards from your drawings of waterfowl. Use your cards for sending greetings to family and friends, or make sets of cards to give as gifts or sell as a fundraiser.

Share & Curious Facts



ASHLEY

Hey guys, I just got back from the library, where I found a cool book on waterfowl fun facts. Did you know that when Goldeneyes fly, the beating of their wings creates a whistling sound that can be heard over a half mile away?

ANTHONY

I didn't know that, but I looked up Goldeneyes in my waterfowl book and it says the same thing. It also says that a lot of people call these ducks "whistlers" because of how loud the whistling is. Plus, they are divers so they need to have a running start to fly because their legs are set so far back. Look how far back they are on this photo I found!



©Rachel Scopes



ASHLEY

Here's another fun fact: In the fall, Wood Ducks feed mostly on acorns in flooded bottomlands. **Biologists** have found as many as 15 pin oak acorns packed into the throat and **gizzard** of a wood duck!

HANNAH

Wow, sounds like they eat like my brother. But what is a gizzard, anyway? I know chickens have them, but what do they do?



SELENA

I know this one! The gizzard is a very muscular organ at the end of the throat that grinds up food items—like breaking the shells of the acorns that Wood Ducks eat. Birds that have gizzards often eat small rocks and grit that remain in the gizzard and help break down hard seed coatings and shells.

MICHAEL

And gizzards taste great deep fried, too!



THE MYSTERY OF THE LABRADOR DUCK

Evidence about behavior

*In your Nature Notebook, keep a set of detective notes about the Labrador Duck. Can you find any clues about why the duck became **extinct** in this description about the behavior of the Labrador Duck?*



SHARE

There is not much information on how Labrador Ducks behaved. After all, **mounted specimens**—the only **evidence**—don't do much! However, Audubon and others noted some behaviors in their journals. All the journal entries suggest that Labrador Ducks were swift, strong fliers and flew away quickly when disturbed.

Audubon described seeing Labrador Ducks in “flocks of seven to ten, probably members of one family.” Colonel Nicolas Pike, who shot a **drake** Labrador Duck at the mouth of the Ipswich River at the south end of Plum Island, New York, in 1844 “never met more than two or three at a time, mostly single birds.” Several journal entries noted that they were seen with other species, such as Gadwalls and Long-tailed Ducks. Audubon also noted that Labrador Ducks could be captured with fish hooks baited with mussels and sunk a few feet below the surface. This suggests they dove for their prey.

Share & Curious Facts



ASHLEY

More fun facts for my friends: In January 1940, a famous U.S. Fish and Wildlife Service biologist named Johnny Lynch observed on Louisiana's Catahoula Lake one of the largest concentrations of ducks ever surveyed from the air in the United States. Although there were far too many waterfowl to count, he claimed as many as 8 million ducks could have been on the lake at the time!

PENCIL-TO-PAPER WRAP-UP



Is there a particular waterfowl activity or habitat that interests you most? Revisit your *geo-bird* form that you drew at the beginning of this unit. Choose one of the behaviors studied in this unit and modify your *geo-bird* with that behavior in mind. If you got to choose another set of words that describe what a duck, goose, or swan does, which would you choose now? Add a note in your Nature Notebook describing your new interests.



Share & Curious Facts



ASHLEY

Here's another fun fact: Did you know that Harlequin Ducks feed on snails and insects under water by diving into rushing streams and walking upstream along the rocky bottom?

Waterfowl Challenge Question

Q. How did ducks help humans discover gold?

A. Waterfowl ingest small particles of stone, gravel, and sand, which are kept in their gizzards to help them grind up hard foods like grain, acorns, and clams. In 1911, a gold rush was spurred in western Nebraska after hunters found small gold nuggets in the gizzards of ducks they had shot. The source of these gold nuggets, however, was never discovered.

What did you learn?

- What do waterfowl do in their daily lives?
- How can you observe bird behavior?
- What are some waterfowl behaviors?



Junior Duck Stamp Program participants watch waterfowl at a wetland. USFWS photo by LaVonda Walton

UNIT 3

Raising a Family in a Wetland



Common Merganser and ducklings
© Alan Vernon

Waterfowl Challenge Question

Q: When does a duck help make a quilt?

Look for the answer at the end of this unit.



Hannah

[Links](#)

[Info](#)

[Photos](#)

[Notes](#)

HANNAH

Did you ever stop to think about where a duck or goose might make a nest? They spend so much time in the water, do you think they lay eggs in the water?

EMILY

And after the young hatch out, can they swim right away? What keeps fish or other critters from eating them when they're so tiny?



CARLOS

It can't be easy raising a family in the water, especially with the way so many wetland **habitats** have been destroyed. I wonder how they do that?



American Wigeon with ducklings. USFWS photo by Donna Dewhurst

In Unit 3...

What will you learn?

- How **waterfowl** survive and reproduce in a wetland
- How waterfowl keep their young ducklings, **goslings**, or **cygnets** safe and well fed
- How waterfowl have **adapted** to raising their young and increasing their chances of survival in a wet and ever-changing habitat

What will you do?

- Explore nest types, and build a nest yourself
- Find the “**prairie pothole**” closest to your home
- Find some duck food, and maybe eat some too!

What will you need?

- Pencil or pen
- Nature Notebook
- Colored pencils
- Ruler or other implement for measuring
- Critter Cube game parts
- Water critter investigation equipment: Long-handled net, white or light-colored shallow dishpan or baking pan, hand lens, small clear jars, empty white ice cube tray, turkey baster, “Macroinvertebrate Tally Sheet,” “Key to the Macroinvertebrate Life in the River.”
- Materials to build an example of a nest
- Materials to build a nest box
- A natural area to visit
- A library to visit
- Access to a computer with an Internet connection
- A **conservation professional** to help with studying waterfowl food at a wetland and building a nest box

Featured Scientist

Michelle McDowell



Photo courtesy Michelle McDowell

- Links
- Info
- Photos
- Notes

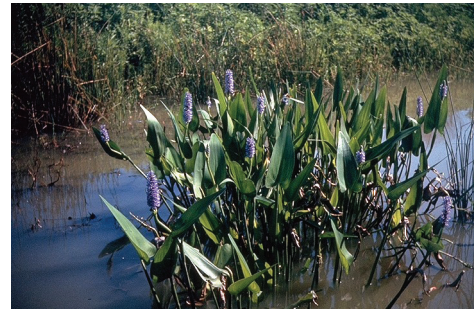
Meet Michelle McDowell, Wildlife Biologist

Michelle McDowell is a wildlife **biologist** at the Rice Lake National Wildlife Refuge in Minnesota. She is studying how to help more wild rice grow on the refuge and in other areas in Minnesota and the Midwest. Wild rice was once very abundant all over the north-central U.S. and Canada. It can only grow in certain types of wetlands where the water level changes regularly and where the water is flowing. Thousands of acres of wetlands have been destroyed for agriculture and development. Many other wetlands were altered so that wild rice could no longer grow there or other more **invasive species** (like pickerelweed) would grow and leave no room for the wild rice.

Michelle and her team are experimenting with mowing the pickerelweed to allow wild rice to flourish. This is no easy task, as pickerelweed (and wild rice) grows in the water! They need special equipment to mow in a wetland.



Rice Lake National Wildlife Refuge



Pickerelweed
Clarence A. Rechenthin
© USDA-NRCS PLANTS Database



Wild Rice © Eli Sagor

Featured Scientist

Heath M. Hagy



[Links](#)

[Info](#)

[Photos](#)

[Notes](#)

Meet Heath M. Hagy, Wildlife Biologist

Heath Hagy conducts research and works with students at Mississippi State University in the Department of Wildlife, Fisheries, and Aquaculture. His research investigates the availability of different kinds of foods for waterfowl at **national wildlife refuges** in Arkansas, Missouri, and Mississippi. They also study waterfowl eating habits.

One aspect of his study investigates the abundance of **aquatic invertebrates** in moist-soil wetlands of these refuges. Aquatic invertebrates are small animals with no backbone, such as snails, worms, **crustaceans**, and insects. Aquatic invertebrates are abundant in moist-soil and forested wetlands during the winter, and provide protein-rich foods for waterfowl, other birds, and fish. The aquatic invertebrates also provide important **ecosystem functions**, such as converting the **nutrients** present in dead grass and leaves into food. A nutrient is a substance that a living organism needs to live and grow.

Another study at Mississippi State investigated what **dabbling ducks** eat in the winter. A few kinds of foods that migratory and resident waterfowl like to eat, for example, are acorns from several different types of oak trees and seeds from grasses. Biologists will use this information to help develop a wildlife **management** plan that would assure availability of important foods. With their partners, including other government agencies and private groups, they will make a plan to **manage** wetland habitats to assure that ducks will have enough food. National wildlife refuges are managed by the U.S. Fish and Wildlife Service.



All photos © Heath Hagy



Featured Scientist

Joseph Marty



Photo courtesy Joseph Marty

Links	Info	Photos	Notes
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Meet Joseph Marty, Wildlife Biologist

Joseph Marty works as a graduate assistant at Mississippi State University in the Department of Wildlife, Fisheries, and Aquaculture. He investigates the availability of waste rice and rice seeds as food for waterfowl on Gulf Coastal Prairies of Louisiana and Texas. His research contributes to the efforts of the Gulf Coast Joint Venture.

Joseph studies the abundance of rice left in the fields after harvest, and moist-soil seeds in fields where rice has been harvested. To learn how much food is available for wintering waterfowl, Joseph takes samples of soil in the fields when early migrating waterfowl are arriving, and again in November when later migrating waterfowl are arriving. He washes the soil using a series of sieves to separate the rice and moist-soil seeds from the remainder of the soil sample. The seed is dried and then weighed to determine an **estimate** of the total amount of seed available within the field. These estimates help predict the amount of energy that is available to waterfowl from eating the left-over rice and seeds. Results from the project help managers make decisions on farming practices and landscape **conservation** for migrating and wintering waterfowl in this region.



Rice is an important waterfowl food.
USFWS Photo by Bill O'Brian



PENCIL-TO-PAPER WARM-UP

In this unit you'll add another layer of complexity to your *geo*-bird. This time you'll fine-tune your *geo*-bird according to its life cycle and reproduction activities. Is your *geo*-bird a chick, fledgling, or an adult? Is it male or female? What is its behavior during nesting? With a friend or in a small group of classmates, brainstorm words that describe some of the features or behaviors having to do with waterfowl reproduction (for example: chick, camouflage, defense). Create a new *geo*-bird illustrating one of these features.

REMEMBER: Your *geo*-bird sketch is a quick drawing of your choice of waterfowl using only **geometric** shapes.

GETTING STARTED

The most important task of any living thing is to survive. The second most important task is reproducing. You've learned some of the challenges waterfowl face to merely survive. Now imagine the challenges of building a nest, laying eggs, and keeping young ducklings, goslings, or cygnets safe and well fed. Waterfowl have some amazing **adaptations** to raise their young and increase their chances of survival.

Here are some tips for knowing what to call waterfowl males, females, and young! Keep these handy as you read about and talk about ducks, geese, and swans.

	Male	Female	Young
Goose	gander	goose/hen	gosling
Duck	drake	duck/hen	duckling
Swan	cob	pen	cygnet

Begin with the *Explore* section and read through the choices of activities. Choose at least one activity, and carefully follow all of the directions. When you are satisfied that you have a good start on understanding the main ideas for Unit 3, move on to the other sections: *Investigate*, *Express*, *Share*. Plan to do at least one activity in each of the sections. Don't forget the Pencil-to-Paper Wrap-Up at the end of the unit!



EXPLORE

In this section you'll explore the challenges waterfowl face in order to hatch and care for their young. Remember that waterfowl are usually found in wetlands or along the sea coast, and even in low spots that are occasionally filled with water, places where rain water collects, and drainage ditches. Even if you don't see a duck, a goose, or a swan, you will see the habitat (food, water and shelter) that is important to their survival.

How do waterfowl find mates? The first step in reproducing is to find a mate. How do waterfowl find mates? Waterfowl use some amazing and interesting behaviors to attract mates. Most scientists think that these interesting behaviors evolved from basic survival behaviors like **preening** and bathing.



ACTIVITY: The following table lists some of the most interesting courtship behaviors in the world of waterfowl. In late spring or early fall, visit the natural area you've chosen for observing waterfowl. See how many of these behaviors you can observe. Write down which behaviors you've observed in your Nature Notebook. The actual process of mating may involve the male forcing the head of the female underwater!

Sample mating behaviors	Observed?
Head bobbing	
Bowing	
Fluttering wings	
Sounds – Mergansers have a cat-like call; Mallards whistle and grunt.	
Chasing each other—Mergansers chase each other on the water, in the air, and even under the water! Canvasbacks chase each other while flying.	
Fluffing feathers to appear larger.	

Mating for life. Geese and swans tend to be **monogamous** (“mah-nah-gah-muss”)—they often stay with the same mate, year after year. Most ducks, however, only mate for a single season. They will form a “pair bond” and stay together for one season, but then will split up and find a different mate the following year. Often there are more males than females in the population, so there are “bachelor” **drakes**. “Till death do us part” may be true for many geese and swans, but it is not true for ducks.



EXPLORE

ACTIVITY: Look at waterfowl behaviors on YouTube or other websites. Swan mating rituals are very beautiful!

ACTIVITY: Why do you think there are often more male ducks than female ducks? At the time of hatching, all waterfowl have about as many male chicks as female chicks. What do you think happens between the time of hatching and adulthood that would cause more male ducks to survive? Write in your Nature Notebook the possible causes of mortality (death) for ducks, geese, and swans. When are they most vulnerable? What differences in appearance can you see between male ducks and female ducks that you do NOT see between male and female geese and swans?



ACTIVITY: Why do you think geese and swans mate for life, while ducks do not? No one knows for sure, but if you wanted to find out, what questions would you ask? Write your question in your Nature Notebook.



USFWS photo by Tim Bowman



USFWS photo by Donna Dewhurst



EXPLORE

Here are some interesting differences between geese, swans, and ducks that might help you come up with ideas for questions about why geese and swans mate for life, but ducks do not:

1. Geese and swans live longer than ducks.
2. Geese and swans have fewer young each year.
3. Geese and swans have larger bodies than ducks.
4. Goslings and cygnets mature more slowly than ducklings (less precocial).
5. Geese and swans tend to show more **site tenacity** (likely to return to the exact same breeding and wintering sites).
6. Geese and swans tend to have more limited food resources in their breeding grounds.
7. Male and female geese and swans are usually the same color (you can't tell the sexes apart by looking at them); male and female ducks are usually very different in coloration.

Explore & Curious Facts



JASMINE

I saw a pair of Mallard Ducks on a pond today. The male followed the female around everywhere. I guess they were a couple!

MICHAEL

Probably so, but did you know that ducks don't mate for life? I saw a nature show on TV that said most ducks pair up for one season, but after **breeding**, the male doesn't really help with nesting or raising the young, and the following year they both will find new mates.



ASHLEY

I'd find a new mate, too, if the guy didn't help raise the kids! But seriously, my waterfowl book says that there are a few duck species that do tend to keep the same mates year after year. But they don't stay together all year. Amazingly, after breeding, they go their separate ways, but then find each other again on the wintering or breeding grounds—even from among hundreds of other individuals!

JACOB

Yeah, that's pretty amazing. I think that's the way it is for sea ducks. And then there is the Ruddy Duck, the only duck species in North America where the male may mate with more than one female within a single season. He sets up a breeding territory and puts on elaborate courtship displays to impress the females. I guess the guy that looks the best gets the most mates.



SELENA

Things are totally different for geese and swans. They tend to mate for life. I was reading online where some pairs do break up, but it usually only happens if the pair is not able to successfully hatch eggs. Also, if one of the pair dies, the other will mate again the following year.



ASHLEY

And don't forget, male geese and swans help guard and protect the nest and help care for the little goslings and cygnets!



The World's Largest Nursery. The map in Figure 1 shows an area in North America that is important breeding habitat for millions of ducks, geese, and swans: It is called the *Prairie Pothole Region*. Potholes are shallow depressions formed by the activity of glaciers, and in wet years they fill up with water and with water-dwelling insects, tiny mollusks, and other **invertebrates**. This region is also sometimes called "The Duck Factory" because it is such good habitat for "making ducks."



EXPLORE

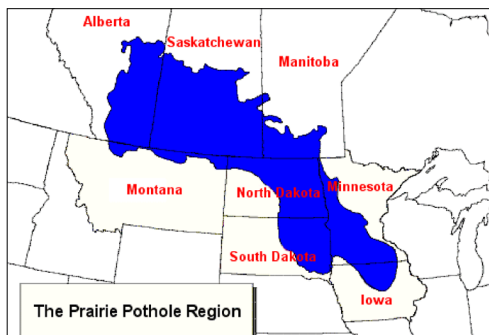


Figure 1. Prairie Pothole Region (USFWS)



USFWS photo by John Solberg and Peter Fasbender



ACTIVITY: Do some research in the library or on the Internet to find out if there is a prairie pothole pond or lake close to your home. How many miles is it from your home to the closest prairie pothole? Figure out how to measure the distance and write the figure in your Nature Notebook.

ACTIVITY: Why does the Prairie Pothole Region attract ducks, geese, and swans? What would happen if someone built a house or a school or a shopping center near a prairie pothole? Can waterfowl and people live near each other? How would you find the answer?



EXPLORE

Where to build a nest? Each species of waterfowl builds its nest in a specific type of habitat. Look at the information below about four common types of waterfowl nests.

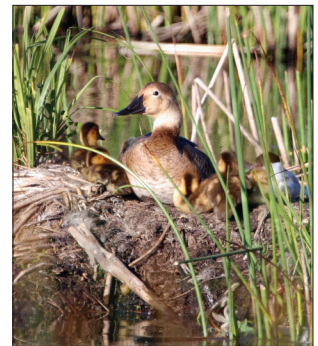
- Upland – Mallards and Pintails arrive in the Prairie Pothole Region during April and May to establish their nesting territories. They look for grassy upland habitats with nearby shallow ponds and wetlands where the **hens** can eat protein-rich invertebrates like insects and snails to recover from **migration** and get ready to nest. The protein, fat, and calcium in these critters are just what a female duck needs to produce and lay a **clutch** of eggs, which is no small feat. For instance, a typical clutch of Ruddy Duck eggs weighs more than the hen herself! Once they've eaten enough, they explore the surrounding grasslands to find the best place to nest. Some species nest farther from wetlands; some nest in thicker cover. Researchers have learned that more Mallard ducklings hatch when the nests are built in dense, heavy vegetation.
- Overwater – Redheads and Canvasbacks make their nests right in wetlands, on floating mats of vegetation like cattails and bulrushes. They prefer deeper, year-round wetlands with dense stands of **emergent** vegetation (plants that stick out of the water). Hens create a platform of vegetation to support the eggs. They fold cattails and other plants into a cup-shaped raft.
- Cavities – Some ducks, like Wood Ducks and Hooded Mergansers, nest in holes in trees. Ducks can't create their own holes, so they depend on cavities created by woodpeckers or damage from decay, wind, or lightning. They also will readily use man-made nesting boxes.
- Dump nesting – Some ducks (particularly **cavity nesters**) use a strategy called "dump nesting." A hen Wood Duck, Redhead, or Hooded Merganser will lay eggs in another duck's nest, hoping the other hen will raise her young! Some Wood Duck boxes will be so full of eggs from a number of hens, that the hen who laid the first eggs will abandon the nest.



Brant nest
USFWS photo by Robert Gill



Ruddy Duck hen on nest
Nick Hill, Sylvan Heights Waterfowl



Canvasback hen on nest over water
USFWS photo by Donna Dewhurst



Wood Duck hen in nest cavity
USFWS illustration by Tom Kelley



ACTIVITY: What do you think are advantages and disadvantages of each type of nest site? Which would be the easiest to build? Which would be the safest from **predators**? What special habitat is needed for each? Make a chart in your Nature Notebook, like the example below, and describe the pros and cons of each type of nest.



EXPLORE

Nest type	Habitat Needs <ul style="list-style-type: none"> • Ease of building • Safe from predators • Nest components 	Pros	Cons
Upland			
Overwater			
Cavities			
Dump nesting			

How to build a nest? What kind of materials does a duck, goose, or swan need in order to build a nest?



ACTIVITY: Look at a website or book, or go to a local wetland area where you can see different species of waterfowl. Pick a duck, goose, or swan species to focus on for this activity. Find out where it nests. Also, find out what the average numbers of eggs that species lays each year. In your Nature Notebook, make a list of materials you think the bird would need to build a nest, and then try to find those materials yourself. Where would you look?



ACTIVITY: Using natural materials you can find around your home or school, try to build a nest that has room for at least four eggs. How would you organize the materials so that they would stay together in the form of a nest during the **incubation**, hatching, and feeding of the chicks?

- Were you able to find materials to build a nest? Where did you find them? Where do waterfowl find materials to build a nest? Draw a picture of the nest you built in your Nature Notebook or take a photo and tape it in your book.

ACTIVITY: Look for bird nests that have fallen out of a tree or bush, or one that is still in place if possible. **Observe** the nest (don't touch or hold) and describe it or draw it in your Nature Notebook. Where is the nest? What does it look like? What materials are used to build the nest? Are the materials woven together or just a loose collection? (NOTE: Please leave the nest where you found it.)

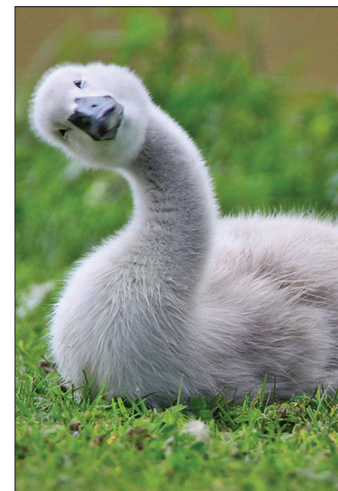


Transformation. How long does it take before an egg becomes a gosling, duckling, or cygnet?

EXPLORE



ACTIVITY: Pick three types of birds from among duck, goose, or swan species. Find out details about the incubation of the eggs for each species. What size and color are the eggs? How many eggs are laid at the same time? How long is the chick in the egg? What do the parents do while the chick is in the egg? What does the chick look like when it hatches? Keep track of the details of your investigation in your Nature Notebook, and include a description that compares the incubation period for different types of waterfowl. Create a chart or table in your Nature Notebook to help organize your data.



Cygnet © Mark Philpott

Explore & Curious Facts



SELENA

It was so sad—this morning I saw a dead Wood Duck on the lake by my house. I wonder what killed it? I hope the biologists come out and make sure no more of these beautiful ducks die.

HANNAH
Sorry you had to see that, but remember, death is just part of life, and it happens every day—we just usually don't have to see it. And yes it is important for biologists to know about individual animals and the things that are important to their survival. But wildlife managers need to make decisions that affect ALL of the ducks in North America. So it's important for them to study populations. That is, they need to know how **all** the Wood Ducks or other species are doing – not just one duck or one family.



ANTHONY

And to help them manage whole populations, the biologists with the U.S. Fish and Wildlife Service, along with the Canadian Wildlife Service and wildlife agencies in every state, province and tribe, conduct a survey each year to determine the population of waterfowl in North America.

CARLOS
How can they possibly determine how many ducks, geese, and swans there are in North America, much less determine how many eggs are in each of their nests and how many of them will survive?



ANTHONY

I know it sounds impossible, but by understanding what ducks need to survive and using special math called statistics, they can come up with a very good estimate. I learned a lot about this on this cool website called www.flyways.US.

MATTHEW
Waterfowl biologists use this information to determine whether each species has a large enough population to be hunted, and if so, how many can be hunted without hurting the population. Biologists fly in helicopters and small planes to identify and count waterfowl. They also check out the habitat to determine the condition of the breeding grounds. They put all this information together to estimate how many young will be produced that year and how many of them are likely to survive.





INVESTIGATE

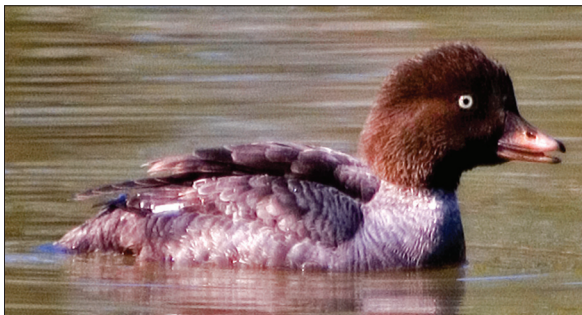
True Colors. Waterfowl have some of the brightest and most interesting colors and patterns in the animal world. Why are some ducks so colorful when other ducks just fade into the background?

ACTIVITY: Here is a photo of a drake (male) Wood Duck and a hen (female) Wood Duck. Which do you think is the male and which is the female? Why do you think their color helps them survive and/or reproduce? Summarize your ideas in your Nature Notebook.



© Kevin J. Woolley

The Goldeneye Duck is another species where the male and female do not look alike. Which do you think is the drake?



USFWS photo by Donna Dewhurst

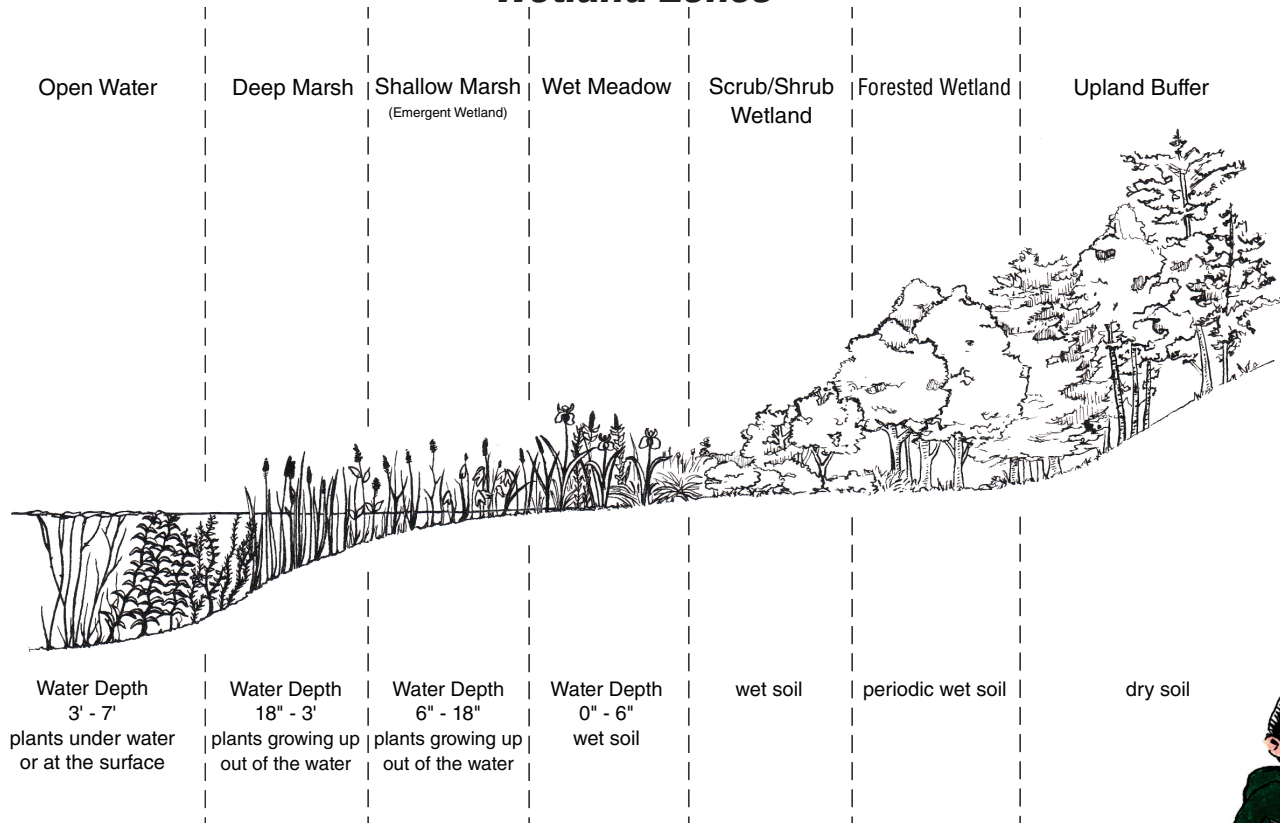


USFWS photo by Donna Dewhurst

Visit a waterfowl nesting site. With help from your teacher or leader, find an area near you that might provide nesting habitat for waterfowl.

ACTIVITY: Contact a biology teacher or a conservation professional in your community to learn about local waterfowl nesting sites. Wetlands are good places to look. How many wetland zones can you identify?

Wetland Zones



Laura Maloney, DJ Case & Associates



ACTIVITY: Visit a nesting site and do a “habitat assessment.” (Make sure you have permission from a parent or guardian and that you go with a partner.)

- Look for the different types of nesting sites: upland, overwater, and cavities. Which species do you think might nest there?
- Select a portion of the area you are visiting and draw a map in your Nature Notebook showing as many of the habitat characteristics as are present in the area. Make a chart like the one on page 104 in your Nature Notebook. Which habitats are present at your site? What behaviors are the birds performing in each area?
- Mark the areas on your map that might serve as the best nesting places. In your Nature Notebook, describe the pros and the cons of the various sites. Which type of waterfowl is most likely to nest there? Why?



INVESTIGATE

Habitat	Present?	Used for which behavior?	Possible Behaviors
open water			Aggression Courtship Dabbling Diving Drinking Feeding (on what?) Mating Preening Resting Swimming Walking
emergent aquatic vegetation			
barren shoreland			
shoreland with little vegetation			
vegetated shoreland/ grasses			
vegetated shoreland/ bushes			
vegetated shoreland/ variety			
edge between open water and shoreland			



INVESTIGATE

ACTIVITY: Find out what time of year you might expect to find various species nesting in a natural area near your home. (It will depend on how far north/south you live, but will be sometime between March and June). Visit the area in the spring and see if you can observe any nesting ducks, geese, or swans.

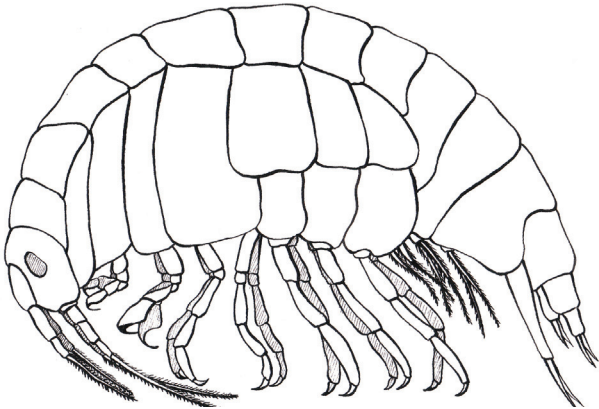
- In your Nature Notebook, record and describe any behaviors you observe (see list above). Record any sightings of nests or young.
- Invite a conservation professional to meet with your group. Ask your leader or teacher for help finding someone who can visit your class. Before the visit, write down your questions about what species of waterfowl come to the area, and why they find it attractive for nesting. Summarize what you learn in your Nature Notebook.



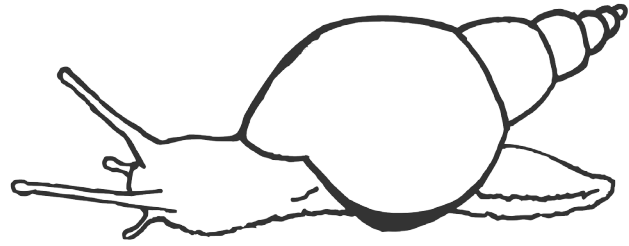
Food for a Growing Family. The most important food for nesting waterfowl and their young are aquatic invertebrates: tiny insects, snails, and other creatures that live in wetlands (and shallow seas for sea ducks). Some of the most important of these creatures are called **amphipods** and **gastropods**. Populations of these tiny creatures are declining in many places. Why do you think this might be happening? Read *Meet Heath M. Hagy* (page 91) to learn what scientists want to know about this source of food.



INVESTIGATE



Amphipod (actual size 1mm)
Laura Maloney, DJ Case & Associates



Gastropod (actual size varies)
Dan Wolfe, DJ Case & Associates

ACTIVITY: What can we learn about the quality of the water by studying the diversity of the tiniest creatures that live in lakes, ponds, and streams? Try the Critter Cube Count game to help you learn about possible explanations. How healthy was the “stream” in your game? If these tiny creatures are disappearing, what does that mean about the quality of water where waterfowl are living?

Critter Cube Count

- The object of the Critter Cube Count is to determine a water quality score for an imaginary stream. The game mimics the steps followed to check the water quality of a local stream using **macroinvertebrates** (or “water critters”) as an indicator. Freshwater macroinvertebrates are animals without backbones that are larger than ½ millimeter (the size of a pencil dot). These animals live on rocks, logs, sediment, debris, and aquatic plants during some period in their life. They include crustaceans such as crayfish, mollusks such as clams and snails, aquatic worms, and the immature forms of aquatic insects such as stonefly and mayfly nymphs.
- To use this method outdoors, you would go to a stream, collect macroinvertebrates in a net, and then identify them. You would record the types and numbers of critters in a formula on the Macroinvertebrate Tally Sheet. The results can help you predict if your stream is healthy or polluted. The next activity, *Find some duck food for yourself*, provides the directions you’ll need if you want to try to collect macroinvertebrates at a stream or pond.



Your team will need:

- “Macroinvertebrate Tally Sheet” and “Key to Macroinvertebrate Life in the River” — (Find these at the end of Unit 3.)
- Four “Critter Cubes.” (Instructions for making these are at the end of Unit 3.)
- An ice cream bucket or similar container.
- A clear, flat surface like a card table or a clear area on the floor.

Directions

1. The “Macroinvertebrate Tally Sheet” shows pictures of macroinvertebrates grouped according to their sensitivity to pollutants. Group 1 is the most sensitive; group 4 is the least sensitive. On the back of the tally sheet, see how to calculate the health of the stream by sampling the critters found there.
2. Now play the game:
 - a. Place four Critter Cubes into the container provided by your leader.
 - b. Shake the bucket so the cubes are mixed.
 - c. Dump them onto a flat surface.
 - d. Use the “Key to Macroinvertebrate Life in the River” and tally sheet to identify the macroinvertebrate pictures that are face up on each of the dice.
3. Circle the corresponding pictures on the tally sheet and enter the total number of animals you circled for each group in the boxes. Follow the directions on the form to determine the score for the imaginary stream you just “sampled.”
4. What were the results of your stream water quality test? Write the results in your Nature Notebook.



Certain species of plants or animals are called “**biotic** indicators.” Their presence or absence in an ecosystem indicates how healthy that ecosystem is and how much pollution is present. Some aquatic macroinvertebrates are very sensitive to pollution and can only survive in pollution-free waters. Others are very tolerant of pollution and can survive in polluted waters. Scientists can use the presence or absence of these organisms to determine how clean the water is.

Find some duck food yourself: Go to a nearby shallow wetland with an adult and see what you can find using the following materials and techniques.

INVESTIGATE

ACTIVITY: Take your net, a white or light-colored shallow dishpan or baking pan, a hand lens, some small clear jars, and a copy of the ID chart from your educator. It may also be helpful to bring an empty, white ice cube tray and a turkey baster, but please don't take anything from the kitchen without asking your parents! Wear shoes that you have permission to wear in the water, rubber boots, or better yet, waders.



- When you get to the wetland: Fill the dishpan about halfway with water from the pond. Stand along the edge of the pond or wetland and dip your net. Skim the net right along the bottom. It's okay to get some of the mud from the bottom into your net, but try not to get too much. Put the net into the water in the pan and turn it inside out, so that anything you scooped up will go into the pan.
- Do you see anything moving? What did you find? Get several samples with your net from different places along the shoreline. Here is where the turkey baster comes in. When you see something you'd like to look at more closely, you can "suck it up" with the turkey baster and place it in a square in the ice cube tray or in a smaller jar. Use your hand lens to study it and see if it looks like any of the species listed on the "Key to Macroinvertebrate Life in the River" chart.
- Waterfowl eat many of the species you will find! Write about and draw what you find in your Nature Notebook. List all the species you can identify. If you find organisms that you can't find on the ID chart, draw pictures of them or take photos.
- How many different species did you find? Usually, the more different types of organisms there are, the healthier the habitat. This is called **biodiversity**. Biodiversity is very important for healthy ecosystems. Scientists around the world are concerned about the loss of biodiversity as species go **extinct** and habitats are changed by humans. National wildlife refuges, parks, and other public lands help conserve biodiversity.
- Talk with your natural resources partner about your results and their implications for waterfowl and wetland management.





The Food that Grows on the Water. During the breeding season, waterfowl are mainly carnivores — eating the invertebrates that you found in the previous activity. However, waterfowl also need to “eat their vegetables” and need a variety of plants as well. One of the most important plants to North American ducks is wild rice. Wild rice is especially important to waterfowl at stopover sites during their migration. You’ll learn more about this in **Unit 4 – Going the Distance** (page 121). Waterfowl eat domesticated rice as well, the same kind of rice that you and I eat. Read *Meet Joseph Marty* (page 92) to learn about his studies of this food source.

Ducks can get very low on energy with all the flying they do during migration. Read *Meet Michelle McDowell* (page 90) for a story about scientists who study ducks that arrive at a national wildlife refuge. Sometimes they are very weak and in poor condition from the long migration journey. Within a few days of eating the rich diet of wild rice, they can regain the weight they lost and be prepared for the rest of their journey. Wild rice is to ducks as spinach is to Popeye (a cartoon character). Wild rice is also very important in Native American culture. The Menominee tribe is named after wild rice. It’s pronounced “Me-NOH-muh-nee.” It means “wild rice people” in Ojibwe. The Ojibwe gave the Menominees this name because wild rice was their major food crop.



Ricing © Rabbett Strickland

ACTIVITY: You too can eat duck food! Here is a Native American recipe for wild rice. If you can’t find cattail buds or roots, you can use nuts. The proportions of each ingredient can be adjusted to the taste of the cook. Ask an adult to help you in the kitchen.



© Alexa Clark

Wild Rice Recipe

recipe by www.Nativetech.org



Ingredients:

- Turkey broth
- Sage
- New cattail buds or roots, water chestnuts or crunchy somethings; whatever is available.
- Salt & pepper to taste if you like that
- Wild rice
- Cranberries

Directions:

Boil up some wild rice in turkey broth. When it is almost done, add the sliced crunchy somethings and a handful of fresh cranberries (no sugar). Add what herbs you like; a little sage perhaps? Note: The thing to remember is to only add enough water to cover the rice and keep an eye on it so it doesn’t dry up.

Investigate & Curious Facts



MICHAEL

Why is wild rice so important? Last year, at the Rice Lake Refuge in Minnesota, 600,000 Ring-necked Ducks and 400,000 Mallards stopped to fatten up on wild rice for their journey north to their breeding grounds. If there wasn't any wild rice, couldn't they eat something else?

EMILY

I'm sure they would have found something else to eat, but wild rice has the nutrition and energy that they need for the journey. They seem to prefer it more than anything else, and it also happens to be the healthiest food for them. I sure wish my favorite foods were the healthiest foods for me.



CARLOS

Me too! Wild rice is like an all you can eat buffet for ducks, filled with healthy, nutritious food. If they don't get enough high quality food, they will not have the energy to reach their breeding grounds, or they will not have the energy to reproduce. And that means there will be fewer birds in the population the next year. Chow down!

Buy a Duck Stamp – Save Some Habitat. The Federal Migratory Bird Hunting and Conservation Stamp (commonly called the “Duck Stamp”) is a full-color revenue stamp printed in partnership with the U.S. Postal Service and the U.S. Fish and Wildlife Service. These stamps look like postage stamps, but they are not valid for postage. They were originally created in 1934 as the federal revenue tax that was required by anyone who wished to hunt any migratory waterfowl in the U.S. Today, this stamp along with a state hunting license is still required by hunters, but many non-hunters also buy these stamps. Why?

Ninety-eight percent of all money generated through the sale of the Federal Duck Stamp is used to buy or lease wetland habitat for protection in the national wildlife refuge system. Non-hunters can use the stamp to have admission fee waived at any one of the more than 550 national wildlife refuges that can be found all over the country. Since it began, the stamp program has generated more than \$750 million, which has been used to conserve more than 5.3 million acres of waterfowl habitat.



INVESTIGATE

ACTIVITY: Identify the national wildlife refuge that is closest to your home or school. With the help of your teacher, identify other public lands near your home or school that help conserve waterfowl habitat (parks, fish and game conservation areas, wildlife management areas, reservoirs).

Investigate your question. Coming up with a good question is the most important part of science. How can you come up with a good question? The best science questions are ones that you can answer by comparing, measuring, observing and recording observations, and experimenting. It is very difficult to answer “why” questions. Here are some examples of good science questions for Unit 3:

- Which water body near your home has more food for ducks (compare two ponds in your community)?
- Which water body near your home has more nesting sites for waterfowl?



ACTIVITY: Use the table below to brainstorm and refine questions that you had while studying Unit 3. Use your questions to help you conduct further observations. Write down your questions in your Nature Notebook. All questions are good questions, but if you decide to take the next step and investigate your question, you will need to think of a question that allows you to compare one thing with another.



INVESTIGATE

Type of question	Your questions
Descriptive question: How many? How frequently? When did... happen?	
Comparative questions (comparing two situations): Is there a difference between Groups? Conditions? Times? Locations?	
Correlative questions: (considering how two things are related or connected). Is there a relationship between the weather conditions and the amount of time that a bird feeds?	

ACTIVITY: Propose a **hypothesis** that explains a possible answer to the question you select for studying. This is the first step in developing an investigation. See Unit 2 (page 59) for an example.

ACTIVITY: Propose a way to test your hypothesis. Get help for testing your hypothesis. Ask your teacher or leader to help you find a natural resource professional, teacher, leader, or more experienced student who can help you think through each of the steps. Use the chart below as a guide to help you plan your investigation. See Unit 2 for an example of how to fill out the chart (page 71). You'll want to provide ideas specific to your question.



INVESTIGATE

My question:

My hypothesis:

How could I test my hypothesis?	
To find out whether my hypothesis is true or false, what do I want to do?	
Where would I do the study? <ul style="list-style-type: none"> • Where is the control group? • Where is the study group? 	
What information would I collect?	
<ul style="list-style-type: none"> • What conditions are the <u>same</u> for each group? (control variables) 	
<ul style="list-style-type: none"> • What one condition would I <u>change</u> (independent variable)? 	
<ul style="list-style-type: none"> • What would I measure (dependent variable)? 	
What materials would I need?	
How would I know if I found the answer? <ul style="list-style-type: none"> • What would I have to observe to prove my hypothesis correct? 	



EXPRESS

Practice drawing waterfowl behaviors. Like great musicians or athletes, waterfowl artists must practice a lot to develop their skills. This activity offers you the chance to practice your skills as well.

ACTIVITY: Practice drawing waterfowl **characteristics**. Draw waterfowl in various life stages; differences in size or coloration of young, immature, and adults; different **plumage** in different seasons.

ACTIVITY: Match young to adult, male to female, breeding to **non-breeding** plumage.



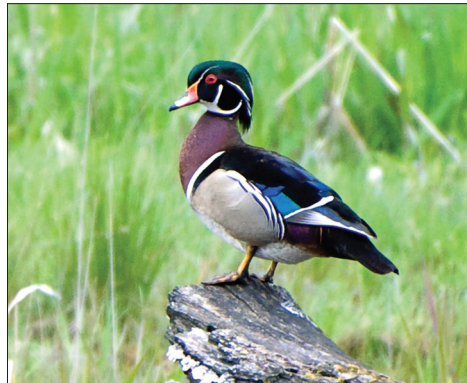
USFWS photo by Donna Dewhurst



© Rick Leche



USFWS photo by Dave Menke



USFWS photo by George Gentry



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USFWS photo by Eugene Hester

ACTIVITY: Practice drawing waterfowl exhibiting different behaviors. Draw, for example, waterfowl engaging in courtship behaviors. Write a story from the hen's and drake's point of view.

ACTIVITY: Make 3D sculptures of nests of various species using natural materials or art materials.

SHARE

Who Took My Home??? Imagine returning from a long trip, driving down your street and finding that your house was gone! Waterfowl may not experience the emotions you would feel if that happened, but many ducks, geese, and swans do lose their homes each year. Some of these losses are temporary, such as when wetlands dry up due to **drought**, or if fire burns all the nesting cover just before nesting season. But each year, some wetlands are permanently drained or filled in for farming or development, and grasslands are plowed and used to plant crops, decreasing the habitat ducks need for nesting. Now imagine returning home, entering your house and finding that everything is covered by a layer of dirt. Even if the wetland itself is not disturbed, if the surrounding grassland is converted to agriculture or buildings and parking lots, there will be more erosion of soil and runoff from human activities (like oil from cars and other types of pollution) that will affect the water quality and the plant and animal life in wetlands.



ACTIVITY: Interview a local conservation professional or land use planner. Ask your teacher or leader for help in finding someone you can talk with. What questions would you like to ask him or her? Make a list in your Nature Notebook.

Here are some sample questions you could ask:

- Are there any state or local regulations that limit human activity that would affect a wetland?
- Are there plans to build or change any wetland area in your community?
- Have any wetland areas in the community been changed to allow building in the past?

ACTIVITY: Write about what you learn, or tell a friend or family member. Do you have any **opinion** about what you learned? If so, share your opinions with others and learn their opinions as well.



Middle school class installing Wood Duck boxes that they've built. Photos courtesy of Victoria Rydberg (Madison, WI)

SHARE

Build a Nesting Structure! When humans create roads and buildings, we often destroy areas that provide nesting habitat for waterfowl. This activity focuses on ways you could help **restore** waterfowl habitat in your community.

ACTIVITY: You can help by building artificial nesting structures for waterfowl. Here are some examples. The most important thing you can do for waterfowl is to preserve their natural habitat. You learned that Wood Ducks nest in cavities or holes in trees. The best way to help cavity-nesting birds is to leave dead trees standing and leave some forest areas undisturbed. Artificial nest boxes, however, can also be helpful. It is important to place them in an area near a wetland, to space them far apart from each other and to check them regularly. Ask for help from a biologist. Wood Duck boxes that are not placed appropriately can actually be harmful for the ducks and make them more vulnerable to predators. If you want help, check with local retirees, scouts, conservation clubs, or nature centers who may be willing to lend a hand.

ACTIVITY: Explore some opportunities in your community to get involved in habitat **restoration** projects, such as planting native grasses along shorelines or removing invasive species. Ask your conservation professional partner for information on existing projects you might join or for ideas about how to start your own project. If you want help, check with local retirees, scouts, conservation clubs, or nature centers who may be willing to lend a hand.

Share & Curious Facts



CARLOS

I'm still trying to figure out why waterfowl would want to fly north in the spring. I mean, it is nice and warm down there in the winter and the lakes never get ice. Why move?

JASMINE
They migrate to northern areas to breed. The summer days are longer in the north, which gives them more time to feed their young on the tons and tons of insects and other invertebrates that hatch up there.



EMILY

That's true, but it's not an easy trip. We took a car trip from Texas to Minnesota one summer, and that was hard enough, even in a car! I can't imagine having to fly it. Waterfowl have to build up fat reserves while they are on their wintering grounds in the south to have enough energy to make it all that way. If there is not enough food on the wintering grounds, they may not nest or will lay fewer eggs.

JACOB
Predators can get 'em, too. Foxes and raccoons can take lots of eggs. In other locations, it may be gulls. For many species, if the eggs are lost, they will re-nest and lay eggs again. But after hatching, most waterfowl will not re-nest, even if the young are lost.



MICHAEL

Drought can really affect reproduction, too. When they arrive on the breeding grounds, if wetlands have dried up, the birds may go somewhere else trying to find suitable habitat. If they cannot find any, they may not be able to produce many eggs, or predators may find most of the eggs if the habitat is not in good condition.

ASHLEY
True, but remember, drought cycles are common in the Prairie Pothole Region, where most waterfowl breed, and even if reproduction is very low in some years, most waterfowl are well adapted to "bounce back" when good water conditions return.



ANTHONY

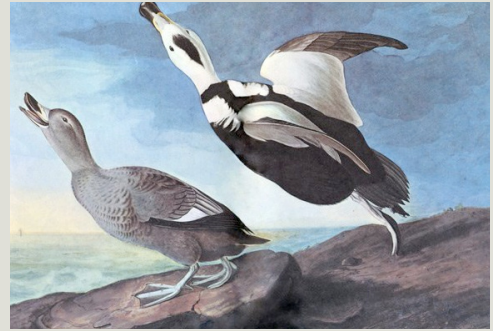
I agree with everything you guys have said, but my waterfowl reference book says that the greatest challenge to waterfowl reproduction is permanent change in their habitat. Ducks, geese, and swans are specially adapted to survive and nest in specific habitats. When those places are permanently changed, usually by us humans, the birds cannot successfully nest and raise their young.



THE MYSTERY OF THE LABRADOR DUCK

Evidence about reproduction

*In your Nature Notebook, keep a set of detective notes about the Labrador Duck. Can you find any clues about why the Labrador Duck became **extinct** in this description about its **breeding** habits?*



There is only one report of a Labrador Duck nest (Audubon 1843). However, it is not certain whether Audubon saw a Labrador Duck nest or the nest of a Common Eider. This nest was very large, formed of fir twigs on the outside, dried grass on the inside, and then lined with down. This fits the description of nests of most sea ducks, so it was probably what a Labrador Duck nest would have looked like. It was found on a rocky island near the shore, a common nesting site for most sea ducks. Animals that live on islands are more vulnerable to predators, because if their food sources or habitats change, it's difficult for them to move away. If a predator is introduced to an island, it could wipe out a population of native animals.

Nothing is known about the breeding habits, number of eggs, or other characteristics of Labrador ducklings. It's likely, however, that they had characteristics similar to other sea ducks (Scoters and Eiders). Most sea ducks have elaborate courtship displays. Scoters have 8–9 eggs in a “clutch,” Eiders have 3–5. It takes 24–31 days for sea duck eggs to hatch. Scoters are precocial. They are covered with downy feathers and their eyes are open when they hatch. They are able to fly in 45–77 days.

Sea ducks are among the slowest ducks to reach the age when they can mate and lay eggs. Young sea ducks do not breed until they are 2–3 years old (most other ducks can breed at one year old). Fewer young are raised each year than other ducks and sea ducks live longer than other ducks.

We don't know if Labrador Ducks were very common or if they were always rare. There are conflicting records from nature journals. Some journals say that they were “found in great abundance” and that it was “a common bird all along our coast from Delaware to Labrador.” Other accounts described the Labrador duck as “one of the rarest ducks.” Animals that are rare are usually much more likely to face **extinction**.





PENCIL-TO-PAPER WRAP-UP

What type of waterfowl did you have in mind when you first drew your *geo*-bird? Did you have a particular type and/or species in mind? What questions would you ask about that species and its nesting habits to make your drawing realistic? Write a few of these questions in your Nature Notebook.



Waterfowl Challenge Question

Q. When does a duck help make a quilt?

A. When it provides us with feathers used for stuffing quilts and pillows. Have you ever heard of a “down coat” or a “featherbed?” These products are made with down feathers from waterfowl, which have excellent insulating qualities. Have you ever heard of “eiderdown?” The feathers in some stuffed quilts and pillows are from the Eider Duck. To line their nests, the females pluck feathers from their breast. Their feathers are harvested in Iceland after the ducks are finished breeding. The nests are found everywhere along the coast and are a valuable source of income for the people there. Eiders feed on mussels, sea snails, crabs, shrimps, barnacles, fish, and other small crustaceans and some sea-weeds.

What did you learn?

- How do waterfowl survive and reproduce in a wetland?
- How do waterfowl keep their young ducklings, goslings, or cygnets safe and well fed?
- How do waterfowl adapt to raising their young and increasing their chances of survival in a wet and ever-changing habitat?

Unit 3. Raising a Family in a Wetland

Group 1: These are sensitive to pollutants. Circle each animal found.



Stonefly Larva



Dobsonfly Larva



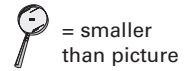
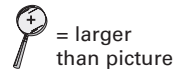
Alderfly Larva



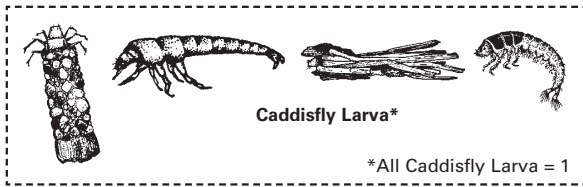
Water Snipe Fly Larva

No. of group 1 animals circled:

Relative Size Key:



Group 2: These are semi-sensitive to pollutants. Circle each animal found.

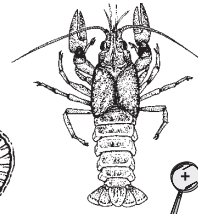


Caddisfly Larva*

*All Caddisfly Larva = 1



Dragonfly Larva



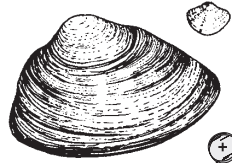
Crawfish



Water Penny



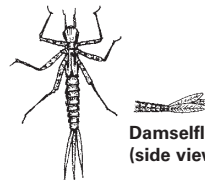
Crane Fly Larvae



Freshwater Mussel or Fingernail clam

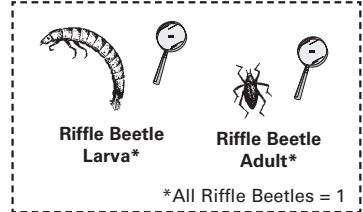


Mayfly Larva



Damselfly tail (side view)

Damselfly Larva



Riffle Beetle Larva*

Riffle Beetle Adult*

*All Riffle Beetles = 1

No. of group 2 animals circled:

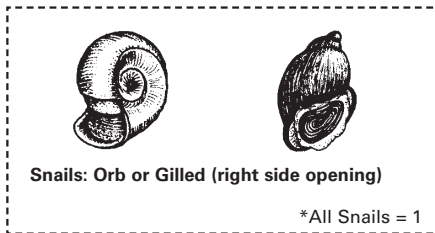
Group 3: These are semi-tolerant of pollutants. Circle each animal found.



Black Fly Larva



Non-Red Midge Larva



Snails: Orb or Gilled (right side opening)

*All Snails = 1



Amphipod or Scud

No. of group 3 animals circled:

Group 4: These are tolerant of pollutants. Circle each animal found.



Pouch Snail (left side opening)



Isopod or Aquatic Sowbug



Bloodworm Midge Larva (red)



Leech



Tubifex Worm

No. of group 4 animals circled:

For more information, call (608) 265-3887 or (608) 264-8948.

Download and print data sheets from watermonitoring.uwex.edu/wav/monitoring/sheets.html

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Water Action Volunteers

Macroinvertebrate Tally Sheet Recording Form *

Name: _____ Date: _____

Stream Name: _____ Time: _____
(make up a name)

Number of animal types from Group 1: Sensitive _____ x 4 = _____

Number of animal types from Group 2: Semi-sensitive _____ x 3 = _____

Number of animal types from Group 3: Semi-tolerant _____ x 2 = _____

Number of animal types from Group 4: Tolerant _____ x 1 = _____

TOTAL NUMBER OF ANIMAL TYPES (A) _____ TOTAL VALUE (B) _____

Index score (C) = The total value (B) divided by the total number of animal type (A)
(C = B / A)

My stream had an index score of: _____

How healthy is your cube count stream? (circle one)

Excellent = index score of 3.6 +

Good = index score of 2.6 – 3.5

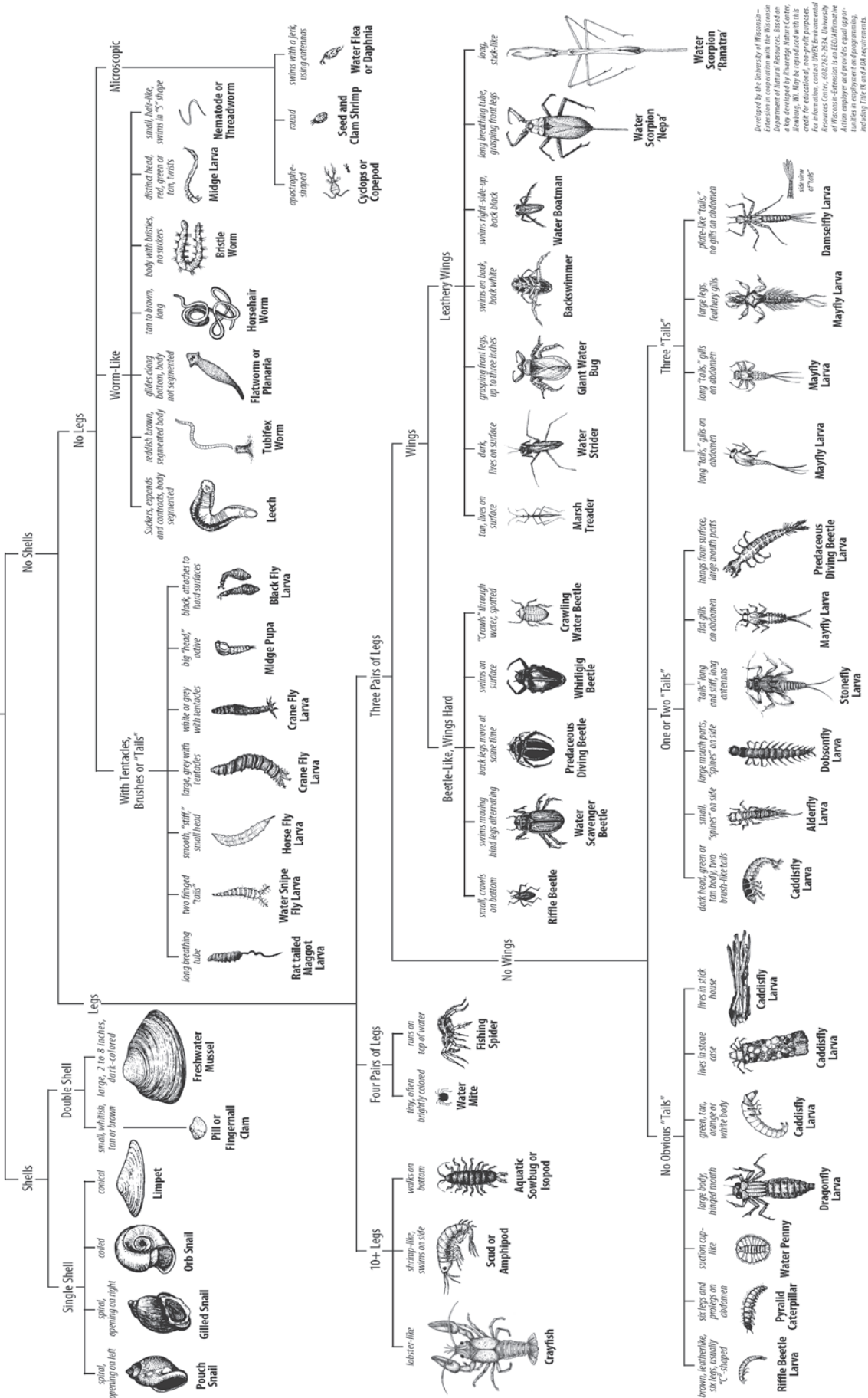
Fair = index score of 2.1 – 2.5

Poor = index score of 1.0 – 2.0

* Adapted from *Water Action Volunteers*, Univ. of Wisconsin-Extension and Wisconsin Dept. of Natural Resources, 2008.

Key to Macroinvertebrate Life in the River

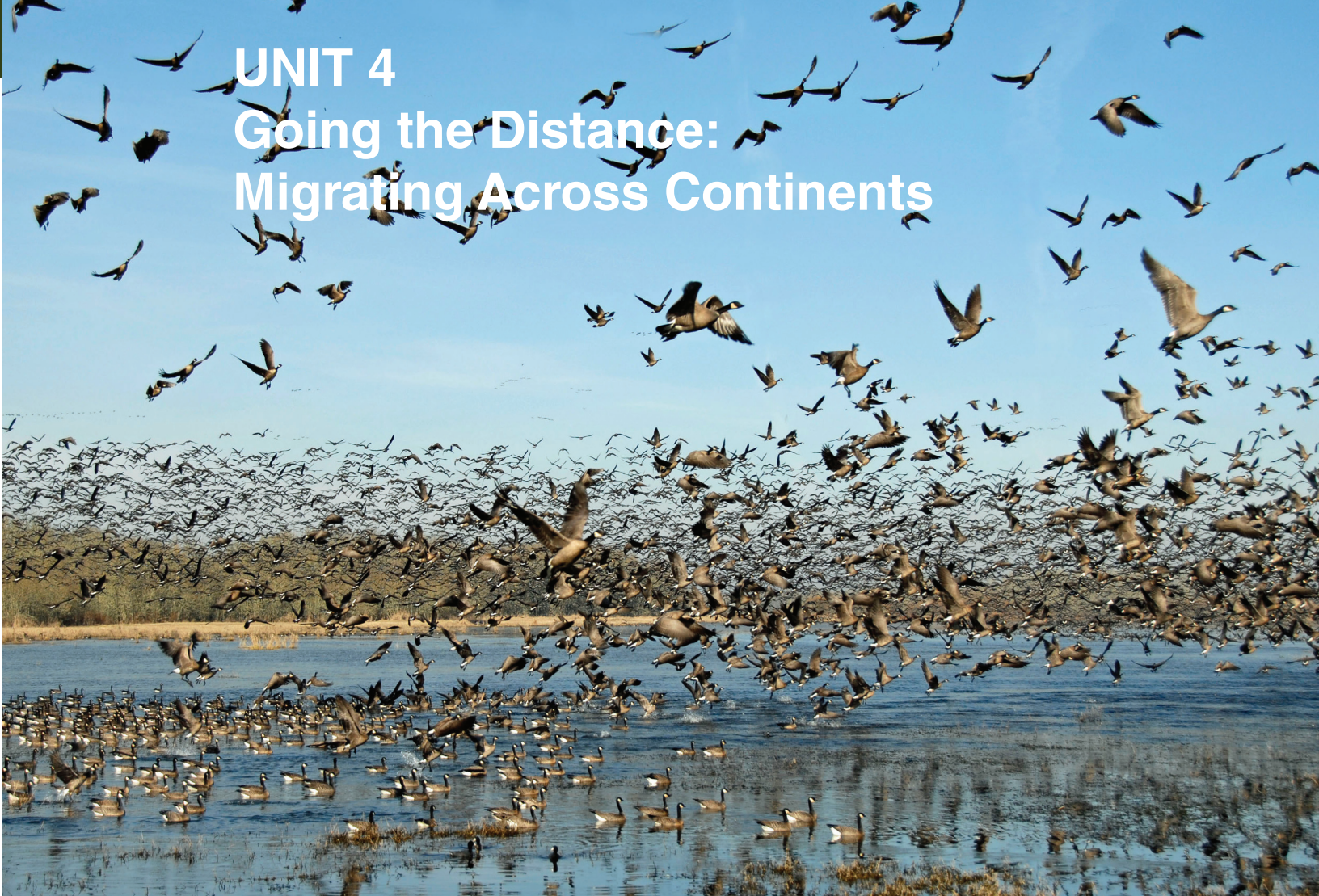
(Sizes of illustrations are not proportional.)



Developed by the University of Wisconsin-Evenson in cooperation with the Wisconsin Department of Natural Resources. Based on a key developed by Katherine Hunter Center. For educational, non-profit purposes. For information, contact WISER Environmental Resources Center, 602/742-2634. University of Wisconsin-Evenson, 1000 University Avenue, Evenson, WI 54925. All rights reserved. Includes in employment and programming, including Title IX and ADA requirements.

UNIT 4

Going the Distance: Migrating Across Continents



Canada Geese
USFWS photo by George Gentry

Waterfowl Challenge Question

Q: When geese fly in a “V,” why is one side of the “V” often longer than the other?

Look for the answer at the end of this unit.



Hannah

[Links](#)

[Info](#)

[Photos](#)

[Notes](#)

HANNAH

Of all the amazing things in the natural world, there probably isn't anything as amazing as long bird **migrations**. Imagine flying from the Arctic Circle down to Mexico! Seems like a lot of bad things could happen to these birds as they make this journey.

JACOB

Not only that, but how did scientists find out about migration? Did somebody try to follow birds around to see where they went? That's pretty amazing, too.



MICHAEL

And now with all the talk about **climate** change, you wonder how that might affect **waterfowl**—and how and where they migrate.



Thousands of Snow Geese in migration.
USFWS photo

In Unit 4...

What will you learn?

- Why, where, and how waterfowl migrate
- How scientists collect information about migratory waterfowl
- How scientists use information they gather to help waterfowl survive
- How migration patterns may be changing with a changing climate

What will you do?

- Investigate some of the mysteries of migration
- Explore migration routes and imagine yourself on a migration journey
- Investigate the impact of climate change on Mallard migration along with a team of scientists
- Create artwork illustrating a migratory journey

What will you need?

- Pencil or pen
- Nature Notebook
- Colored pencils
- Thermometer
- Roll of shelf paper or kraft paper
- Markers or paints
- A natural area to visit
- A library to visit
- Access to a computer with an Internet connection

Featured Scientist

Dr. Michael Schummer



Photo courtesy of
Dr. Michael Schummer

Links	Info	Photos	Notes
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Meet Dr. Michael Schummer, Waterfowl Ecologist

Dr. Schummer works as part of a team. Like many scientists, Dr. Schummer and his team are interested in the question: **Will climate change have an impact on waterfowl migration?** Read more about the work of Dr. Schummer in the *Investigate* section. The Mississippi State University (MSU) scientists in the Department of Wildlife, Fisheries, and Aquaculture continue to work closely with **biologists** and managers of the U.S. Fish and Wildlife Service over a wide range of waterfowl and wetlands science and **conservation** issues, particularly associated with the Lower Mississippi Valley Joint Venture of the North American Waterfowl Management Plan.

Dr. Schummer's co-investigators are Dr. Richard Kaminski of the Department of Wildlife, Fisheries, and Aquaculture, MSU; Drs. Charles L. Wax and Michael E. Brown, Department of Geosciences, MSU; and Dr. Andy Raedeke and David Graber from the Missouri Department of Conservation.



Featured Scientist

Dr. Mike Eichholz

[Links](#)

[Info](#)

[Photos](#)

[Notes](#)



Photo courtesy of Dr. Mike Eichholz

Meet Dr. Mike Eichholz, Waterfowl Ecologist

Dr. Eichholz works with graduate students at Southern Illinois University, using special equipment attached to migrating birds. He uses the information they gather to help biologists to improve their plans for making sure that waterfowl have good places to rest, eat, and breed. The research work of Dr. Eichholz and his students is based on the need to provide adequate feeding habitat for migrating waterfowl. In addition to knowing how much food waterfowl need, biologists also need to know how many waterfowl will pass through a given region and how long they will stay there.

Biologists use satellite and very high frequency **radio telemetry** (VHF telemetry) to learn about migration pathways and stopover times of **non-breeding** ducks. Placing radio transmitters on birds, however, commonly results in changes in their **behavior** (such as failure to migrate), and physiology (such as declines in body mass). In fact, some biologists refer to the use of telemetry packages as “radio-handicapping” birds. Thus, there is a need for alternative techniques that allow researchers to document **movements** of birds in space and time without affecting results.



Photo of geolocator on a duck decoy courtesy of Dr. Mike Eichholz

No perfect technology exists to understand waterfowl migration, but Mike and collaborator Joshua Stafford are interested in some equipment called light-level geolocators. Geolocators were originally designed to help us understand the wide-ranging migration patterns of seabirds that nest in colonies, but have since been used successfully on a variety of birds. Geolocators function by recording the ratio of day to night for marked individuals.

The U.S. Fish and Wildlife Service works in partnership with universities and conservation groups to improve its ability to conserve waterfowl **habitat**. Details about waterfowl migration, such as time spent at stopover sites and distances moved between stopovers, are needed to address the conservation planning goals identified in the North American Waterfowl Management Plan.

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PENCIL-TO-PAPER WARM-UP

In each of the previous units, you've been developing investigative skills. In this unit you'll add a new layer to your *geo*-bird sketch by thinking about what it might look like during migration. Will its appearance change during the journey? How about its habitat? What season is it in your *geo*-bird drawing? How does your decision about the season you choose change the details of your sketch? Create a new *geo*-bird sketch in your Nature Notebook illustrating your bird along a migratory route. Is the setting different from that you chose for your Unit 3 sketch? If so, why? Write your answer in your Nature Notebook. Share your ideas with members of your class or group.

REMEMBER: Your *geo*-bird sketch is a quick line drawing of your choice of waterfowl using only **geometric** shapes.

GETTING STARTED

Blue-winged Teal live and raise their young in northern Canada during the spring and summer. In the fall, they fly to Central and South America, more than 3,000 miles! They make the same journey every year. All species of waterfowl (as well as many other bird species) follow their own unique pathways from their spring and summer breeding grounds to their fall and winter wintering grounds.

This annual journey is called migration. Scientists and wildlife observers have learned quite a bit about how and why birds migrate. There are still, however, many migration mysteries waiting to be solved. In this unit you will explore:

Why waterfowl migrate.

How they know when and where to go.

How they survive the journey.

Where different species of waterfowl go and what paths they take.

What some threats are to their survival and how you can help minimize those threats.

Scientists know the answers to some of these questions, but others remain mysteries!



© janetandphill, Creative Commons

Why is it important to understand waterfowl migration? Understanding where, when, why, and how waterfowl migrate helps us understand what they need to survive. As with many wildlife species, their survival needs are sometimes in conflict with human activities. Understanding their needs will help us make better decisions about human activities that are needed to benefit wildlife.

Begin with the *Explore* section and read through the choices of activities. Choose at least one activity and carefully follow all of the directions. When you are satisfied that you have a good start on understanding the main ideas for Unit 4, move on to the other sections: *Investigate, Express, Share*. Plan to do at least one activity in each of the sections.

Curious Facts



HANNAH

So, why do you guys think waterfowl migrate?

SELENA

I learned that the days are longer in the northern part of the world during the summer. So, if you were raising chicks, longer days would give you more time to gather food. And those little fuzzballs have to eat almost constantly to get big enough to survive the fall migration.



MATTHEW

Good points. Also, I've been to northern Canada in the spring, and I can tell you it is an "explosion" of life. There are more bugs than you've ever seen in your life, lots of young, tender plants, and food everywhere! It would be a great place to raise a waterfowl family.

JASMINE

But you couldn't stay there! Just a few short months later, the cold sets in and the water freezes over. You'd have to be sure you were long gone before that happened, or you would starve for sure.



JACOB

Yep, migration is risky business. It takes a LOT of energy and there are many dangers along the way. But we learned in biology that birds migrate because the risks of staying where they are and starving are greater than the risks of migrating.



EXPLORE

Why do waterfowl migrate? If you were a Blue-winged Teal living in northern Manitoba (see map), why would you want to fly 3,000 miles from home? Why would you want to leave Canada in the fall? There's a compelling reason—soon the wetlands where you live and find your food (plants and small water creatures) will be frozen solid and if you stay you will starve! But now for the more difficult question: you've flown all those miles to South America, where it's warm all year long. Why would you want to fly back to the north in the spring? Check out the clues in the following activities.



Map of Manitoba



ACTIVITY: How do waterfowl know when to go south? Jot some ideas down in your Nature Notebook. You might think they just leave when the food runs out or they start getting cold—but it's a little more complicated than that. What clues might they use to let them know it's time to move? What are some factors that change with the seasons? Some species of ducks and geese leave the north in October and some stay through December. They also vary in the times they return in the spring. Scientists think that changing day length is an important cue for waterfowl to get ready to migrate. When the days start getting shorter in autumn (or longer in the spring) the birds start getting restless. However, changes in the **weather** are the “trigger” to actually get them moving.

- In your Nature Notebook, make a list of reasons you think might explain how waterfowl know when to migrate in the fall. See the Unit 4 description of Dr. Schummer's research for more ideas (page 124). After you complete this unit, return to your Notebook to see if your ideas were correct.

How do waterfowl know where to go? This is a hard question to answer because we can't ask a duck how he or she knows where to go. Have you ever been lost? Maybe you got off the trail at a hike in the woods, or came out of the mall and couldn't remember where mom parked the car. Being able to find your way home is very important. Waterfowl have an amazing ability to migrate thousands of miles—across countries and even continents—without getting lost. And many times, they are able to do this at night or when clouds and fog make it very hard to see the ground beneath them. How do they do this?

If you were a duck, when might you navigate using the stars? When might you need to use the earth's magnetic field? When would you use a landmark, such as a river? What methods do you think are more reliable and help you find the exact place you nested or spent the winter last year? Birds are very good at navigating with landmarks and the sun and stars, but are less precise when using “back-up systems” like magnetic fields. So—would you be able to reach your exact destination more easily if the weather were clear or cloudy?



ACTIVITY: If you wanted to study how birds navigate, how might you set up your experiment? Make notes about your investigation ideas in your Nature Notebook. Show your ideas to a science teacher at your school and ask him or her to suggest ways that you could improve your study. Read *Meet Mike Eichholz* (page 125) and learn how scientists study migration.



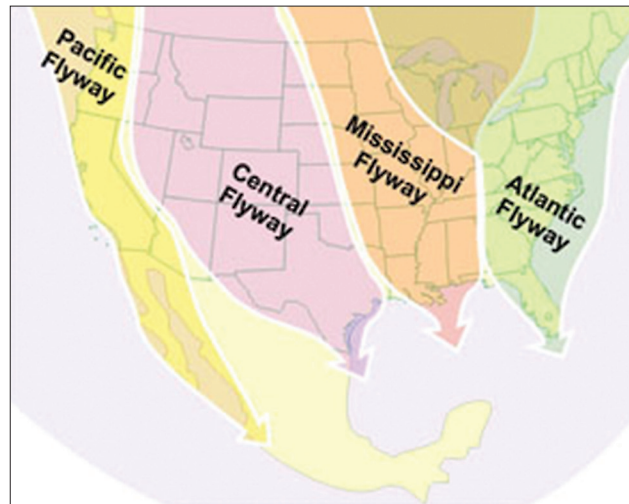
EXPLORE

Where do different species of waterfowl go and what pathways do they take?

More than 100 years ago, waterfowl hunters observed that waterfowl follow distinct, traditional migration corridors or *flyways* in their annual travels between breeding and wintering areas. Here is a map showing the major flyways in North America. Find where you live on the map. Which flyway do you live in or near? These are general patterns, not precise routes. And they are just the flyways in North America. Similar flyways exist around the globe, connecting Asia and Australia, Europe and Africa, etc.



ACTIVITY: Look at the map of the flyways in North America and make a note in your Nature Notebook about which flyway is closest to your home. Then look for information in the library or on the Internet to determine which species of waterfowl typically use the flyway near your home.



Courtesy <http://arctic.fws.gov/birdmig.htm>

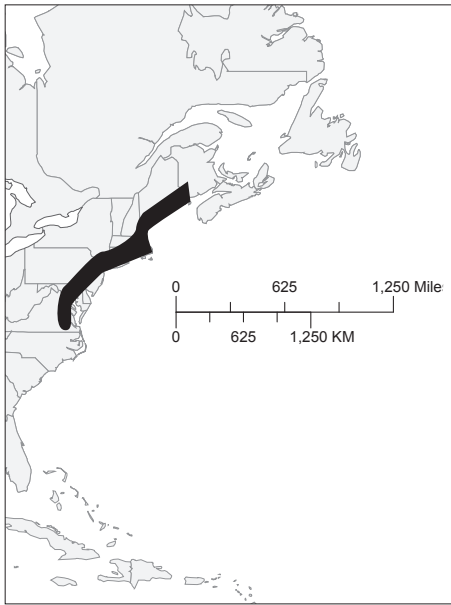


Migration Math: These maps show the migration routes for three species that use a flyway. Many species are found in more than one flyway.

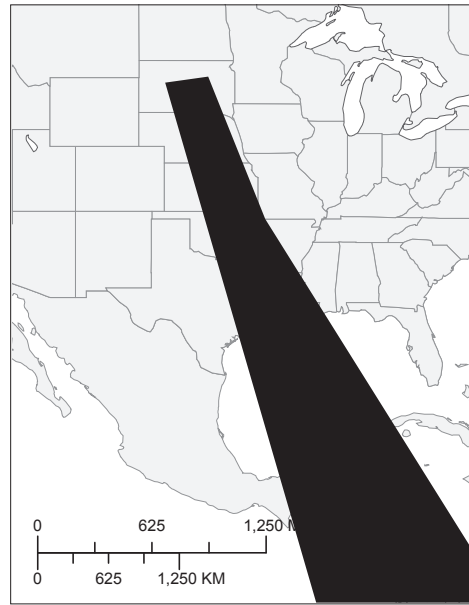
ACTIVITY: Look for the mileage scale on each map. Measure each migration route with a piece of string (may be easiest if the pathway is not straight) or a ruler and then compare the marked string or measurement with the mileage scale to calculate the distance traveled by each species. Practice thinking about distance using the metric system; convert the mileage to kilometers. Calculate how long the journey would take using information on the map. Note the results in your Nature Notebook.



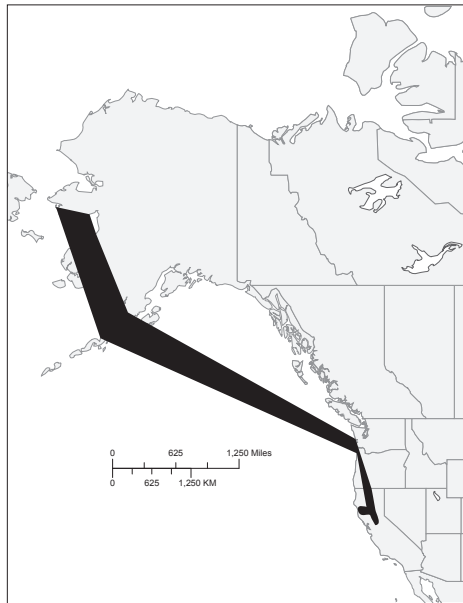
EXPLORE



Atlantic Flyway
Black Duck



Central Flyway
Green-winged Teal



Pacific Flyway
White-fronted Goose

Explore & Curious Facts



HANNAH

How do birds that migrate know where to go? I mean, if they flew the wrong direction in the spring or fall, they would be in big trouble.

ANTHONY

I was reading in my waterfowl book that most scientists think that birds are able to navigate several different ways, and they use the way that works best for their situation.



JASMINE

Makes sense. My Dad is a pilot, and they do the same thing—they make sure they have a back-up navigation system in case the main system fails. You would definitely want a back-up if you were flying this remote Canadian lake.



USFWS photo by Guthrie Zimmerman

HANNAH

Yeah, but what are the different ways—how do they do it?



ANTHONY

Most scientists think that birds are able to navigate by following landmarks, such as rivers, mountains, valleys, ridges, etc. They also follow the sun or stars, especially those stars that remain near the north and south poles.

EMILY

Those are probably the “usual” ways, but remember a while back I told you guys that I saw a TV show that said some waterfowl may have small amounts of the mineral magnetite within their brains, which allows them to follow the Earth’s magnetic field!





CARLOS

That all sounds impressive, but how do scientists figure this stuff out?

EMILY

The TV show said there was a scientist named Steve Emlen who used captive birds in large enclosures. He would train birds to find food using clues. For example, some experiments were conducted in planetariums – you know, those big, dark rooms where they can project stars and constellations onto a black ceiling. He had geese that could find the food by heading north using the positions of the stars. Then he did the same with magnetism, and found out they could find which way to go using just the earth's magnetic field.



NOTE

To learn more about how scientists study migration, read about Dr. Mike Eichholz, Waterfowl Ecologist, in this unit.

.....



How do waterfowl survive the journey? First, let's think about how far some ducks and geese travel. Some of the longer migrations (Blue-winged Teal, Redheads) travel close to 3,000 miles. Bird bodies are built for flight—hollow bones, specialized feathers and streamlined bodies. Most waterfowl fly 28–50 miles per hour. (On average, a car driving on a city street might go 25–35 mph!) They also fly relatively low during their migration compared to other birds, generally lower than 1,000 feet. They will fly up to 6,000 feet while over large bodies of water. Just like jet pilots, they adjust their altitude to find the level where there is the least amount of air turbulence.

EXPLORE



ACTIVITY: Imagine yourself on a 3,000 mile journey.

- If you drove approximately 40 mph and drove 10 hours each day, how many days would it take before you arrive at your destination? Do the math and show your work in your Nature Notebook.
- What would you do when you got tired of driving each day? What would you do when you got hungry? What do you think waterfowl do when they get tired or hungry? There is no Duck Inn or fast-food restaurant serving tadpole burgers or duckweed salad. How could you find the answer?

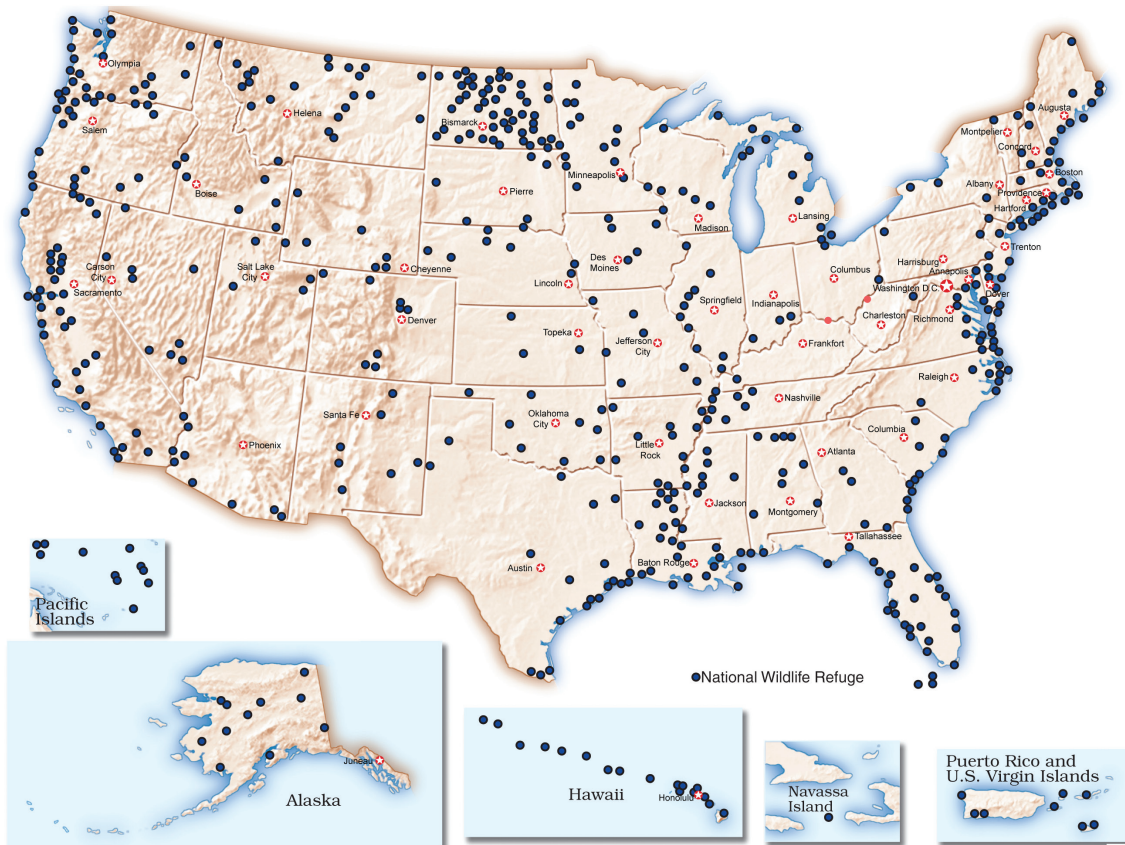


ACTIVITY: Is there a place near your home or in your community where waterfowl could stay overnight on their way? Look at this map of **national wildlife refuges**, and then go to the national wildlife refuge system website (www.fws.gov/refuges) to find the refuge closest to you. In your Nature Notebook, write down the name of the refuge closest to you. Refuges are a national network of lands and waters set aside for the conservation, **management**, and where appropriate, **restoration** of fish, wildlife, and plant resources and their habitats. Refuges are **managed** by the U.S. Fish and Wildlife Service.

- What is the habitat at the refuge closest to your home?
- Why was the refuge established? (HINT: Look on the refuges website)
- Is the refuge managed for waterfowl? If so, how?



EXPLORE



There are more than 550 national wildlife refuges and more than 38 wetland management districts in the system. Visit one near you!



ACTIVITY: Compare the migration routes of each species that you studied in the “Migration Math” activity with the map of refuges. Which stopover sites might be important to each species? Choose a species that migrates through the area where you live, find a national wildlife refuge near you, and read about that site on the refuges website.

EXPLORE



ACTIVITY: Learn what people do at a refuge to help waterfowl and how you might get involved. (HINT: Look at the refuge website at www.fws.gov/refuges for ideas.) In a small group, talk about what questions you could ask to find out more. Make a list of questions in your Nature Notebook. To get started, you could look for information about these jobs: refuge manager, environmental educator, outdoor recreation planner, waterfowl biologist, waterfowl **ecologist**, pilot biologist, and law enforcement officer.

Refuge job	What does this person do?
Manager	
Environmental educator	
Outdoor recreation planner	
Waterfowl biologist	
Waterfowl ecologist	
Pilot biologist	
Law enforcement officer	



© Alan Grinberg

Explore & Curious Facts



ASHLEY

My book of waterfowl fun facts has some interesting stuff on migration. Does anyone know why waterfowl fly in a “V” formation?

CARLOS

Yeah, I got this. If you fly right behind and slightly to the side of the bird in front of you, you run into a lot less wind resistance than if you are flying alone. It’s like race cars drafting off the car in front of them to save fuel.



ASHLEY

Hey, I’m impressed, that’s right! The book says that waterfowl fly in “V” and “W” formations more than any other kind of birds, to conserve energy and to enjoy the safety of large numbers. They will take turns at the lead, where it takes the most energy. They rotate to the back of the flock when they need a break.

JASMINE

How come other birds don’t do that?



ASHLEY

There are many different styles of flight. For instance, most hawks and eagles are **adapted** to soar for long distances. But waterfowl must constantly flap their wings to stay airborne. So ducks and geese need to have more fat on their bodies before migration because they use more energy flying.

MICHAEL

That’s got to be exhausting, flapping their wings all the time. Do they ever get tired or hungry?



ASHLEY

They do take along some food with them in a way, by “fat loading” before their journey. That is, they eat as much **nutrient**-rich food as possible to put on fat before migration.

ANTHONY

Yes, but stopover locations with water, shelter, and food are still crucial for them to survive. Wetlands and ponds are most important for resting and eating. They could be as small as a pond in your backyard, but for the millions of waterfowl and other birds that migrate, many large wetlands are needed at various places across the country.





MICHAEL

I got it. That's where national wildlife refuges, state game lands, and urban parks come in. And some of them are much better than others. I live near Rice Lake National Wildlife Refuge in Minnesota, and it is like a luxury hotel for waterfowl. The managers there make sure the waterfowl get exactly the kind of habitat they need and the highest quality, most nutritious food.

MATTHEW

There are private landowners who create and conserve really good habitats as well. My Dad has hunting buddies who have **restored** hundreds of acres of wetlands that provide great habitat for all kinds of critters, not just waterfowl.



JACOB

That's great, but many stopover sites have been destroyed or changed by human activities, and the high quality food replaced by plants that aren't as good. Waterfowl may still stop at these sites, but they may not get the rest and nutrition they need to continue on their journey or to reproduce once they get to their **breeding** grounds.

INVESTIGATE



Featured Investigator, You. You've learned that all along the migration pathway, waterfowl need a variety of habitat: wetlands, uplands, and nesting sites, including urban and rural locations. Is your community a starting, resting, or stopping place for waterfowl? If so, what is it about your community that attracts waterfowl? If not, is there something missing in your community that is needed to support migrating waterfowl?

ACTIVITY: Look again at the map showing the migratory pathways of waterfowl (page 129). Is your community at the beginning or the end of the pathway, or part of the route?



ACTIVITY: Think of a question about waterfowl migration that you want to investigate, alone or with a group. In your Nature Notebook, write your question and explain the plan for your investigation. What is your question? Who or what resources could help you answer that question?

Meet a Waterfowl Ecologist. Like many scientists, Dr. Michael Schummer and his team are interested in this question: Will climate change have an impact on waterfowl migration? (Read *Meet Dr. Michael Schummer* at the beginning of Unit 4, page 124). Why do you think these scientists care about impacts on waterfowl migration? If you were going to try to answer this question, what factors would you study? If you want to learn how climate change is affecting migration, you have to study at least two **variables**: climate and migration, then see if there is a relationship. In addition to just being curious, there is a practical reason for learning when and where ducks might go. You already learned that habitat for breeding, wintering, and stopover areas is important to waterfowl survival. What if duck migration patterns change and they start going to different places at different times? Perhaps we will need to protect habitat in different areas than the ones those the ducks currently use.



INVESTIGATE

ACTIVITY: Imagine yourself as a member of Dr. Schummer’s team. First you want to keep track of how many Mallards there are at specific locations at specific times. Dr. Schummer’s team observed ducks at important **staging areas**, where Mallards flock together as they travel along the migration route. Look at the data (Table 1, page 138) from one of these staging areas, Grand Pass Conservation Area, Missouri.



- What do you notice about how the number of Mallards changes over the months of October through early January? Does the number change gradually or all at once? Compare the dates and numbers of Mallards in 1999 to the dates and numbers of Mallards in 2000. Is there a difference?
- Apparently, the change in day length makes waterfowl restless and gets them ready to migrate. But changes in the weather are what make them actually start flying! Do you think the weather in 2000 was different than the weather in 1999? Why or why not?
- What do you think caused so many Mallards to migrate at specific times?



Table 1: Mallard migration data from Grand Pass Conservation Area, Missouri

Mallard Abundance		
Date	1999	2000
Oct. 1	100	50
Oct. 14	500	1,000
Oct. 28	8,000	4,000
Nov. 11	15,000	100,000
Nov. 25	60,000	250,000
Dec. 9	80,000	5
Dec. 23	200,000	0
Jan. 6	6,000	0

INVESTIGATE

Investigate & Curious Facts



ANTHONY

I always thought all ducks moved from north to south during winter migration, and then back again in the spring. But I just found out that some ducks move more west to east, such as some Canvasbacks that migrate from North Dakota east to the Chesapeake Bay for the winter. That's near where I live in Maryland.

JACOB

I thought they just moved north and south, too. How did scientists figure out which way they go, anyway?



ANTHONY

It's cool—scientists around the world help track birds by banding. With permits from the U.S. Fish and Wildlife Service, trained banders catch birds in special nets or traps that don't harm them. Metal bands are placed loosely around their legs. The bands have codes that tell where and when the birds were caught. When a banded bird is recovered, like if a hunter gets one, he or she reports the band number to biologists. Since biologists know where the birds were banded, and where they were recovered, over the years it gives them a really good picture of where birds go.

MATTHEW

My Dad has harvested several ducks that had bands, and he goes to the website listed on the band to report it. The banding program provides a lot more information to biologists than just migration patterns, too. You guys should check out www.flyways.US website. You can look up the banding and recovery locations of all waterfowl banded in the Americas since 1914!



SELENA

I just went to that site, and it is really cool. There is a bunch of other interesting information on waterfowl management as well. Like for instance, did you know that pilot biologists and biologist observers with the U.S. Fish and Wildlife Service fly aerial surveys each year to **estimate** how many waterfowl are in the population and to assess how many wetlands are there, how much water is in them, and how much food and cover are available? Check it out. You can read some of the pilot biologists' flight logs to see how they conduct their research on duck populations. You can even see a video from a plane!



HANNAH

And if you're really interested in banding, you should check with a refuge or nature center near you. You might be able to help a biologist band birds.



Leg band for waterfowl
© DJ Case & Associates



INVESTIGATE

What do you think would cause Mallards to migrate? Snow? Freezing temperatures? Dr. Schummer's team of researchers gathered snow and temperature data from weather stations near **waterfowl conservation areas** in Missouri (staging areas) used by thousands of Mallards during autumn migration. The team observed what types of weather resulted in migration of Mallards from the conservation areas. They found that no single factor made Mallards migrate. Rather, the combined effects of cold temperatures, consecutive days below freezing, snow, and the number of days with snow on the ground best explained decreases in the numbers of Mallards on the conservation areas in Missouri. Dr. Schummer's team developed a formula called a Weather Severity Index (WSI) to help them predict when the Mallards would migrate, and to be able to compare migration patterns from one year to another.



INVESTIGATE

ACTIVITY: Look at the chart below to find out how to calculate the Weather Severity Index (WSI). See some examples of the type of data the team collects, and how they record their measurements in the next activity. Try using the WSI yourself. The research team determined that a WSI of 8 or greater caused Mallards to migrate. The larger the WSI values, the greater the chances of a large migration.

Table 2. Steps to calculate the Weather Severity Index (WSI)

WSI – Weather Severity Index =

- Average daily temperature in degrees **Centigrade**
 - Plus (+) snow depth in inches
 - Plus (+) number of days below freezing
 - Plus (+) number of days with snow cover greater than 1 inch
-

Steps to calculate the WSI

1. **Temp** – Convert the **Fahrenheit** temperature to **Centigrade** (ask your teacher for help). Then change the sign in front of the temperature so that colder temperatures ($-^{\circ}\text{C}$) are changed into positive numbers; and temperatures above 0°C are negative. A temperature of 0°C does not change, so the value would remain 0.
 2. **Tempdays** – The number of consecutive days that the temperature was below freezing (0°C).
 3. **Snow** – The snow depth in inches.
 4. **Snowdays** – The number of consecutive days with snow greater than 1 inch.
 5. **To calculate the WSI value**, add values from steps 1– 4 together (Temp+Tempdays+Snow+Snowdays)
-



INVESTIGATE

ACTIVITY: Look at Table 3 for sample information to use to practice calculating the Weather Severity Index (WSI).

- Use the formula to calculate the WSI for Wisconsin, Missouri, and Arkansas on the days described. Was your answer the same as the number in the chart? If yes, then you did the calculation correctly.
- When do you think Mallards might leave each location for areas farther south? Remember: the larger the WSI values, the greater the chances of a large migration.
- Can you predict when they might show up where, based on the information from the few days shown on the chart?
- What might the future hold? Scientists think that temperatures over much of North America will increase over the next century. Choose one of the sites and add 2 degrees to each temperature recording. Don't forget that when the temperature is above freezing, convert the snow cover to zero. How will this new information affect Mallard migration?

Table 3. Sample Weather Severity Index (WSI) calculations for three locations.

Here is a sample of the data that Dr. Schummer's team used to calculate the WSI. If you would like to investigate this idea in more detail, you can use Dr. Schummer's detailed data to study how migration may be affected by weather severity. All together, Dr. Schummer and his team collected data for November 2009–January 2010, from four different locations along the Mallard's migration route. The detailed data are available from your teacher or leader.

Calculations

Location	Day	Temp (°C)	Snow Depth (inches)	Temp	Tempdays	Snow	Snowdays	WSI
Wisconsin	Monday	1	0	-1	0	0	0	-1
	Tuesday	-2	2	2	1	2	1	6
	Wednesday	-5	6	5	2	6	2	15

Missouri	Monday	5	0	-5	0	0	0	-5
	Tuesday	3	0	-3	0	0	0	-3
	Wednesday	0	3	0	1	3	1	5

Arkansas	Monday	8	0	-8	0	0	0	-8
	Tuesday	6	0	-6	0	0	0	-6
	Wednesday	4	0	-4	0	0	0	-4

Investigate & Curious Facts



MICHAEL

I hear all this talk about the Earth's climate getting warmer and all that, but here in the Minnesota winter, it seems just as cold as it ever was. In fact, just yesterday we had one of the coldest days on record for this time of year. How do they know about climate change?

JASMINE

One thing to remember is that climate is not the same as weather. Weather refers to temperature and precipitation at any one point in time. Climate is the range of weather conditions in a certain region over a long period of time—like decades or centuries.



CARLOS

And climate is hard to study. At our school we have some weather instruments, and one of the classes records temperature and precipitation every day. We have this information for almost ten years now, but it is still hard to see definite **trends**. We will need those same measurements at the same spot at the same time for many years to be able to say anything about climate. It is definitely NOT the same as weather.

ASHLEY

You might have one very cold and snowy year and the next year might be warmer with less snow. But in class we learned that the climate of North America has been getting gradually warmer for many years, and scientists think it may continue to get warmer for many years to come.



MATTHEW

This long-term climate change could affect local weather and could influence how far Mallards will migrate. Increasing temperature may reduce snow and ice cover up north near Michael and allow Mallards to stay closer to their breeding grounds. Think about it like a duck: When they fly north in spring to nest and raise ducklings, why would they travel any farther or any sooner than necessary?



© Horia Varlan



© Frederick Ohlin

Looking at the past to understand the future. Bird migration is a seasonal event that happens every year at approximately the same time. The study of seasonal events is called **phenology** (“feen-ohl-oh-gee”), which literally means “the science of appearance.” What other phenological events can you think of? Do you ever notice when the first green buds begin to appear on trees in the spring? When the ice first forms on the lake in the winter? When a certain flower blooms? Do these things happen at exactly the same time each year? Just as birds pay attention to cues to know when to migrate, all wild animals and plants undergo changes throughout the year, determined by factors (like temperature and day length) that change with the seasons.



INVESTIGATE

ACTIVITY: Aldo Leopold (1887–1948), was a well-regarded Wisconsin scientist and writer who is celebrated around the world for his work as an ecologist. Aldo and his family recorded observations of many plants and birds over many years. Here, we’ll look at one of the waterfowl species that they observed each year: The Canada Goose.

- These data shown in Table 4 include 1937–1945 dates for Canada Geese passing through Wisconsin in both spring and fall on their way to or from their breeding grounds further north; and 1998–2007 dates from Aldo’s daughter, Nina Leopold Bradley’s, more recent observations. Look at the table below. You will notice some gaps in the data set. There were some years that Aldo or Nina did not record their first sighting of the Canada Goose. What do you notice in comparing Aldo’s observations with Nina’s? Write your observations in your Nature Notebook.



Table 4. Leopold goose migration data

ALDO	1937	1938	1939	1940	1941	1942	1943	1944	1945
Spring Arrival	25 Mar	12 Mar	1 Apr	31 Mar	30 Mar	8 Mar	4 Apr	12 Mar	24 Mar
Fall Arrival			15 Oct	22 Oct	12 Oct	27 Sept	17 Oct	15 Oct	6 Oct

NINA	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Spring Arrival	22 Feb	13 Feb		5 Mar			11 Feb			
Fall Arrival	6 Sept		18 Sept	12 Sept	26 Sept			13 Sept		15 Sept

Data courtesy of Nina Leopold Bradley and Sarah Wright



INVESTIGATE

- It may appear that there is a trend, but how could we measure how much of a difference there is between Aldo’s and Nina’s observations?
- It is easier to calculate differences in dates and average dates if you change the calendar date to a Julian date. A Julian date is a number assigned to a date, with “1” assigned to January 1st, “2” assigned to January 2nd, and so on. This allows us to compare dates and calculate the difference in arrival over a period of time.
- Use Aldo’s and Nina’s data to fill in Table 5:

Table 5. My Julian date calculations for the Leopold data

Data Description	Calendar Date	Julian Date
Average spring arrival date		
Average fall departure date		
Spring arrival date: Aldo – 10 year average		
Spring arrival date: Nina – 10 year average		
Fall departure date: Aldo – 10 year average		
Fall departure date: Nina – 10 year average		
Earliest spring arrival date		
Latest spring arrival date		
Earliest fall departure date		
Latest fall departure date		

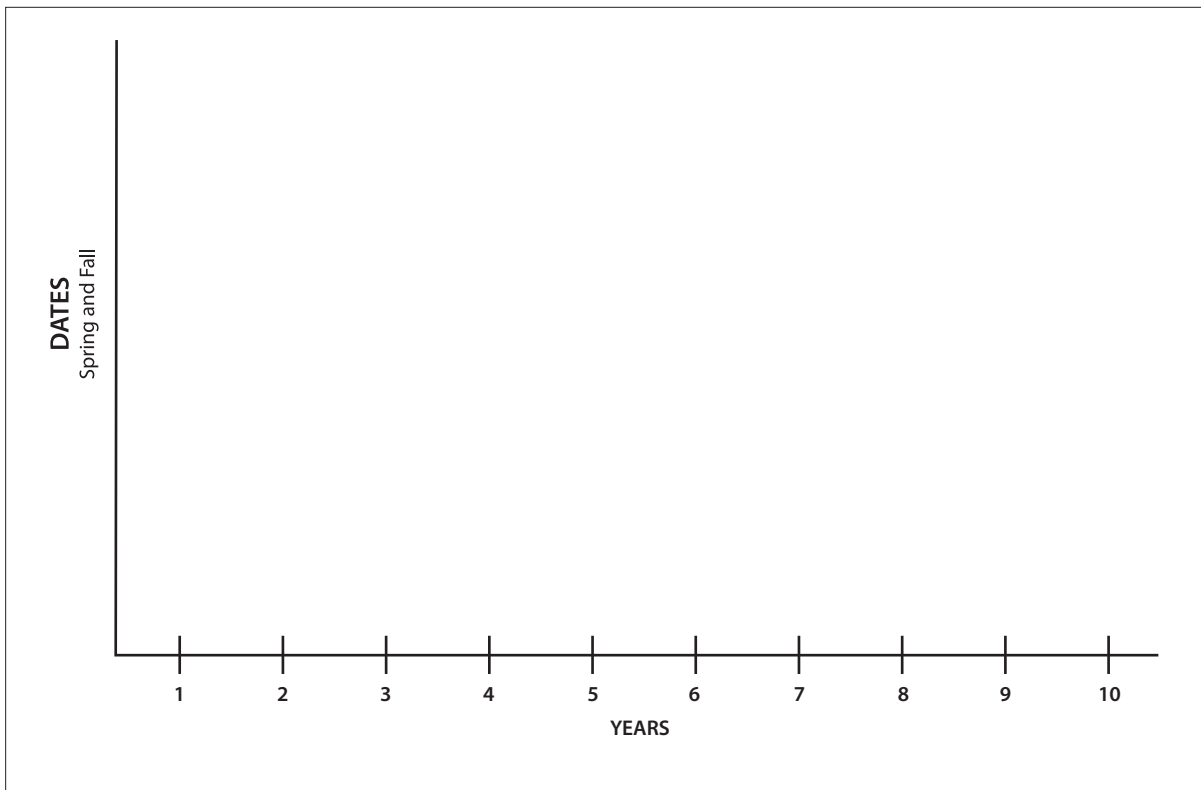


Use Aldo’s and Nina’s data to make a graph in your Nature Notebook, plotting the Julian dates by year for both Aldo’s and Nina’s 10-year periods. Use a different color for Aldo’s and Nina’s data. Be sure to include a legend that explains which color is Aldo’s data and which color is Nina’s data. Table 6 shows a sample to help you make your graph.



Table 6. Sample graph for your Nature Notebook

INVESTIGATE



In your Nature Notebook, describe what you observe and explain your conclusions. When (month and year) was the earliest arrival of the Canada Goose to Wisconsin? When (month and year) was the latest? What is the difference? What does this tell you about when geese are arriving in Wisconsin in the spring? Is it earlier or later? By how much? Why do you think this might be the case?

You too can be a phenologist! These data are very useful to biologists studying wildlife and how their growth and behavior patterns are changing with climate. Use your Nature Notebook to record seasonal changes that you observe. There are even websites where you can enter your data and be part of international research teams studying the phenology of plants and animals! If you are interested in exploring these sites, check with your teacher for resource ideas.

Investigate & Curious Facts



SELENA

Have any of you guys ever heard of Aldo Leopold? He is considered the father of modern wildlife management, and he also was a very good writer. My uncle gave me a copy of his most famous book, *A Sand County Almanac*. It is really good. You should see if your school library has a copy.

JACOB

I never heard of him, but I looked him up online and found a lot of information. Like he was very interested in the timing of life cycles, and he was always carrying around a notebook to record events like the first bloom of flowers and return of migrating birds.



SELENA

Exactly! As I'm reading *A Sand County Almanac*, I've noticed his interest in the timing of natural events comes out on almost every page. And he writes it so beautifully! The book contains observations Aldo made from 1936–1945 near his family's farm near Baraboo, Wisconsin. The whole Leopold family did this for fun during their trips to the farm that they called the "Shack."

JACOB

One website said that when Aldo's daughter, Nina moved back to Baraboo in 1976, she started right where Aldo left off, recording over 300 natural events, and when she passed away in 2011, she still had a clipboard for making observations hanging in her kitchen. Over a lifetime, that hobby could provide a lot of information to help in the study of long-term trends affected by climate.



SELENA

I copied a photo of Aldo Leopold and his daughter Nina near his "shack." He reminds me of my grandpa. And here is a sample of his writing to help us as we wait for the spring. (From *A Sand County Almanac*, "March: The Geese Return.")

"One swallow does not make a summer, but one skein of geese, cleaving the murk of a March thaw, is the spring."

"The whole continent receives as net profit a wild poem dropped from the murky skies upon the muds of March."



Photo courtesy family of Aldo Leopold



Photo courtesy Aldo Leopold Foundation
www.aldoleopold.org

EXPRESS



Tundra Swan
© Gene Reineking

Artist’s Statement: “The Tundra Swan is a brief visitor to central Wisconsin. As I walk at night on the ragged edge of spring, the calls of this magnificent bird tell me that winter is indeed in retreat. A powerful and graceful flier, the swan rests on ephemeral lakes of snowmelt covering frozen farm fields before it heads for the wide, wild places.” — Gene Reineking



Visit your favorite bird. You’ve learned that some waterfowl travel long distances, through several different countries. Have you ever traveled to another country? If not, think about a country you might like to visit. Each country (and sometimes even each region within the same country) has its own unique way of life or culture. People speak different languages, eat different foods, wear different types of clothes, make their living in different ways, and have unique forms of art, music, and dance.

ACTIVITY: Choose one of the species you learned about in the “Migration Math” activity in *Explore*. List the countries that species travels through. Find photos of landscapes from various places along the migration route. Learn about the culture of the countries, particularly examples of their visual artwork — painting, drawing, sculpture. If possible, find examples of waterfowl in their artwork or writing. How does this culture view waterfowl?

ACTIVITY: Create artwork that reflects the different cultures and habitats your species travels through on its annual migration. Check the next group of activities, “Draw it yourself,” for some ideas.



Draw it yourself.

ACTIVITY: Create a series of paintings, drawings, or sculptures of the same species using different artistic techniques used by different cultures. For example, you might draw a Blue-winged Teal using Inuit (northern Canada and Alaska), Native American, and Central American artistic styles.

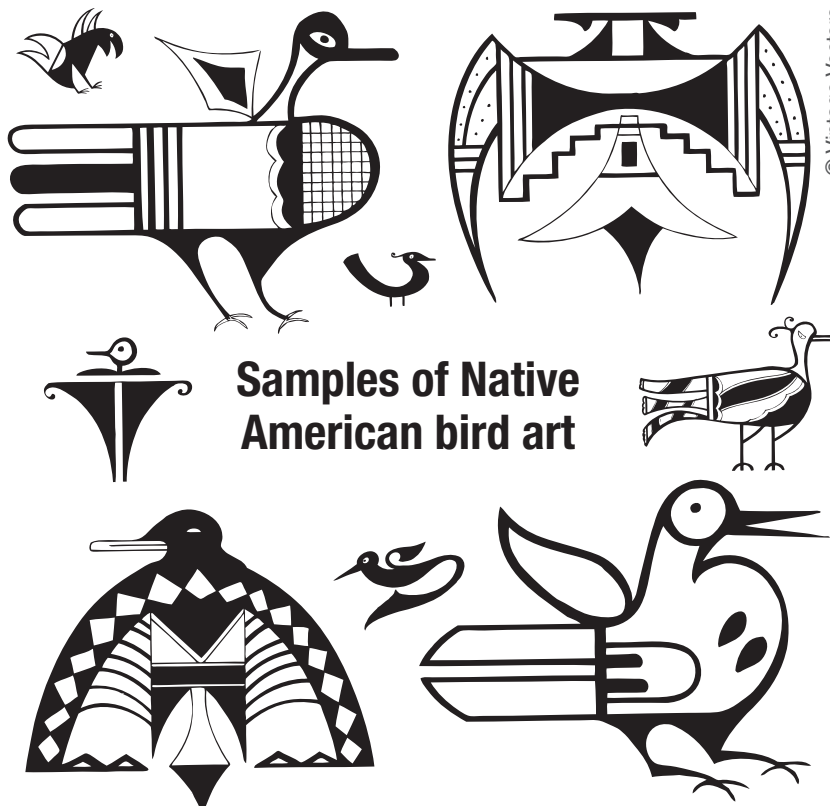
ACTIVITY: Create a large mural that traces your species' migration pattern, highlighting each area with photos, drawings, or paintings of habitats and landscapes from that area.

ACTIVITY: Write a travel journal of a waterfowl species. You can begin at the wintering grounds or the breeding grounds. Write from the bird's point of view, considering all of the factors (how, why, where, and what) you learned above.

ACTIVITY: Find photos or artwork of landscapes from various places where a specific species might land along the migration route. In your Nature Notebook, describe what might attract the duck to that spot—or why they might want to avoid some areas.



Dancing goose, Qiatsuk Shaa



Samples of Native American bird art



ACTIVITY: Find an area near your home that you can visit regularly, once a week or even once a month. It could be a wetland habitat for waterfowl, a woods, a prairie, or even a city park. Spend at least 30 minutes outside observing. Write and draw what you see in your Nature Notebook. Here are things to look for:

- Plants | Do they have leaves? How big are the leaves? Do they have flowers or fruits?
- Animals | What animals do you see? Where are they? What are they doing? Do you see signs that animals have been there? (Tracks, droppings, chewed leaves, feathers, fur, etc.)
- Weather | If you have a thermometer, measure the air temperature. Is it windy or calm? Cloudy or sunny? Raining or snowing? Is there any snow on the ground? If so, how much?
- People | Are there any other people? What are they doing?
- Make sketches of any specific things that interest you.
- After you've observed details in your area, think about the overall "mood" of the place on this particular day. How does this place make you feel?
- Make a drawing that expresses how you feel about the place.
- "Use the eye of a scientist and the heart of an artist."
(Jeff Maas, elementary teacher, Madison, WI)
- Each time you go to this place, notice what is different from the last time you visited. Look back at your previous journal entries. You will be surprised at how much things can change and how much is happening!

SHARE

What could you share? Share what you've learned or feel about waterfowl migration with classmates, family, friends, and others in your community.

- Your artwork.
- The results of your science investigations or explorations.
- Fun facts (related to migratory waterfowl).
- Your time (ask your teacher for suggestions about migratory waterfowl **stewardship** activities).
- Your Nature Notebook — create a blog.
- A video of your artwork or Nature Notebook on your teacher's website or animoto.com
- Other ideas? Write them in your Nature Notebook and share them with your group.



Reflection on waterfowl migration.

ACTIVITY: Using the medium of your choice (drawing, painting, writing, music, etc.) write about or tell someone something interesting or fun you learned from the activities about waterfowl migration.

THE MYSTERY OF THE LABRADOR DUCK

Evidence about migration

Throughout these units, we have been investigating the mystery of the Labrador Duck, which became **extinct** over 125 years ago. No one knows for sure what caused the **extinction**, but we have many clues. There are no definite records of Labrador Duck breeding, no confirmed sightings of nests or eggs. There are several eggs in museums that are labeled as Labrador Duck eggs, but DNA research shows they are not. The labels indicate they were collected in various places on the Atlantic coast of Canada and Greenland. Labrador Ducks probably nested along the Gulf of St. Lawrence, the coast of Labrador, and the Canadian Arctic. Most of the records of sightings of the Labrador Duck were in their wintering grounds, along the Atlantic coast from Nova Scotia south to Chesapeake Bay. The closely related Spectacled Eider Duck may offer clues. Scientists recently answered the question: “Where do Spectacled Eiders go in winter?” The population was decreasing and they were listed as a threatened species. Scientists knew their breeding grounds were in Alaska and Russia. Finally, some breeding Eiders were fitted with radio transmitters and followed. One of these transmitters was later found in the Bering Sea! The scientists could not believe it! They thought this bird had flown off course and ended up in the wrong place (The Bering Sea is very far north and scientists didn’t think this would be a suitable wintering ground). However, when they went to look for the bird, they found thousands of Spectacled Eiders in an opening in the sea ice (called a polynya) in the Bering Sea. It was the entire world population of Spectacled Eiders all in one place. (Why do you think this was a dangerous situation for the population of Eiders? Remember that Eiders are related to the Labrador Duck).



ACTIVITY: Highlight a possible migration route of Labrador Ducks on the map on the next page.



ACTIVITY: Write a story to explain what might have gone wrong along the migratory route of the Labrador Duck to cause its extinction.

PENCIL-TO-PAPER WRAP-UP



If a migrating duck, goose, or swan was the subject of your Junior Duck Stamp art contest entry, what additional questions would you ask about waterfowl migration to make your drawing realistic? Write a few of these questions in your Nature Notebook.



Waterfowl Challenge Question

Q. When geese fly in a “V,” why is one side of the “V” often longer than the other?

A. Because it has more geese. It’s an old joke, but there’s more to the story. Scientists have determined that the V-shaped formation that geese use when migrating serves two important purposes: First, it conserves their energy. Each bird flies slightly above the bird in front of him/her, resulting in a reduction of wind resistance. The birds take turns being in the front, falling back when they get tired. In this way, the geese can fly for a long time before they must stop for rest. The second benefit to the V formation is that it is easy to keep track of every bird in the group. Flying in formation may assist with the communication and coordination within the group. Fighter pilots often use this formation for the same reason.

Have you ever watched a NASCAR race? Drivers rarely race side-by-side, but rather follow each other very closely around the track until they try to pass. The car in the front disrupts the wind, which takes a lot more energy (gas) than the cars that follow in the “wind shadow” of the lead car. This technique is called “drafting.” It’s the same thing with geese. The lead bird disrupts the wind and the others draft off of it.

What did you learn?

- Why, where, and how do waterfowl migrate?
- How do scientists collect information about migratory waterfowl?
- How do scientists use information they gather to help waterfowl survive?
- How might migration patterns change with a changing climate?

UNIT 5

Learning from the Past; Taking Action for the Future



Mallard hen
© viamoi, Creative Commons

Waterfowl Challenge Question

Q: What does it mean if you call someone a “lame duck?”

Look for the answer at the end of this unit.



Emily

- Links
- Info
- Photos
- Notes

EMILY

What kind of jobs are there that work on **waterfowl** issues? I think it would be cool to get a job that would help waterfowl or the places they live.

MATTHEW

If you want to save waterfowl **habitat**, you should buy a duck stamp—almost all the money goes toward buying land for the **national wildlife refuge** system. It's a really cool program.



JACOB

I think I'd like to work in a job that deals with the problems that sometimes come up between people and natural resources—like the issue of nuisance Canada Geese in cities and suburbs.

Hannah

Cool, but I'd rather be one of those pilot **biologists** who flies around counting ducks and geese. I love to fly! Check out the cool picture of pilot biologists.



USFWS photo by Guthrie Zimmerman



MICHAEL

If you guys do get jobs like that, be sure to work with the public so regular people know what they can do to help waterfowl in their day-to-day lives.

In Unit 5...

What will you learn?

- Who created the Duck Stamp and why
- The kinds of jobs that people do who want to learn about and **manage** waterfowl habitat
- What happens when there is conflict between the needs of people and **stewardship** of the environment
- What you can do to help waterfowl populations

What will you do?

- Investigate the effect of large goose populations on people
- Investigate the effect of spilled oil on waterfowl populations
- Carry out a stewardship activity

What will you need?

- Pencil or pen
- Nature Notebook
- A natural area in an urban setting to visit
- A library to visit
- Access to a computer with an Internet connection
- A **conservation professional** to help with studying waterfowl

Look for themes.

This unit is a little different than the others. Although it has the *Explore* and *Investigate* sections just like the other units, these are captured within four major themes:

- Urban waterfowl
- Species in decline
- **Climate** change
- Habitat gain and habitat loss

Start by choosing one of the themes, and work through as many of the activities as you can. If you like, try activities in another theme, or better yet, try them all. You will find *Express*, *Share*, *Mystery of the Labrador Duck*, and *Pencil-to-Paper Wrap-Up* at the end of the unit.

Featured Artist

Raina Huang

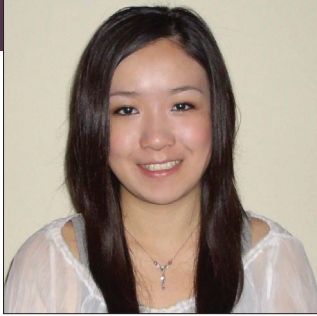


Photo courtesy of Raina Huang

- Links
- Info
- Photos
- Notes

Meet Raina Huang, 2010 Junior Duck Stamp winner

Raina was inspired to enter the competition by her concern for endangered wildlife. She learned that the Junior Duck Stamp Program works to raise awareness about waterfowl and wetlands, and that Federal Duck Stamp funds are used to purchase vital habitat for wildlife. She wanted to use her artistic talent to help these efforts. She is amazed by the diversity of waterfowl that exists and was fascinated by the colors and patterns in the Hooded Merganser, the subject of her winning entry. Raina loves to go birdwatching and learns about wildlife and their habitat from careful observation. She has lived in three countries (China, Japan, and the U.S.) and is fluent in all three languages. She has seen the great diversity of wildlife in very different habitats around the globe and has experienced different cultures. Raina loves biology and has volunteered at a local hospital since her freshman year in high school. Raina's advice for other young people, "Nature has given so many incredible things to us. It's time for us to give something back."



Here is the stamp created with Raina's winning artwork. To see all the Junior Duck Stamps from 1994-2011, go to page 164.



Featured Artist

Lily Spang

- Links
- Info
- Photos
- Notes



Photo courtesy of Lily Spang

Meet Lily Spang, 2009 Junior Duck Stamp winner

Lily first entered the Junior Duck Stamp competition when she was nine. She had always loved nature, wildlife, and art. She realized this was a way to combine her interests. In 2008, at 16, she won the Ohio Junior Duck Stamp Contest and placed in the top 10 at the national level. Then in 2009, Lily won the national competition with her colorful Wood Duck. She loved the variety of colors in the **drake** and the iridescence of the blues and greens. Lily likes to paint portraits of animals: “I like to meet animals to get to know them. That’s when I do my best work,” she said. “Since entries are judged by anatomical correctness as well as artistic value, I found that to progress in the contest each year I had to learn more about waterfowl as well as improve artistically. I began to research waterfowl, and the more I learned the more I became interested in **conservation**. To learn more, I started by finding lots of great books on waterfowl. I also bought a camera and went out to find and photograph the actual birds, whether in the zoo, on the river nearby, or in a private aviary.” Lily gets to know waterfowl while kayaking with her father on the Maumee River, catching glimpses of ducks in their natural habitat, and paying close attention to detail. While perfecting paintings she has observed dead ducks from friends’ freezers to make sure her details are accurate. “Local decoy carvers and wildlife artists were incredibly helpful to me, generously sharing their time and knowledge of waterfowl and art.” Artist Greg Clair worked with Lily and encouraged her to select the Wood Duck for her entry. Sadly, Mr. Clair died while Lily was working on her entry. Harold Roe, a former winner of the Ohio Duck Stamp contest and one of the top 10 in the Federal Duck Stamp competition, stepped in and advised Lily on her entry. Mr. Roe thought that a strength of Lily’s painting was that it was simple and uncomplicated. He said: “I would encourage students participating in the contest to observe waterfowl firsthand and to learn all they can about them. Since a contest like this is subjective, it helps to set specific artistic goals for each entry and focus on personal improvement from year to year. Also, it’s important to find people knowledgeable about waterfowl, conservation, and art and ask them to review your work, explain a duck’s wing, lend a mount or decoy, etc. So many people are more than happy to help a young artist.”



Here is the stamp created with Lily’s winning artwork. To see all the Junior Duck Stamps from 1994-2011, go to page 164.

Featured Scientist

Kira Newcomb



USFWS photo by Clayton Ferrell

Links	Info	Photos	Notes
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Meet Kira Newcomb, Wildlife Biologist

Kira investigates the mystery behind the population decline of the American Black Duck at national wildlife refuges (refuges) in Western Tennessee and the **Mississippi Flyway**.

How Black Ducks use their habitat and survive in the Mississippi Flyway is not well known. Mallards also live in the same areas and can cross-breed with Black Ducks. Biologists do not understand how the presence of Mallards may affect Black Duck habitat use and survival in the Flyway. Key questions include whether or not Black Ducks avoid agricultural habitats often used by Mallards, whether Black Ducks prefer habitat on lands surrounding the refuges, and what composition and distribution of habitats is best for the survival of Black Ducks.

As the Black Ducks arrive at refuges during **migration**, Kira and her colleagues trap, band, and attach radio transmitters to approximately 65 females. They will follow radio-marked ducks daily by vehicle and semi-weekly by airplane. They record **movements**, habitat use, and **estimate** survival of these birds in important habitats in western Tennessee.



Black Duck
USFWS photo by Clayton Ferrell

This information is vital for guiding wildlife **management** strategies at refuges that are managed by the U.S. Fish and Wildlife Service, and at other wildlife areas managed by state natural resources agencies and private conservation organizations.

Kira works as a graduate assistant at Mississippi State University in the Department of Wildlife, Fisheries, and Aquaculture.

.....



PENCIL-TO-PAPER WARM-UP

You've now thought a lot about the basic forms, habitat, life-cycles, and migratory journeys of waterfowl and how they might be reflected in art. Let's add another layer of complexity to your sketches by adding human influence to the mix. In your small group, brainstorm some ideas about how humans and waterfowl interact or are influenced by each other. Now add one of those ideas to a new *geo*-bird sketch. Would your *geo*-duck drawing include hunters or hunting dogs? Would your *geo*-swan be swimming in an urban park? Would your *geo*-goose be eating corn from a field in late fall or looking for its wetland home in a new suburban strip mall?



Trumpeter Swan
USFWS photo by Dr. Thomas G. Barnes

GETTING STARTED

In the past, human activities caused changes in the environment that created problems for waterfowl and other wildlife populations. Over time, people recognized the problems and did something to solve them. What are the problems faced by waterfowl today? What is being done to solve these problems to help ensure healthy waterfowl populations in the future? The following background reading, along with the story of the Duck Stamp, introduces the activities in Unit 5.

Learning from the Past

People have been interested in waterfowl throughout history. Images of ducks, geese, and swans have been found in cave paintings in Europe from the last Ice Age, in murals in Egyptian tombs, and in artwork from ancient cultures in Peru. Nearly every Native American tribe passes down legends that include references to ducks, geese, or swans. Native Americans hunted waterfowl for food and used their feathers for clothing, decorations, and ceremonies.



© Travis S., Creative Commons

When Europeans arrived in North America, they were amazed at the abundance of waterfowl; populations seemed limitless. Hunting was an important source of food for early settlers. Market hunters (people who hunted ducks and geese to sell as food) harvested large numbers of ducks and geese and sold them. What do you think happened to wild populations of waterfowl when they were hunted rapidly and sold for profit?

If you guessed that waterfowl populations started to fall, you were right! By the end of the 19th century, hunters and other outdoor enthusiasts started to notice that the seemingly endless waterfowl populations were dwindling due to over harvesting, habitat loss and **drought**. In response, concerned citizens, politicians, and conservation groups worked to create laws to protect wild birds, and particularly migrating birds. These included the Lacey Act in 1900, establishment of the National Wildlife Refuge System in 1903, and the Migratory Bird Treaty Act of 1918. (See the Timeline on page 161 for details.)

Even with laws limiting hunting, populations of many waterfowl species continued to plummet in part because of the “Dust Bowl Days” of the 1920s and 1930s. Hunters, who knew a great deal about the needs of waterfowl, realized that protecting wetland habitat for waterfowl was just as important as establishing hunting regulations. In response, President Franklin D. Roosevelt signed the Migratory Bird Hunting Stamp Act (the word “conservation” was added to the title some years later).

This 1934 law required hunters to buy a special stamp, in addition to a state hunting license, in order to hunt waterfowl. The revenue raised by sales of the special stamp was to be used to buy or lease land, including wetlands and grassland habitats that are important for waterfowl survival.

Money raised from selling the Migratory Bird Hunting

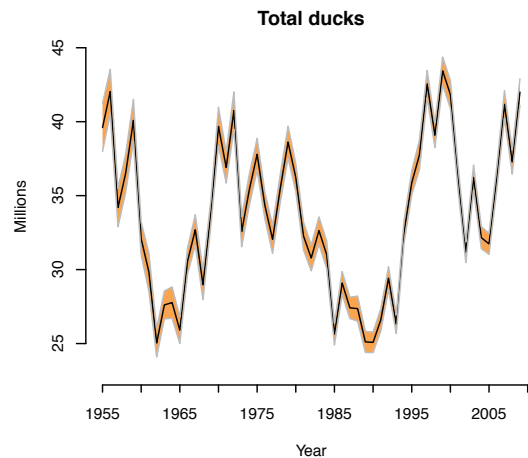


USFWS photo of market hunting era

and Conservation Stamp, or “the Duck Stamp” goes into a special fund and is used only to buy wetland habitat that is protected within the national wildlife refuge system. Since 1934, over half a billion dollars have been raised to purchase more than 5.3 million acres of habitat!

After these important conservation laws were passed, and state and federal natural resource agencies began monitoring wildlife populations and protecting habitat, populations of waterfowl began to increase! The U.S. Fish and Wildlife Service and all state natural resources agencies consider carefully managed hunting to be an important management tool. Since the beginning of modern wildlife management (starting in the 1930s) regulated hunting has never caused any wildlife species to become endangered or **extinct**. Today, most duck populations are stable or increasing.

Here is a graph showing waterfowl populations from the 1950s to the 2000s. The orange shading around the line shows the 95% confidence interval around the estimates. Ask your teacher if you’re interested in what that means.



(from: Waterfowl Population Status, 2010. USFWS.)

TIMELINE:

- 1900** President William McKinley signed the Lacey Act, the first law to protect wildlife. It prohibited illegal take, transport, and sale of plants, fish, and wildlife and created civil and criminal penalties for these actions.
- 1903** President Theodore Roosevelt established Pelican Island National Wildlife Refuge, along Florida’s Atlantic Coast. It became the first in a now 95-million-acre network of U.S. lands and waters set aside specifically as havens for wildlife.
- 1911** A group of arms and ammunitions manufacturers led by Harry S. Leonard of the Winchester Arms Company founded one of the first organizations to preserve wildlife, the American Game Protective and Propagation Association (AGPPA). The AGPPA became the force behind the establishment of the Migratory Bird Treaty Act of 1918. The Migratory Bird Treaty Act restricted market hunting, put limits on hunting for recreation, and stated that all migratory birds and their feathers, nests, and eggs were fully protected by the Federal government.
- 1934** President Franklin D. Roosevelt signed the Migratory Bird Hunting Stamp Act (the word “conservation” was added to the title some years later). Jay Norwood “Ding” Darling designed the first Migratory Bird Hunting and Conservation Stamp. In 1934, Ding Darling was the new Director of the Bureau of Biological Survey, a Federal agency responsible for managing populations of birds and other wildlife.

Federal Duck Stamp Program

Since 1934, the Federal Migratory Bird Hunting and Conservation Stamp, also known as the “Duck Stamp,” has been a required purchase for waterfowl hunters. These stamps are not postage stamps; they have a greater purpose: to help preserve wetland habitat for waterfowl and other migratory birds, and lots of other types of wildlife.

Ninety-eight cents of every dollar generated by the sale of Federal Duck Stamps is used to acquire wetland habitat to add to the national wildlife refuge system. After 78 years, the Federal Duck Stamp Program is one of this country’s most successful conservation programs. Duck Stamp sales have generated more than \$750 million, which has been used to buy or lease more than 5.3 million acres of waterfowl habitat.



First Federal Duck Stamp, 1934

By now you might be wondering: can I buy a Duck Stamp?

The answer is yes! Anyone can buy a Duck Stamp.

Hunters over the age of 16 are required to buy a new Duck Stamp every year to legally hunt waterfowl. But lots of other people buy Duck Stamps, too. People who watch birds buy Duck Stamps because they know it helps to protect habitat for lots of different birds.

People who collect stamps buy them because Duck Stamps are a unique addition to their collection. People

who just care about the outdoors buy Duck Stamps to support waterfowl and wildlife conservation. And people who visit national wildlife refuges buy Duck Stamps because a current Duck Stamp gets you free admission to any refuge in the country.

The first Federal Duck Stamp was produced in 1934. It was designed by Jay N. “Ding” Darling, who was a conservation leader and an editorial cartoonist. For the first 15 years of the Duck Stamp Program, famous artists were asked to submit designs for each year’s stamp. Beginning in 1949 and continuing today, the stamp is selected through a design competition. The contest is open to any artist 18 years or older who wants to enter; hundreds of hopeful artists submit designs each year. Many state natural resource agencies also hold art contests to select a design for their state duck stamps. Sometimes, hunters are required to buy a state duck stamp in addition to the Federal Duck Stamp. The money raised by state duck stamps helps purchase habitat in those states.



Funds from sales of Federal Duck Stamps have been used to purchase millions of acres of high quality wetland habitats. Photo by USFWS Refuge Staff

Junior Duck Stamp Program

In 1989, with a grant from the National Fish and Wildlife Foundation (NFWF), the first curriculum was developed for the Federal Junior Duck Stamp Conservation and Design Program. This arts curriculum taught wetlands and waterfowl conservation to students in kindergarten through high school. The program incorporates scientific and wildlife management principles into a visual arts curriculum.

The Junior Duck Stamp curriculum made its debut as part of a pilot program in California; in 1990, 3,000 students in public and private schools were the first to participate in the Junior Duck Stamp Program curriculum and art contest. Florida and Illinois were added in 1991, while Arkansas, Kansas, and Vermont entered the program in 1992. At that time, a state stamp sheet was developed using the “Best of Show” winners from each participating state from 1991 and 1992. This \$10 stamp sheet included nine state Junior Duck Stamp designs. It was determined that a national competition, using the “Best of Show” winning designs from each state, would be held to select a design for the Federal Junior Duck Stamp.

Maryland and South Dakota entered the program in 1993. With eight states competing, the first national competition was held to select only one stamp design to become the first Federal Junior Duck Stamp. On June 30, during the First Day of Sale Ceremony for the Federal Duck Stamp, judges selected the national first, second, and third place Junior Duck Stamp winning designs. The first Federal Junior Duck Stamp design winner was Jason Parsons from Canton, Illinois. His design titled “Ruffling Redhead” was used to create the first junior stamps which sold for \$5.00 each.

All 50 states eventually joined the program. The U.S. Fish and Wildlife Service supported legislation to gain Congressional authorization for the Federal Junior Duck Stamp Program and to direct the proceeds from stamp sales to support conservation education in the form of awards and scholarships for the participants. The Junior Duck Stamp Conservation and Design Act of 1994 directed the Secretary of the Interior to create a Junior Duck Stamp as well as to license and market the stamp and stamp design.

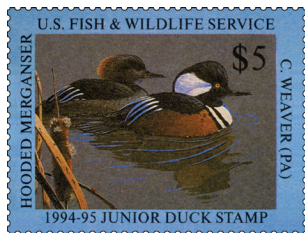
In 2010, Congress reauthorized the Junior Duck Stamp Conservation and Design Program Act for an additional five years. The Program continues to expand the use of its conservation education curriculum throughout the U.S. and its territories. Today, all 50 states, the District of Columbia, and the U.S. Virgin Islands have joined the program and each year more than 27,000 students submit entries to state or territorial Junior Duck Stamp contests.

As part of the program, students are invited to create a North American waterfowl art piece and write a conservation message for submission to their state contest. First place winners from all 50 U.S. states and territories advance to the national contest, where one entry is chosen to be the next Junior Duck Stamp design. At the national level, first, second, and third place winning entries receive cash prizes. In 2012, the program celebrates its 20-year anniversary. All of the funds from the sale of Junior Duck Stamps go to support the program for the next year.



First Junior Duck Stamp, 1993

Junior Duck Stamps, 1994-2011



Curious Facts



EMILY

Think about how much it must cost to pay for a national wildlife refuge, or restoring natural habitats for waterfowl, or managing those populations. Who pays for all that?

MATTHEW

This may surprise all of you, but hunters actually pay for much of the wildlife conservation effort in the United States!



EMILY

What? How do they do that?

MATTHEW

My Dad is a hunter, and he says there are four main ways hunters pay for conservation:

- Duck Stamp—All hunters who hunt waterfowl have to buy a Duck Stamp. Since 1934, the duck stamp has raised over \$750 million that has been used to buy land for the national wildlife refuge system all across America. Hunters are not the only ones who buy duck stamps, but they buy the majority of them.
- Hunting Licenses—In addition to the duck stamp, hunters must buy one or more additional licenses from the agency that manages wildlife in the state where they are hunting. Most or all of that money is used for conservation work.
- Taxes—Most people don't know it, but hunters pay an 11% tax on all firearms and ammunition they buy. This tax money is distributed to the state wildlife agency for use in managing and conserving all kinds of wildlife.
- Conservation Organizations—Many hunters belong to private organizations that are dedicated to conservation of wildlife and habitat. These organizations do tremendous good in assisting wildlife conservation efforts on private lands.

And the public agencies that manage natural resources all recognize regulated hunting as a valid and valuable tool for managing wildlife populations.



© Jon Marshall, DJ Case & Associates





Theme: Urban Waterfowl

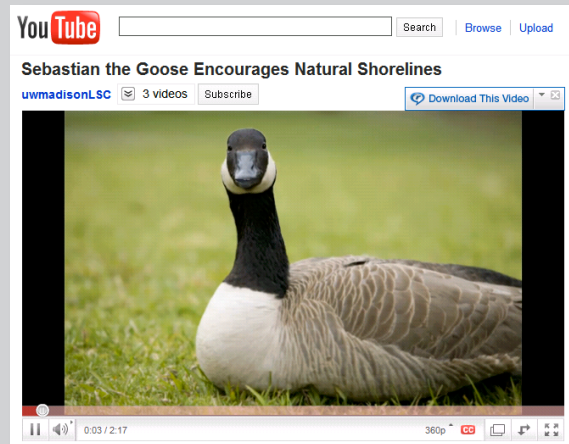
EXPLORE

Urban Waterfowl – Make way for Ducklings and Goslings! Mallards and Canada Geese are very adaptable species. They can survive very well around humans and there are thriving populations of these birds in many cities and towns across North America. Many people like to see ducks, geese, and swans in city parks. People enjoy watching **hens** guiding their ducklings in ponds and across busy city streets. Other people find these birds to be a nuisance, especially if their numbers get too large.

ACTIVITY: What problems do waterfowl cause when they choose to live in a suburb or city? Sometimes humor can help us understand. Watch the YouTube video about Sebastian the Goose, and answer the questions about Sebastian in your Nature Notebook. After watching the video, list as many problems that you can think of that waterfowl might cause when they live within a city or town. Do you think the benefits are worth the cost? (NOTE: If you can't access the YouTube video, check out the Urban Waterfowl activity in the *Investigate* section and read the news article about geese in Madison, Wisconsin.)

Questions about the YouTube clip:

- Where does Sebastian live?
- What does Sebastian like to eat?
- Where does Sebastian leave his **feces** (poop)?
- What challenges does Sebastian face in these urban areas?
- Is Sebastian's favorite place to live safe for his **goslings**?
- What is Sebastian's solution for reducing the number of geese in urban areas? And what would you recommend to people who own or take care of land near water (like a park, recreation or picnic area, golf course, or family home)?





INVESTIGATE

Urban Waterfowl. Is there a problem with too many ducks, geese, or swans in your town? Does your town have a strategy to deal with these challenges? There is much disagreement about what to do about urban waterfowl.

ACTIVITY: Review the news article on page 168 about Canada Geese in a city park in Madison, Wisconsin: What questions do you have about this issue? What are some of the different views of the people interviewed? What do you think should be done? How can you learn more?

- Investigate to find out more. If you have Canada Geese present in parks in your area, apply your investigation skills to see if you can learn something about what attracts geese to the area or how to reduce any problems you've noticed. In Units 1, 2, and 3, you learned how to ask a question, pose a **hypothesis**, and design a study. In your Nature Notebook, write down your question about urban waterfowl. What is your hypothesis?

My question:

My hypothesis:

- Mallards also pose similar problems in some cities. Are there too many ducks or geese living near you? Interview people in your community to learn about their concerns and what they think should be done. Also talk about the problem with a conservation professional, if possible. Keep notes in your Nature Notebook.



Doodle space:

Warner Park Geese are Cooked

By Kristin Czubkowski | *The Capital Times* |

Posted: Friday, April 16, 2010 6:34 am. Reprinted with permission.

Citing the need to prevent a “Miracle on the Hudson” emergency landing in Madison, the city’s Board of Park Commissioners signed off Wednesday night on a plan to kill geese at Warner Park.

The reduction proposal would involve the first lethal measures taken against geese in a Madison park despite years of discussion about how these geese — and their droppings — are overwhelming city parks, particularly Vilas Park on the near west side.

The hazard the large birds pose to airport traffic, however, has sped up the process at Warner Park, located off Northport Drive on the north side, with introduction and approval of the plan all at the same meeting.

The proposal was brought forth by representatives of the Dane County Regional Airport, who confirmed on Thursday that they were proposing that 80 to 100 geese be captured and euthanized early this summer, when the birds are molting and flightless.

The geese would be euthanized by U.S. Department of Agriculture staff according to American Veterinary Medical Association-approved

methods, Dane County environmental officer Lowell Wright said at the parks commission Wednesday night. Once tested for safety, the meat could be donated to local food pantries.

Airport operators are responsible for wildlife management within 10,000 feet of an airport according to federal regulations, Wright told commissioners. Warner Park is 7,500 feet from the airport’s main runway and was identified as a problem area after nine of the 67 birds captured on airport land in 2008 and 2009 were found to be Canada geese banded by the Wisconsin Department of Natural Resources at Warner Park. The DNR counted 132 resident geese in the park in that 2007 banding.

Geese, due to their large size, are particular flight hazards because they cause substantial damage when they are struck by airplanes or sucked into engines, said Dane County Regional Airport spokeswoman Jennifer Miller. Most notably, a flock of geese disabled the famous Flight 1549 out of New York in January 2009, which prompted a “miraculous” emergency landing on the Hudson River.

After the incident, New York officials approved the

killing of more than 1,200 geese near the city’s major airports and the Federal Aviation Administration required all major airports to conduct wildlife hazard assessments if they had not already.

“I think you’ve got a dangerous situation there. I don’t want to test out another Miracle on the Hudson here,” said Ald. Joe Clausius, a member of the commission.

But Trish O’Kane, a UW-Madison Nelson Institute Ph.D student in environment and resources who frequently studies birds at Warner Park, is not yet convinced the situation is that dire.

O’Kane, who was at the parks commission meeting for another item on the agenda, said in an e-mail Thursday to *The Capital Times* that she was “stunned” by the proposal and the speed with which it passed.

She says she has a lot of questions about it, including whether Warner Park geese have become an unfair target with only nine of the 67 birds “dispatched” at the airport in the past two years confirmed to be Warner Park geese.

O’Kane also noted from airport-provided numbers that bird observations dropped from 5,396 in 2008 to 1,586 in 2009 and wanted to know how the observations were being made.

She also questioned whether capturing and killing the Warner Park geese might disturb other birds nesting at Warner Park and wondered why other habitat modifications were not considered, particularly since the practice of mowing grass down to the water’s edge creates the physical environment geese like.

“Is the parks department going to stop creating geese habitat as part of geese management, or are they just going to kill geese every year?” she asked. “Thirty years ago, according to neighbors, there were hardly any geese in Warner Park because the grass was tall. Neighbors report that there were flocks of pheasants, not geese.”

Environmental history is important, she added. “We just keep repeating the same mistakes.”

Two members of the parks commission wanted to refer the proposal for another month, but didn’t get enough votes to do so.

Parks staff were generally supportive of the reduction plan, noting that they would also work with airport staff to develop a long-term management plan for the geese that would include such non-lethal measures as habitat modification and active harassment.

The city has long documented geese problems at Vilas Park, with geese feces blamed for much of Lake Wingra’s water quality issues. Despite years of discussion about the nuisance and potential public health hazard, however, city officials have never engaged in any concerted effort to remove the birds.

But some people say mitigation efforts are long overdue. Jim Lorman, an Edgewood College professor who has studied the goose population at Vilas Park, says the airport safety issues might jumpstart citywide efforts aimed at goose population management.

“There basically hasn’t really been an effort. The effort that has existed has been very, very minor,” he says, citing an experimental planting effort at the Vilas Lagoon that volunteers hoped would discourage geese from nesting.

Lorman serves on the Dane County Lakes and Watershed Commission and Friends of Lake Wingra, both of which are currently involved in planning efforts for water quality and geese management. Lorman also has studied the effects of the geese with his students, calculating at one point that the 42-acre Vilas Park accumulates about 600 pounds of goose poop per acre — and more when migratory populations stop over.

While harassment could prove effective, particularly with the use of trained dogs, Lorman says it often takes years to retrain geese to find other habitats. He supports “harvesting,” saying it would likely prove the most effective method for reducing the number of geese as long as systematic management takes place after the harvest.

“You can’t blame them for taking advantage of the fantastic environment we’ve set up,” he says. “It’s a problem that we have created and it’s up to us to change that.” ■



INVESTIGATE

Investigate & Curious Facts



MICHAEL

How come waterfowl do so well living in cities?



USFWS photo

HANNAH

It's simple biology: Waterfowl will live wherever they can find the food, water, shelter, and space that they need. Not all kinds of waterfowl will use the kind of space that is available in cities, but some sure do love it!

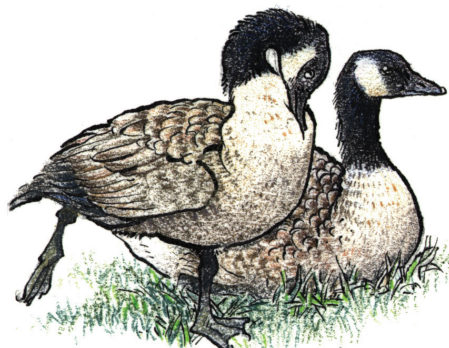


ASHLEY

I think we humans have created excellent waterfowl habitat in cities, often without realizing it. Geese and ducks love to eat short, tender grass, especially when sprinkled with tasty fertilizer. It's even better when their food is near water, like a pond.

HANNAH

Yeah, the large mowed lawns, parks, and golf courses are perfect habitat for Canada Geese! There are fewer predators in the city and usually no hunting allowed. There may be farmland close-by to provide leftover corn and other grains that may even last through the winter months. It sounds perfect, if you're a goose!



Water Resources Clip Art, University of Wisconsin-Extension Environmental Resources Center, 1999

Theme: Species in Decline

Species in decline: Scaup, Pintail, and Common Eider. Why are populations of some species of waterfowl declining? There may be multiple reasons for each species that is in decline. Each species has unique **adaptations** and **behaviors**. Changes in the environment may affect one species more than another. Reasons for decline often involve changes in the habitat. They affect certain species because the changes affect specific habitat elements that are important to those species.



EXPLORE

ACTIVITY: Match species, problems, and solutions. Following are descriptions of three species of ducks that are in decline and three problems with habitats. Look for clues in their **breeding**, migration, and food habits to decide which problem is important in the decline of which species. Then look at “How you can help” and decide which action will help which species.

This activity is a good challenge for a small group of students working together. To make it easy to talk about which bird goes with which problem and which possible solution, photocopy the information cards and glue each onto a separate piece of paper. You should have nine pieces of information:

Birds: 1) Scaup, 2) Pintail, and 3) Common Eider.

Problems: 1) Farming and land use practices; 2) Exotic invasive species; 3) Habitat changes, predators, and lead poisoning.

How people can help: 1) Protect shoreline areas and don't use lead shot to hunt waterfowl; 2) Take care of your boat and equipment; 3) Farmers leave fields **fallow**.

Read all the information on your own, and then in your small group discuss which problem is important to the decline of which species? Which solution might help?

Summarize your findings in your Nature Notebook.



Doodle space:

Scaup

Food habits: Greater Scaup dive to feed on **aquatic** plants and animals. In coastal areas, mollusks constitute the principle diet items. In freshwater habitats, seeds, leaves, stems, roots, and tubers of aquatic plants (sedges, pondweeds, muskgrass, wild celery, etc.) are important items as well as **invertebrates** like snails and aquatic insects.

Breeding: Greater Scaup breed on the tundra and in the boreal forest zones from Iceland across northern Scandinavia, northern Russia, northern Siberia and the western North American Arctic. It is estimated that three-quarters of the North American population breeds in Alaska. Greater Scaup nest predominantly on islands in large lakes and lay an average of nine eggs.

Migrating and Wintering: Greater Scaup make extensive flights across the boreal forests of Canada prior to reaching their wintering grounds along the Atlantic coast and the Great Lakes, or migrate offshore from Alaska to their wintering grounds along the Pacific coast. Greater Scaup occasionally are observed during winter in Central America and the Caribbean.

Population: Greater and Lesser Scaup are counted together, because they are difficult to distinguish during aerial surveys. Scaup populations have steadily declined since the 1980s.



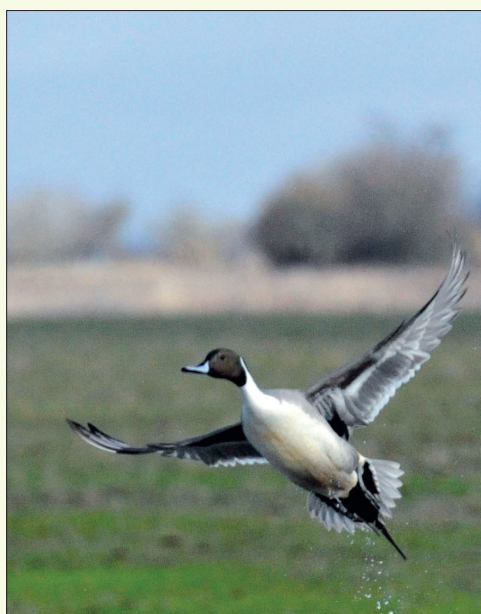
Greater Scaup drake
USFWS photo by Donna Dewhurst

Pintail

Food habits: Pintails dabble and “tip-up” to feed on the seeds of aquatic plants. They also make extensive use of waste grain.

Breeding: In North America, they breed from Alaska, the central Canadian Arctic and western Greenland south to the western and central United States. Northern Pintails nest in open areas near wetlands located in prairie and tundra habitats. Unlike other **dabbling ducks**, Pintails have unique nesting **characteristics**. They prefer to nest away from water in sparse cover. Researchers have found many Pintail nests in the crop stubble that is typical of summer fallow fields, or those that are rested in alternate years. Only one in ten Pintail nests hatches successfully, and Pintails usually don't try to build more than two nests during the spring breeding season.

Migrating and Wintering: Northern Pintails are among the first ducks to migrate south in the fall and north in the spring. Over half of the Pintail population in North America migrates through California. The majority of these birds winter in the Central Valley of California, but some continue south to the west coast of Mexico. Pintails using the Central Flyway winter in the Texas Panhandle and on the Gulf Coast of Texas and western Louisiana. The majority of Pintails using the Mississippi Flyway winter in Louisiana, with smaller numbers wintering in Arkansas, Tennessee, Mississippi, and Alabama. Along coastal wintering grounds, Pintails concentrate on shallow fresh or brackish estuaries adjacent to agricultural areas. Northern Pintails are common winter visitors to Central America, the Caribbean, and northern Colombia.



Pintail duck
USFWS photo by George Gentry

Population: Pintails once were one of the most abundant ducks in North America but have suffered a disturbing decline since the 1950s. In 2009, the breeding population was estimated at 3.2 million birds, substantially below the North American Waterfowl Management Plan objective of 5.5 million.

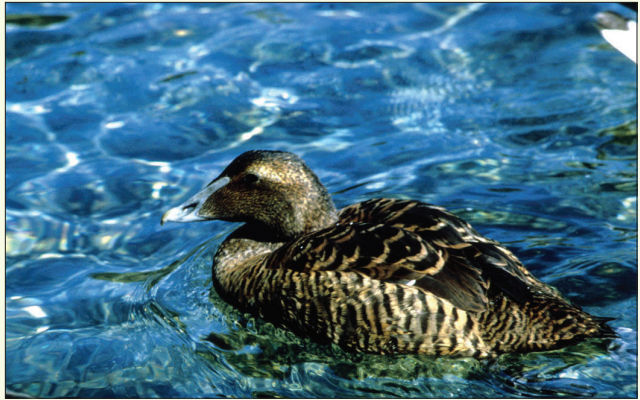
Common Eider

(Steller's Eider and Spectacled Eider have similar habits and are also in decline)

Food habits: Common Eiders dive (up to 20 meters deep) to feed on mollusks and **crustaceans** found in shallow waters around submerged ledges and reefs off rocky coastlines. Diet includes mussels, clams, scallops, and urchins.

Breeding: Common Eiders breed along the coastline of Alaska, nearly the entire coastline of Hudson Bay and eastern Canada, as well as the northern coast of Maine. They typically nest on islands or coastline. Nesting habitat varies from open areas or in grasses and weeds to under shrubs and spruce trees. Female Common Eiders often nest in dense colonies (but also nest individually) and lay an average of 3–5 eggs. Most sea ducks have delayed reproductive maturity (they don't reproduce until they are 2–3 years old) and low rates of reproduction (they don't lay many eggs). Even minor reductions in the survival of adults can send populations into decline.

Migrating and Wintering: Common Eiders are difficult to track because most migrate over large water bodies and remote areas. In the east, they winter from Greenland to the Gulf of St. Lawrence and south along the Atlantic Coast to Virginia. In the west, they winter south to southern Alaska. This is one of the only waterfowl species in the world that spends the entire year in Arctic waters. Because they nest in remote areas, very little is known about sources of mortality (causes of death).



Common Eider hen
USFWS photo by Glen Smart

Population: In North America four races of Common Eiders are recognized: Pacific, Hudson Bay, Northern, and Atlantic. In the mid-1970s, the North American population was estimated at 1.5 to 2 million birds. In northeastern North America, the average annual fall flight in the mid-1980s was estimated at 311,000–376,000 birds and the annual number of nesting pairs in the mid-1990s was estimated at 71,000. A general decline has been observed in all North American races.

Over 150,000 pairs of breeding Common Eider ducks once thrived along the Newfoundland and Labrador coastline. Today their numbers are a mere 12,000 breeding pairs.

Problems for Waterfowl: Farming and Land Use Practices

In the **Prairie Pothole** Region, more and more land is turned to cropland every year. Up until the 1970s about half of the land in this region was left fallow (“fal-oh”), or left unplanted every other year. Gradually, more farmers started planting crops every year. These changes have proven challenging to ducks that like to nest in the crop stubble of fallow fields. In fields where at one time ducks could successfully hatch a nest before farm machinery tilled the stubble, they now find either the machinery plows under their nesting attempts, or stubble-covered land is nonexistent. Leaving fields fallow is not only good for ducks, but helps conserve soil.

In California’s Great Central Valley, seasonal wetlands (wetlands that are only wet for part of the year) are very important for wintering waterfowl. These include tidal marshes, mudflats, salt ponds, muted tidal ponds, and freshwater marshes. However, these lands are also highly valuable real estate for humans. Balancing the needs of wildlife with the needs and wants of people is a critical task for human society.



Farmed wetland
USFWS photo



Housing development near wetland
USFWS photo by Steve Hillebrand

Problems for Waterfowl: Exotic, Invasive Species

Exotic species are plants, animals, and diseases that are “out of place.” Invasive species are those that can out-compete other organisms and take over an area. In new areas where they may not have any natural predators, the populations of these species can literally explode, causing great damage to native plants and animals. These invaders often “hitchhike” on boats, clothes, water toys and other equipment that people use to work and play in the water. People moving from one body of water to another may transport these invaders without even knowing it.

There are many exotic and invasive aquatic plants and animals. The faucet snail is one example. It is an aquatic snail native to Europe that was introduced to the Great Lakes in the 1870s. It was probably brought to North America unintentionally with the solid ballast of large timber transport ships or perhaps with vegetation used in packing crates.



Faucet snails (*Bithynia tentaculata*)
Courtesy of Minnesota Department of Natural Resources

The snail is an intermediate host for three intestinal parasites that can kill waterfowl. These parasites have a complex life history and require two intermediate hosts, such as the faucet snail, to develop. When waterfowl consume the infected snails, the adult parasites attack the internal organs and cause lesions and hemorrhage. Infected birds have difficulty diving and flying before eventually dying. This parasite has contributed to the deaths of about 9,000 Scaup in 2007–08 on Lake Winnibigoshish in Minnesota.

Faucet snails are found on rocky shorelines, river and lake bottoms, aquatic plants, docks, and other objects placed in the water. They can spread by attaching to aquatic plants, boats, anchors, decoy anchors, other recreational gear, and equipment placed in the water. Movement by **waterbirds** may also spread this **invasive species** to new waters.

Learn much more about invasive species and how you can help stop them at the Stop Aquatic Hitchhikers! website (www.protectyourwaters.net).



Faucet snail

Problems for Waterfowl: Habitat changes, predators, and lead poisoning

For most waterfowl in decline there is not just one reason. Various factors combine to decrease survival of adults and young birds. Offshore islands are becoming occupied by people for fishing and farming. This human disturbance affects ducks' ability to breed. Also, because there is less suitable habitat for the ducks, they are more vulnerable to predators like gulls and Arctic foxes. Another hazard for the birds comes in the form of lead. Sometimes lead shotgun pellets used by hunters land in places where birds can eat them. Birds often mistake lead shot for seeds or grit that their **gizzards** use to grind up food. Eating just a few lead pellets can cause lead poisoning, possibly resulting in death. Hunters have made great changes in the way they hunt and the ammunition they use to help protect wildlife populations. Lead shot was banned nationwide for waterfowl hunting in 1991, but it is still used in some remote areas in the Arctic.

How can people help? No. 1

Protect shoreline areas and small islands from human development. Hunters should not use lead shot when hunting waterfowl.

How can people help? No. 2

Whenever you take any type of boat, floats, diving equipment, swimsuits, water toys, or other equipment from one body of water to another, inspect for and remove aquatic plants, animals, and mud before transporting. Preferably spray with high-pressure, hot (120° F) water for a couple minutes. Have your parents run your swimsuit through the laundry, and clean all your water toys and other equipment. Make sure that clothing; pants legs, cuffs and pockets are free from plant seeds and debris, as well as shoes and boot soles that could potentially be redistributed to different habitats. Check out the *Learning and Lending a Hand Program* on national wildlife refuges, where you can volunteer to clean up invasive species (www.fws.gov/invasives/volunteersTrainingModule/).

How can people help? No. 3

Farmers can leave fields fallow (unplanted) every other year. Don't farm areas currently in prairie habitat. Plant unused farmland with native grasses and/or other plants that occur naturally and require less water resources. Some state and federal agency programs and even some local conservation organizations create cooperative agreements with farmers, paying them to keep some of their lands out of production. This is usually done for lands that have bad erosion problems or lands that are highly valuable for their wildlife or conservation benefits.

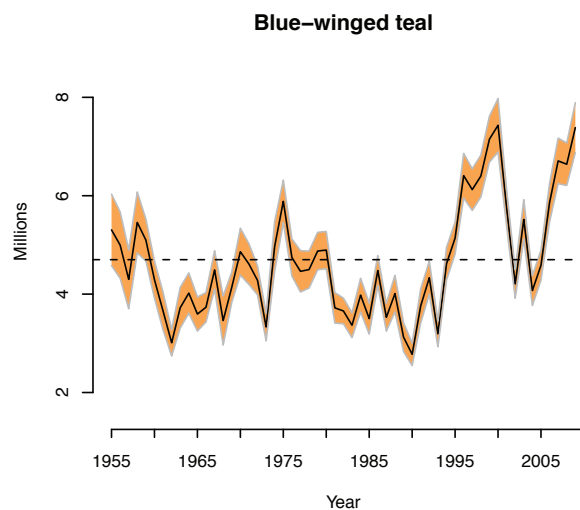
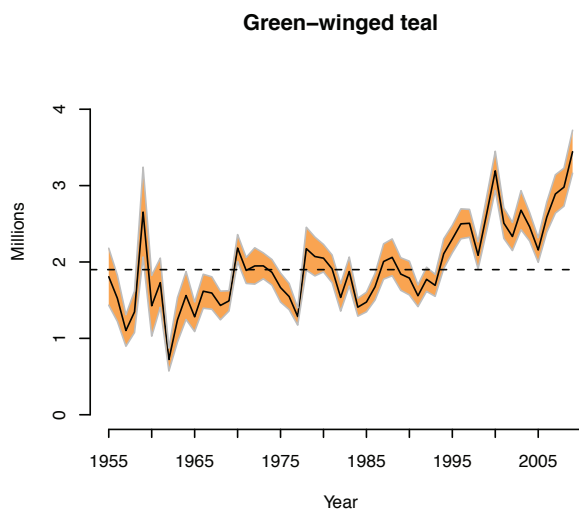
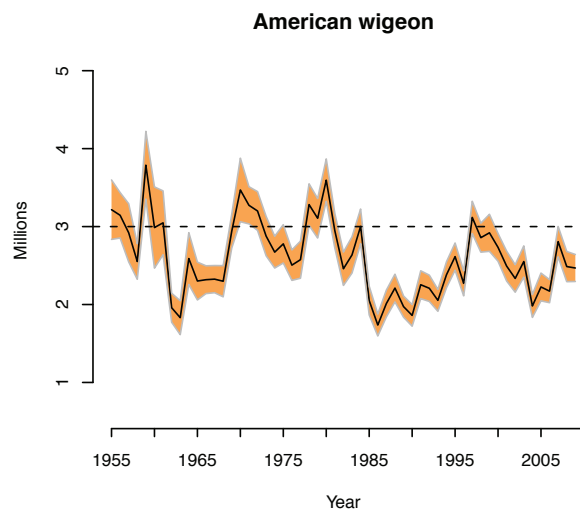
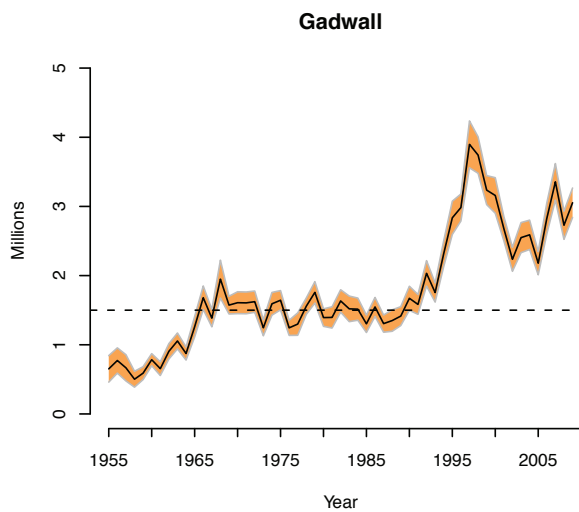
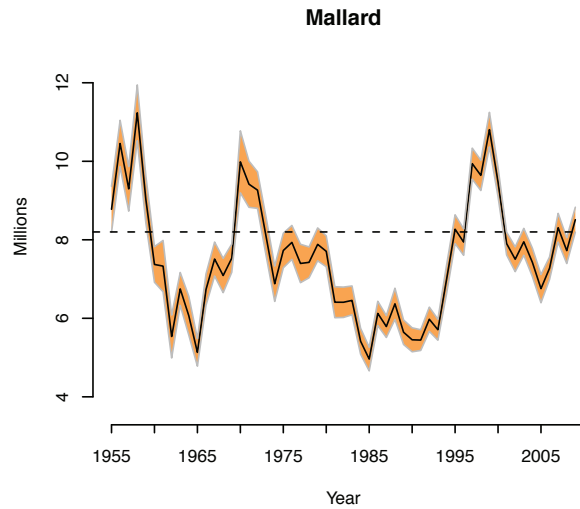
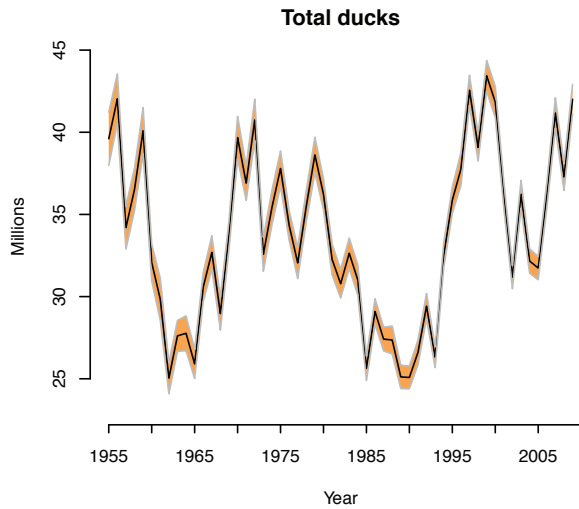
Species in decline. The Labrador Duck is the only waterfowl species that has gone extinct in North America. Even though most duck populations are stable or increasing, there are a few species that are declining in population.



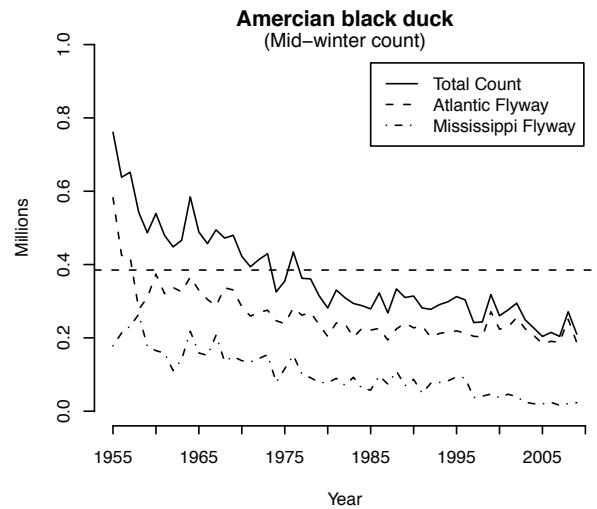
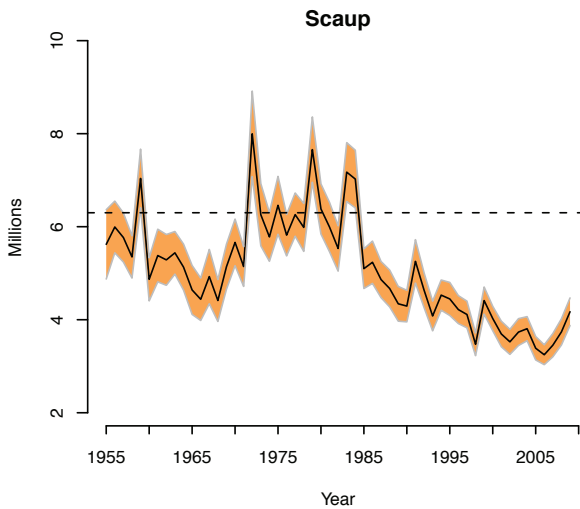
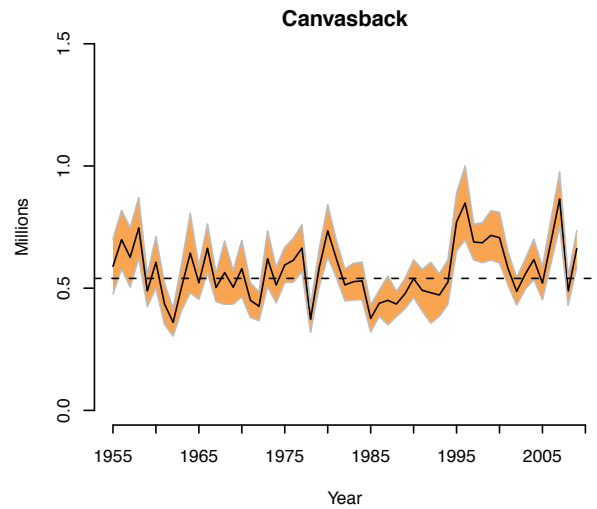
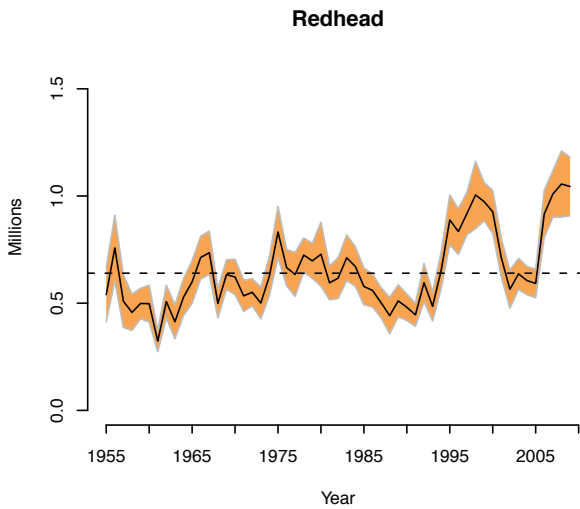
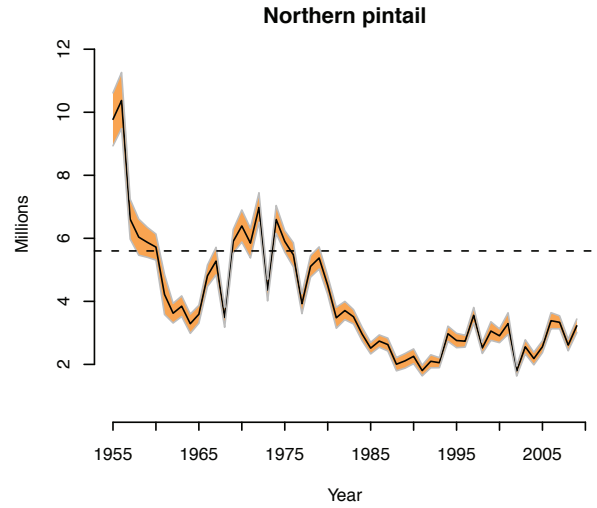
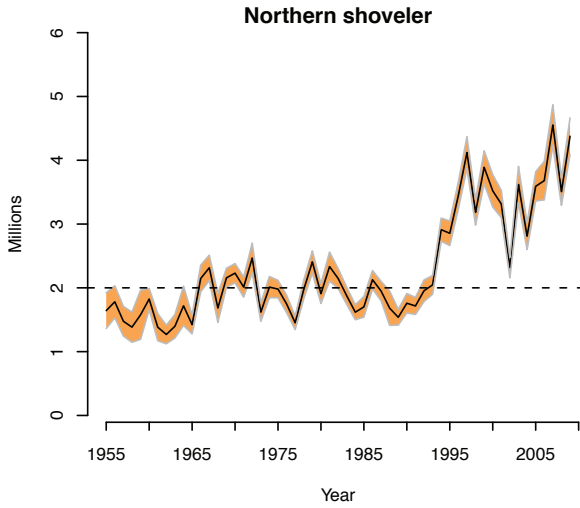
ACTIVITY: Look at the graphs of duck populations from 1955–2009 (on pages 179-180). Which species have increasing populations? Which ones are staying about the same? Which are decreasing? Read about these species online or find a good reference in your school library. Use the lessons from this guide to help you figure out what might be happening. What is unique about these species? Why might they be in trouble when other species are doing well? Consider the duck's: habitat, body shape, **behavior**, reproduction, and migration pattern.

Duck	DESCRIBE Increasing, staying the same or decreasing?	DESCRIBE Species qualities: habitat, body shape, behavior, reproduction, migration	Your ideas about the problem
Pintail			
Scaup			
Black Duck			
Steller's and Spectacled Eider Ducks			
American Wigeon			

Figure 3. Breeding population estimates and population goal (dashed line) for selected duck species. From *Waterfowl Population Status Report, 2009*, (USFWS).



Unit 5. Learning from the Past; Taking Action for the Future



Investigate & Curious Facts



JACOB

In class today we talked about invasive species—you know, plants or animals that are from other parts of the country, or other parts of the world. Some of these exotic species are known as invasive species; they out-compete native species and take over.

ASHLEY

Do people bring them here on purpose? Like for plants in their gardens or fish for their ponds?



JACOB

Yes, that sure happens—a lot of them are sold through the Internet as pets or garden plants, and then they get away and establish their own populations in the wild.

HANNAH

Other times, they get transported around unintentionally, on ships and airplanes and stuff. They often leave their predators and competitors behind in whatever country they came from. Without these natural checks and balances they reproduce fast and out-compete native species. They can cause great damage to natural areas and even human health.



JACOB

And after they become established, people can transport them around without even knowing it, such as by moving boats with snails attached from one lake to another; carrying plant seeds on shoes or swimsuits or pet's fur; carrying firewood with bugs or eggs attached and leaving it in campgrounds; and driving and biking with plant seeds in tire treads.

HANNAH

This is becoming a really big problem for a lot of wildlife, not just waterfowl.



Theme: Climate Change



In Unit 4 (Migration) you learned how Mallards might be changing their migration patterns with changes in climate. Migration patterns of many species of waterfowl are changing. Many are staying in their northern breeding grounds later into the fall and returning earlier in the spring. Some, like the Canada Goose, are staying in or near their breeding grounds all year. When migrating birds return early, the food they need for successful reproduction may not be available.

EXPLORE

Changes in climate will have indirect impacts on other waterfowl as well. Over the past 50 years, precipitation patterns in North America have changed. In some areas, like the Prairie Pothole Region, summers have been drier. What do you think this might mean for waterfowl habitat? Many of the potholes depend on spring and summer rain and will dry up in periods of drought. Other potential changes include a **trend** toward decreasing water levels in the Great Lakes and a rise in sea level that will affect coastal wetlands. If these trends continue, as scientists predict, many wetlands and estuaries may be lost, or the type of food and quality of habitat may change in a way that makes it harder for waterfowl to survive. Scientists working with the U.S. Fish and Wildlife Service, like Kira Newcomb featured in this unit, are studying how waterfowl respond to habitat changes.

How do you know what to think about climate change? Scientists have gathered a lot of information to help them understand climate. Try these activities to help you think more about what it means when reporters or authors use information to explain climate.

ACTIVITY: What is **evidence** and what is **opinion**? You probably have opinions about many things like: who will win the World Series or which is the best kind of pizza. And you have experience in gathering evidence. Many activities in this guide have helped you do the work of a scientist when you explored your own questions. You learned to ask questions, develop hypotheses, and investigate events.

For an example of an opinion, look again at the waterfowl challenge question in this unit. What does it mean if you call someone a “lame duck?” Could you give evidence about whether someone is a “lame duck?” No, but there will be plenty of different opinions. In a small group try these examples. Is it a fact or an opinion?

Information	Fact or opinion?	How could you find out?
Drinking milk helps you to grow strong bones		
People in Kansas are nicer than people in Nebraska		
All basketball players are tall		
Wood Ducks are prettier than Mergansers		
Most geese fly south for the winter		

ACTIVITY: Find 10 stories or reports about climate change on the Internet, in magazines, in newspapers, or listen to news on the radio and television. Look especially for stories about climate and wetland habitat. For each story about climate change, answer the following questions:

- What is the source of the information?
- Who wrote the story or report?
- Do you think the article uses information that is based on evidence or information based on opinion? Is any specific research or data discussed?

What kinds of evidence could you gather? To investigate changes in climate you would need to collect information for hundreds of years, or look at information that others have collected over that time. One source of information is the data gathered at local **weather** stations placed by meteorologists in each state. Volunteers collect the data. Taken all together, these data are helping scientists learn more about changes in climate. You can help. Practice collecting weather information by collecting data about your community.

As an example of how important this information can be, look back at the work of Aldo Leopold and his daughter Nina who you learned about in Unit 4. They recorded changes in nature that they saw throughout the seasons. Keeping track of **phenology** or seasonal changes over long periods of time is one way to study how climate impacts wildlife.



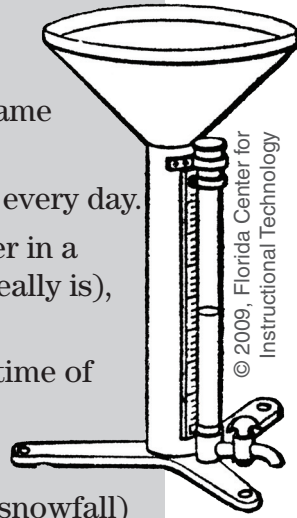
USFWS Employee checking weather station
USFWS photo by John and Karen Hollingsworth





ACTIVITY: Collect data using the school weather station or at home. Take the temperature at your home or school following the directions below, and make a graph showing your results.

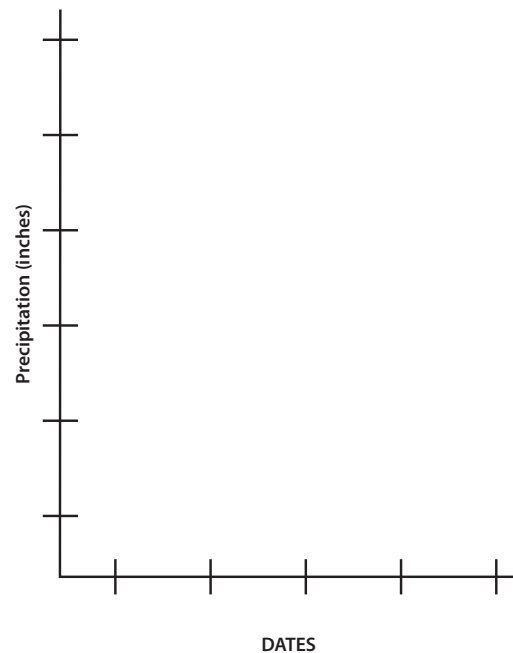
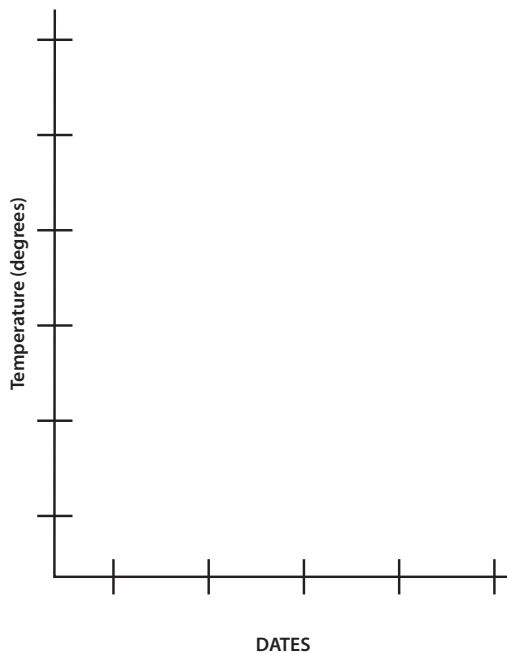
1. Choose a period of time: how many days, weeks, or months you will record the data in your Nature Notebook. At a minimum, collect information from at least seven days.
2. Record the data at your home or school.
3. Organize your findings in a graph. Look for trends. Are the data the same for each day, or different? Do they increase or decrease?
 - Get a reliable outdoor thermometer and start recording the temperature every day.
 - To make sure you collect temperatures accurately, place the thermometer in a location that is always shady (so a sunny day won't seem hotter than it really is), and record the temperature at the same time every day.
 - Take two readings if you can — a daily high temperature at the warmest time of day (late afternoon) and the coldest time (very early in the morning).
 - Make a field note in your Nature Notebook.
4. Catch some raindrops or snowflakes. Get a rain gauge (or a ruler for snowfall) and record the amount of precipitation every time it rains or snows. Each day you collect precipitation information, make a field note in your Nature Notebook about the start and stop time for the rain or snow fall. For example, did it rain 2 inches over an 8-hour time period or did it all come down in 2 hours?



Rain gauge

© 2009, Florida Center for Instructional Technology

Table 7. Sample graphs for your Nature Notebook

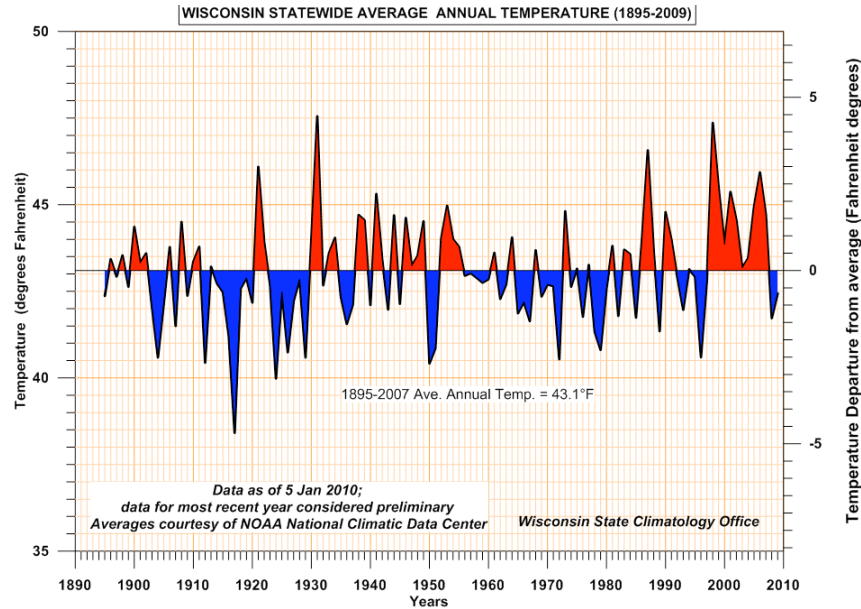


ACTIVITY: Scientists are studying many **variables** in climate change. They are studying trends in daytime highs, nighttime lows, and changes in each season. Find out what changes are happening in your state. How might these changes affect the waterfowl that breed and/or migrate there?



INVESTIGATE

Using data to learn about climate change. Look at these data for Wisconsin from 1890 to 2010. What can you learn from these data? What other questions do you have? What additional data would you need to answer those questions?



ACTIVITY: Look at data for your state. Many states have a State Office of Climatology. The state office will have temperature and precipitation data going back 100 years or more! Ask your teacher or leader for help finding the office in your state that keeps these data and how you can access it. Invite a meteorologist from a local television or radio station to talk with your class about long-term weather data for your area.

Remember that weather and climate are not the same. Climate is the composite weather conditions, or the “average weather” in a certain area over a very long period of time. Weather can change from day to day (sometimes even hour to hour), but climate change is something that happens over hundreds of years.

- Once you have data about your community, what can you look for? Do you see general trends? When were the hottest temperatures? When were the coldest temperatures? When were the greatest rain and snowfalls and the driest periods? Are there more extremes (very hot, very cold, or very high precipitation) at one time of the year vs. another?

THEME: Habitat Gain and Habitat Loss

Habitat Gain and Habitat Loss. Urban areas offer a **gain** of habitat for Mallards and Canada Geese. But the single biggest factor affecting waterfowl (and most other wildlife, for that matter) is **loss** of habitat. As human populations grow, and as we use more land for housing, farming, and other development, that means less useable land for wildlife. Waterfowl are particularly vulnerable, because many of them rely on wetland habitats. Scientists estimate that at the time of European settlement, there were more than 200 million acres of wetlands in the lower 48 states. By 1997, that number had declined more than 50 percent, down to about 105 million acres. The 1950s through the 1970s were years of major losses, but the rate of loss has slowed now. By the 1980s, years of wetland losses and a 10-year drought had really taken a toll on waterfowl populations, and a crisis was brewing.



EXPLORE

In response, the U.S. and Canadian governments took action. Scientists were asked to identify waterfowl habitat areas of major concern across the continent and to develop a conservation plan called the North American Waterfowl Management Plan. It was signed by both governments in 1986. The Plan made it clear that the two federal governments did not have the resources needed to save these vital habitats alone. This led to the formation of *Conservation Joint Ventures*: private- and public-sector partners working together to conserve the continent's waterfowl populations and their essential habitats.



ACTIVITY: What if your community really wanted a new grocery store or theater or school, and the best location was near a wetland. Think about what you have learned in Units 3 and 4 about the habitat needs of waterfowl. Given what you've learned, do you think it would be worth it to drain the wetland? There is no right or wrong answer to this question. In your Nature Notebook make a list of reasons why it might be best to drain the wetland and reasons why it might be a bad idea. Are there any other choices?

ACTIVITY: To make a difference, people work together to use their resources and skills to solve the problem. Scientists featured in this guide are each contributing to a partnership. Reread the information about featured scientists in some or all of the units in this guide. List organizations involved in these projects. What are some reason why these organizations would want to participate?

Invasive Species

Invasive species are plants and animals and diseases that can out-compete other organisms and take over an area.

All organisms must be **adapted** to survive in their environment. Because plants can't move, they have even more pressure to develop ways to cope if they live in places that are very hot, cold, wet, dry, or shady. They may have to spend lots of energy defending themselves against animals, too, like building thorns or making chemicals so that they taste bad. It's sort of like having to "put your eggs in one basket" to do well in a certain place with certain conditions.

But invasive species have special abilities when they come in to a new place! That's because these weedy species "hedge their bets" ...they're good at living in LOTS of different conditions. These species may be adapted for living in environments where conditions change frequently, or in environments that have been disturbed (e.g., by fire or erosion). Such species, which can thrive in a wide range of environmental conditions, are most likely to become invasive if they get to a new place. Usually, it's we humans who are responsible for bringing species to new places where they have the opportunity to invade! Sometimes we plant invasive species on purpose in our gardens, or carry them accidentally on boats, car tires, or even the bottoms of our shoes!

Once they get to a new place, successful invaders usually have several of these special abilities:

- make LOTS of babies! (seeds for plants, eggs for insects)
- grow really fast, so they "elbow out" their neighbors
- thrive under a wide range of temperature and moisture conditions
- build "networks" for strength in numbers! For example, invasive plants often have really huge root systems or grow in groups so that they suck up all the food and water
- sometimes bully neighbors with chemicals (e.g., spotted knapweed) or steal their homes (e.g., cowbirds)
- are INVINCIBLE (sort of) because they've escaped from the enemies in their homeland, so they can concentrate on just growing and making babies (or producing seeds).



Purple Loosestrife (*Lythrum salicaria*)
USFWS photo by Todd Harless



EXPLORE

An example of an invasive species that causes problems for waterfowl is a plant called purple loosestrife. The plant has a large, woody taproot with fibrous roots that form a dense mat that crowds out other beneficial vegetation, reducing habitat available to waterfowl. Additional invasive plant threats to wetlands include salt cedar, phragmites (“frag-my-teez”) and hydrilla (“hi-drill-uh”). Get to know plant species that have invaded the waterways or wetlands in your community. On page 90 you learned about Michelle McDowell’s work to control pickerelweed (a native invasive plant) so that wild rice can grow.

A couple resources include the National Invasive Species Center (www.invasivespeciesinfo.gov/) and the FWS Invasive Species page (www.fws.gov/invasives/).

ACTIVITY: Contact a local national wildlife refuge or your state natural resources agency by visiting the local office, inviting a conservation professional to meet with your group, or by investigating information online. Most state agencies have programs to help volunteers learn to identify invasive species and take action to reduce their populations. Learn which invasive species are causing problems in your area and how you can help.

ACTIVITY: You and your group or class can join CitSci.org, a group of universities that are helping local groups use global positioning system equipment (GPS) to map the location of invasive species that threaten waterfowl in your area and to share results with others.



Invasive *Phragmites* invades a wetland.
USFWS photo by Steve Hillebrand

Oil Spills. People use oil and gas to make electricity, for transporting things we buy to stores, to heat and cool their homes or offices, to cook, and to get around every day. Oil comes from under the ground and from under the sea. Sometimes the drilling equipment fails and oil is spilled on the ground or in the water. Two stories help us understand how a spill affects waterfowl: the Exxon Valdez spill near Alaska in 1989 and the spill in the Gulf of Mexico in 2010.

The Exxon Valdez spill

While attempting to avoid icebergs, the Exxon Valdez ship that transported oil from Alaska, ran into a reef. The damaged ship spilled approximately 257,000 barrels of oil. *Picture the swimming pool at your school or in your community. The amount of spilled oil is roughly equivalent to 17 Olympic-sized swimming pools.* The timing of the spill, the remote and spectacular location, the thousands of miles of rugged and wild shoreline, and the abundance of wildlife in the region combined to make it an environmental disaster. Approximately 1,300 miles were impacted by the oil. It took more than four summers of cleanup efforts before the effort was called off. Not all beaches were cleaned and some beaches remain oiled today. At its peak, the cleanup effort included 10,000 workers, about 1,000 boats, and roughly 100 airplanes and helicopters. It is widely believed, however, that wave action from winter storms did more to clean the beaches than all the human effort involved. Information about the spill is provided by the Exxon Valdez Trustee Council.



INVESTIGATE

The Gulf of Mexico spill

The Deepwater Horizon oil rig explosion in 2010 was the beginning of the largest oil spill in history. Approximately 5 million barrels of oil leaked into the Gulf of Mexico over a three-month period. The tragic events that killed and injured workers was only the beginning. Many other people were affected along the Gulf Coast. The Gulf of Mexico as well as the shoreline all along the Gulf Coast is vitally important habitat for wildlife, including many species of waterfowl. It is the wintering ground for a large percentage of North American waterfowl. It will take years before we know what the long term impacts will be. However, we know that waterfowl will be hurt by the oil spill. Information about the spill is provided by RestoreTheGulf.gov.

ACTIVITY: Read about the Exxon Valdez and the Gulf of Mexico spills.

- How many gallons of oil were spilled by each?
- After the Exxon Valdez accident, populations of waterfowl suffered sudden, catastrophic declines. After a few years, however, most of these populations recovered to their pre-oil spill levels. Read about the Exxon Valdez accident to learn about how the waterfowl populations are doing today.

Explore & Curious Facts



CARLOS

Did you guys see the TV show on the Gulf of Mexico oil spill that happened in 2010? The day after the explosion on the drilling platform, U.S. Fish and Wildlife Service and other natural resource agencies was on the scene to begin planning how to help wildlife and prevent important habitat from being damaged.

MICHAEL

I didn't see that show, but we talked about it in school. Some of those U.S. Fish and Wildlife Service people and their conservation partners were out looking for oil-covered birds. Some were doing airplane surveys to see where the oil was and what areas along the shore would be affected. Some were looking at habitats to make sure they knew what was there before the oil reached the shore. It was sad to hear about the people who died in the explosion and the wildlife killed by the oil spill.



CARLOS

What do you think people can do to reduce the chances of these kinds of accidents?

Kids, if you want to do something positive, check out the “Restore” ideas on page 201.

Access to history. Find articles in your local newspaper’s archives about waterfowl and people interactions. Expand your scope to your county, state, or region if local articles are scarce.



ACTIVITY: Make a note about any unique facts or trends in your Nature Notebook. What have you learned about conservation of wetlands and waterfowl habitat in your community?



© Vicki DeLoach

Oil Spill in the Gulf: People Making a Difference. There are many people who work every day to conserve habitats and study wildlife. Many work for the U.S. Fish and Wildlife Service. When there is an emergency, like the 2010 oil spill in the Gulf of Mexico, people with a variety of skills are needed to make a difference. There are immediate needs, such as saving individual, oiled birds. More long term projects, such as keeping oil from invading healthy wetlands or removing oil from beaches, are just as important (in the long run, they are even more important).

ACTIVITY: Here are five stories told from the point of view of U.S. Fish and Wildlife Service staff and volunteers who got involved in the Gulf oil spill. For each story, identify the conservation goal of the work that person decided to do, and then write down the skills that person needed to meet that goal. Read Story No. 1 about pilots Randy Wilson and Paul Yakupzack for an example of how to complete the activity.

- After reading the stories, write your ideas about the following questions in your Nature Notebook. If you were living in the Gulf area, what type of skills do you have that could help in the **restoration** efforts? Is there a particular type of stewardship activity in which you'd like to participate?



INVESTIGATE

Doodle space:

U.S. Fish and Wildlife Service Service Story No. 1 (Sample Exercise)

At the time of the Gulf of Mexico spill, Randy Wilson worked for the U.S. Fish and Wildlife Service protecting migratory birds in Jackson, Mississippi. After the spill, he was assigned to mainly work on spill recovery. As he prepared to board his helicopter at 7 am, he received a mandatory safety briefing from Heath Bell, a National Park Service employee who usually worked in Fire and Aviation at Big Cypress National Preserve in Florida. Wilson then took off with his partner, Paul Yakupzack, Refuge Manager at Mandalay/Bayou Teche National Wildlife Refuge, and headed south toward Timbalier Bay, looking for wildlife to rescue.

For weeks, the U.S. Fish and Wildlife Service had been running daily helicopter flights out of Lakefront Airport as part of the biggest emergency response ever, flying low over the beaches and marshes of Louisiana to look for oiled or injured wildlife, as well as to track the path of oil from the Gulf of Mexico oil spill. But the Service quickly found it did not have enough trained personnel to fly, maintain, staff, and manage five daily flights, seven days a week, so they reached out to their Department of Interior partners, the National Park Service.



Randy Wilson and Paul Yakupzack prepare to board a helicopter at New Orleans' Lakefront Airport for a daily reconnaissance flight to look for oil and wildlife. USFWS photo by Phil Kloer

Conservation goal: *To look for oiled or injured wildlife and to track the path of oil by using planes and helicopters.*

Skills needed: *Aviation skills, navigation skills, communication skills, habitat recognition skills (knowing where to find the wildlife that may be in danger), willingness to work long hours, and willingness to work with others.*

U.S. Fish and Wildlife Service Service Story No. 2

At the time of the Gulf of Mexico spill, Hugh Morrison was assistant regional director for budget and administration for U.S. Fish and Wildlife Service in the Mid-West Mountain Prairie Region. He considered himself an unlikely candidate to work on the Gulf of Mexico oil spill response team. His office was hundreds of miles away in Lakewood, Colorado, and he worked in an office organizing projects, deciding what needed to be done, finding workers to do the projects, and making sure workers had enough money to do their work.



“I wanted to help, but I didn’t see how my skills could help in the spill response,” he said.

But he soon found out what hundreds of U.S. Fish and Wildlife Service people discovered in the response: There is a great deal of need for people with every type of skill.

Hugh heard that there was a need for people who could help coordinate all the different projects that were going on to clean up, study, and prevent the spread of the oil spill. Morrison was assigned to the Unified Area Command Center in New Orleans, where he



Hugh Morrison at work in New Orleans: “Working on the spill has helped me to reaffirm to myself I can operate effectively in a somewhat chaotic environment.” USFWS photo by Phil Kloer

helped to keep track of what needed to be done and make sure that there were people and funding to carry out the projects. Like nearly all emergency responders, Hugh worked at a make-shift office with a lap-top, a phone, and a wall covered with maps that tracked the oil spill’s movement.

Morrison’s tasks at the Unified Area Command were varied. He went to the airport the morning that the big “pelican airlift” took off, transporting 48 pelicans to Aransas National Wildlife Refuge in Texas. Since he knew about all the different projects, he was the best person to speak to the television interviewers.

He also worked on a project to provide funds to Louisiana farmers who live further away from the ocean to help them grow additional crops. Why? When migratory birds fly back to the area in the fall, they will settle inland (because the extra crops will provide food for them) rather than continuing on to the Gulf of Mexico, where they might be exposed to oil.

Conservation goal: _____

Skills needed: _____

U.S. Fish and Wildlife Service Service Story No. 3

At the time of the Gulf of Mexico spill, Pete Tuttle worked for the U.S. Fish and Wildlife Service as a contaminant specialist. He studied how different types of pollution can affect animals, plants, and ecosystems. He understood how to **restore** an ecosystem after it has been polluted. He helped to assess the damage that the oil spill did to the marshes and beaches in the Gulf of Mexico and the wildlife that needed these habitats to survive. At the time, people who lost their jobs or businesses because of the oil spill could receive payment for what they lost. What about the ducks and geese that lost their homes? They were not able to fill out forms to say how much their homes were worth and how much they needed to spend to find new homes. That was Pete’s job! He determined which habitats were damaged, how they were damaged, and what needed to be done to restore them so the wildlife could return.



Pete Tuttle conducting field assessments. USFWS photo by Tom MacKenzie

Conservation goal: _____

Skills needed: _____





INVESTIGATE

U.S. Fish and Wildlife Service Service Story No. 4

At the time of the Gulf of Mexico spill, Stacy Armitage worked in visitor services for the U.S. Fish and Wildlife Service. Her job was communicating with the public, especially visitors to national wildlife refuges. Stacy wrote daily reports on the numbers of animals impacted by the spill, shoreline locations where oil had reached land, and the results and accomplishments of air and field operations to contain or respond to the spill (e.g., number of work crews, how many miles covered, how much wildlife rescued, etc.). Stacy made sure important information went to the people who needed that information. Stacy’s reports helped everyone involved in the response to understand the extent of the problem, what needed to happen next, and what had already been accomplished. Stacy also helped the public to better understand the impact of the oil spill and what was being done about it.



Stacy Armitage working with the public. USFWS photo by Jennifer Strickland

“I have to admit that as a person who has dedicated her professional life to natural resource conservation, it was painful to read the reports that came in on impacts to the critters. I found that the best way for me to deal with my thoughts about the helpless animals who can’t protect themselves from the oil was to focus on the fact that we in the Service and our partners are doing all we can to help them,” she said.

Conservation goal: _____

Skills needed: _____

U.S. Fish and Wildlife Service Service Story No. 5

At the time of the Gulf of Mexico spill, Kayla DiBenedetto worked as a fisheries biologist with the U.S. Fish and Wildlife Service near where she grew up in Louisiana. These coasts and wetlands are her “native habitat.” “I suddenly went from using my knowledge and skills to help prevent future disaster to fish and wildlife, to addressing the present disaster that was unfolding right before my eyes. In my backyard. At an unimaginable scale,” she said.

Kayla was assigned to a wildlife rescue team at Grand Isle, Louisiana. Her job was to find and collect oiled birds and deliver them to a wildlife center, where their life-saving clean-up could begin. Along with other teams, she roved the beaches, the Gulf waters, and the island rookeries looking for birds in trouble and responding to calls on reports of oiled birds. While they were out there, they also monitored the status of the booms holding back the oil and reported any locations where the boom was missing, had come apart, or was damaged and in need of repair.



Kayla DiBenedetto carries an oiled pelican from a nesting area where she netted it in Barataria Bay. Photo by Coast Guard Petty Officer 2nd Class John D. Miller

During the first couple of days, the team found only a few birds. On day three the oil arrived in full force, and oiled birds were everywhere—on the beaches, floating on the water, on the island, stuck in a boom, caught by oil skimmer boats. Most were alive. The team’s job was to capture them safely, not an easy task. They relied on training, but experience was the best teacher. Kayla said, “I guess you can say you don’t know what you can do until you do it.”

Conservation goal: _____

Skills needed: _____



INVESTIGATE

Investigate & Curious Facts



CARLOS

You know, we've spent a lot of time talking about waterfowl populations. But what I don't know is how scientists know whether populations are up or down? Do they count them?

SELENA

I read about this on the Flyways.US website. There is no way to count every single duck, goose, and swan in North America, but using a special kind of math called statistics, waterfowl biologists have figured out ways to come up with very good estimates. They estimate how many birds are in the population in the spring and how many of each species are being harvested in the fall hunting seasons. Managers can use this information to set hunting regulations and management actions to make sure that populations of all species remain healthy and strong.



Catching geese for banding
USFWS photo



MATTHEW

Good sleuthing, Selena. Here are the methods biologists use to come up with the estimates.

- Spring Breeding Population and Habitat Survey— biologists fly thousands of miles in small airplanes across duck and goose breeding areas in the spring, counting the numbers of different species that they see and assessing habitat conditions. That would be a cool job!
- Waterfowl managers send written surveys to hunters, asking them how many ducks and geese they harvested during the hunting season. My Dad got one of these, and he filled it out after his hunting season this year.
- Waterfowl managers also ask a certain number of hunters to send in wings or tail feathers from the birds they harvest, so the managers can identify which species are being harvested and sometimes how old the birds were. My Dad hasn't been asked to do this, but one of his hunting buddies did it.
- Scientists put leg bands on thousands of ducks and geese each year, and many bands are reported by hunters and others who find them. We talked about this already. Biologists can tell a lot about waterfowl movement patterns from these reports.

EXPRESS

Write. Look up information about a waterfowl species in decline. Use the information in this unit, look for information on the Internet, or speak with a waterfowl specialist to find out what waterfowl species are in decline in your community. Choose one of those species to focus on in more depth.

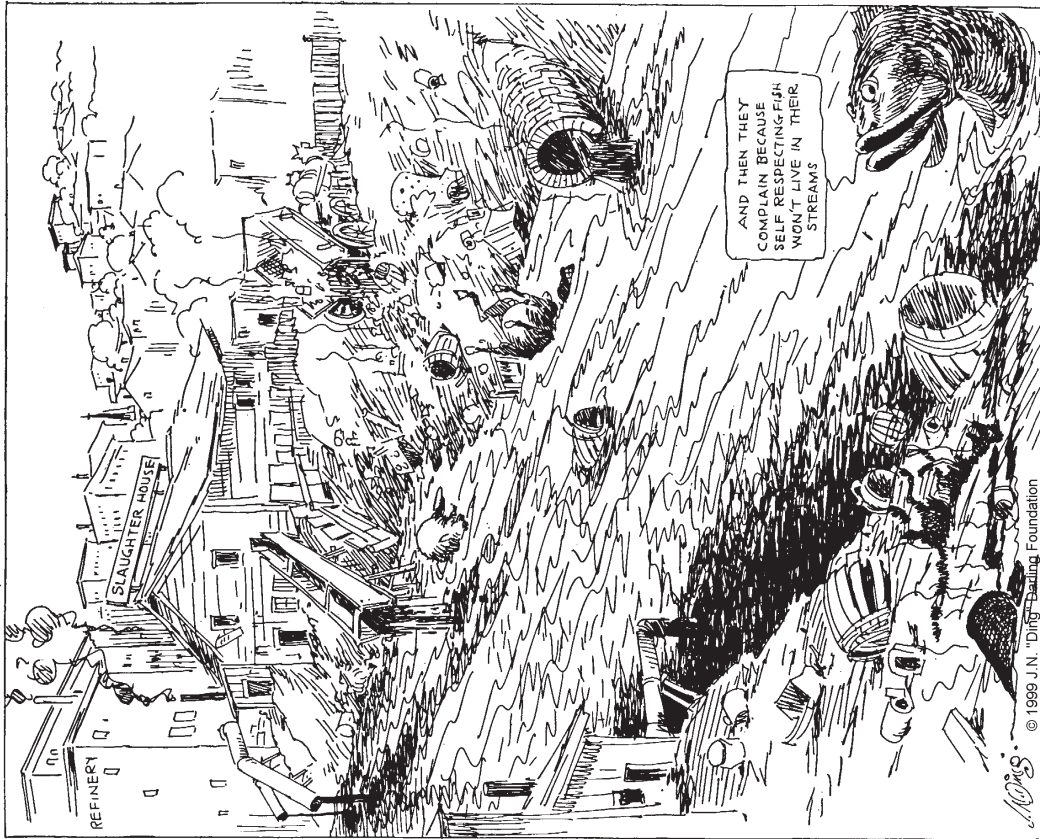
ACTIVITY: Write a mystery story about how and why the waterfowl species you chose became endangered, using real facts about that species and its habitat needs.

Draw. Cartoons and Conservation: People often wonder, “Can one person really make a difference?” One man’s efforts helped to create the Federal Duck Stamp Program and changed the way many people looked at wildlife, hunting, and conservation. Jay Norwood Darling, from Iowa, was a writer and newspaper editor famous for his conservation work and his cartoons. When he signed his cartoons, he sort of abbreviated his last name—thus his nickname became “Ding.” He used his art as a way to influence public opinion about the need for conservation. In 1934, he was appointed to a committee to help solve the crisis of declining waterfowl populations. He helped national wildlife refuges to grow by leaps and bounds. He also founded the National Wildlife Federation and a refuge in Sanibel Island, Florida, an important wintering ground for many waterfowl species (now called the Ding Darling National Wildlife Refuge).

ACTIVITY: Study the Ding Darling cartoons on pages 199-200.

- What message was Mr. Darling trying to convey in each cartoon?
- What are some current issues that he might be concerned about today?
- Draw your own cartoons about these issues using his style and techniques.

Doodle space:



All cartoons courtesy of the Jay N. 'Ding' Darling Wildlife Society.



© 1999 J.N. "Ding" Darling Foundation

All cartoons courtesy of the Jay N. 'Ding' Darling Wildlife Society.



© 1999 J.N. "Ding" Darling Foundation

Restore. Read about the work of Kira Newcomb, wildlife biologist at the beginning of this unit. Kira is working with the U.S. Fish and Wildlife Service to understand what Black Ducks need in order to survive. With the help of people like Kira, the U.S. Fish and Wildlife Service can help to improve the habitat where waterfowl live.

People all over the country, including students like you, are restoring wetlands and creating new wetlands for waterfowl habitat. Middle schoolers in Victoria Rydberg's class in Portage, Wisconsin, have helped restore several wetlands in central Wisconsin. Partnering with the Wisconsin Waterfowl Association, Victoria's class learned about waterfowl and the habitat they need. Over eight years they worked on many different wetlands in Central Wisconsin. When a landowner identified a wetland that had been degraded or abandoned as farmland, the school worked with the family to restore it to pre-settlement conditions. First, they surveyed and mapped the area to learn about the existing plant communities and soils. Then they researched the history of the land using aerial photography, soil maps, farm crop data, and other historical documents to try to paint a picture of what might have been there before it was plowed. Every project was different in the length of time needed for research, planning, and construction, but students were on-site at least one day each week until all projects were completed.



Students help restore wetlands in central Wisconsin. © Victoria Rydberg

ACTIVITY: There are people who are combining art with restoration and creating beautiful art and landscapes that benefit waterfowl and other wildlife. Study the work of the artists listed below by looking online at their websites. Use any of these artists as inspiration to create your own artwork.

Involve your community in helping create the artwork.

Study the art of Lily Yeh – How has she used art to help communities? How could you use art to help communities, waterfowl, and the environment?

- Betsy Damon: Betsy and Keepers of the Waters inspire and promote projects that combine art, science, and community involvement to restore and preserve water resources.
- Lynne Hull: Lynne creates sculptures for wildlife.
- Lorna Jordan: Lorna's art builds structures that communities need, and that are sustainable and useful features in the community setting.
- Patricia Johansen: Patricia works with engineers, city planners, scientists, cities.
- Mel Chin: Mel's art focuses on reclaiming sites contaminated from chemicals.
- Lily Yeh and the Barefoot Artists: Lily explores the environment through art projects with people in communities all over the world.

ACTIVITY: There are many organizations that can help you find an area near you where you might be able to help with a wetland restoration. Check out the Learning and Lending a Hand Program on national wildlife refuges (www.fws.gov/invasives/volunteersTrainingModule/).

With the help of your teacher or leader contact an organization and ask them to help you plan a stewardship activity.

SHARE

An art contest of your own. Think about what it would take to plan a school-wide waterfowl art contest. Depict relationships of people and waterfowl interactions in your community. Who would be the art judges? Where would you display the artwork? Would you invite students' families and friends and other community members to the exhibit?



ACTIVITY: Develop an exhibit on waterfowl and people past and present. Work with the school or local library staff. Find books, songs, movies, magazines, and other library resources that could help you tell the story.

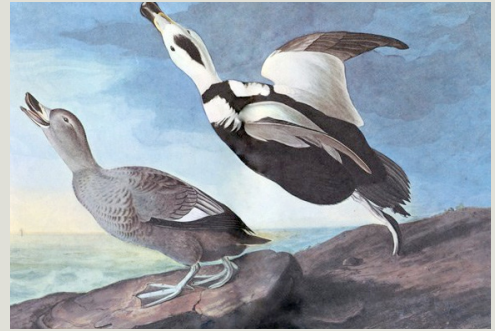
ACTIVITY: If your school doesn't have one already, plan your own Junior Duck Stamp Art Contest. If you already have a contest, contact the local newspaper and ask them to do a story on it.

Doodle space:

THE MYSTERY OF THE LABRADOR DUCK

Evidence about interaction with people

Labrador Ducks, like nearly all ducks, were hunted for food. (There are conflicting accounts of how they tasted, so it's uncertain how many were killed). Until the 1900s, there were no regulations on how many ducks could be hunted. In the 1700s, feathers of many types of birds were used in making and decorating hats. There are no specific records of Labrador Ducks being killed for their feathers, but the attractive black and white **plumage** of the drake may have looked fashionable! During the 1700s and 1800s, there were many changes along the Atlantic Coast. There was a “mass migration,” but not of ducks—of people. The “New World” was settled by people from Europe and other parts of the world, towns with harbors were built along the coast, ships carried goods and passengers, fisherman caught shellfish for food.



We may never know for sure, but there are a number of possible factors that may have caused the **extinction** of the Labrador Duck. We read about the Labrador Duck in each unit of this guide. Look again at the clues in each unit. List as many possible reasons for extinction as you can think of from what we know about the Labrador Duck. You may also want to read about Eider Ducks and reasons for their decline earlier in Unit 5. The Eider Duck is related to the Labrador Duck and may provide additional clues. Now look at your list and think about which reasons make the most sense to you. What do you think caused the Labrador Duck to go extinct?

Unit 1 – Labrador Duck body shape and appearance.

Unit 2 – Labrador Duck behavior.

Unit 3 – Labrador Duck reproduction.

Unit 4 – Labrador Duck migration.

Unit 5 – Labrador Duck and people.

PENCIL-TO-PAPER WRAP-UP



Now that you know more about the relationship between humans and waterfowl, how would your *geo*-bird sketch change? What interests you most about human influences and waterfowl? Write your ideas in your Nature Notebook. Then think about what questions you'd need to ask to make some of those ideas come alive in a painting or poem.



Waterfowl Challenge Question

Q. What does it mean if you call someone “a lame duck?”

A. Have you heard people using the terms “lame duck Congress” or “lame duck governor?” Why do you think that people use ducks to make this comparison?

One definition of a “lame duck” is a person who is worthless or not of assistance.

“Lame duck” has also been used to describe a person in office that is finishing his or her term and will not be returning. “Lame duck” was originally an 18th century term for investors in the stock market who could not, or would not, pay their brokers. Later in 1926, a Wisconsin newspaper wrote the headline: “Making a lame duck of Coolidge.”

Calvin Coolidge would be the first of many American presidents to be saddled with the name “lame duck president.”

What did you learn?

- What is the official name of the Duck Stamp?
- Who invented the Duck Stamp and why?
- What kinds of jobs are available for people who want a career helping to learn about and manage waterfowl habitat?
- What happens when there is conflict between the needs of people and stewardship of the environment?
- What can you do to help improve the quantity and quality of good habitat for waterfowl?

VOCABULARY

A

abiotic – non-living.

adaptations – traits that improve a plant's or animal's ability to live in a particular environment.

adapted – able to live in a particular environment because of particular traits.

aggression – a forceful act of one individual on another in order to dominate or control

altricial – an animal that is completely dependent on its parent to care for and feed it.

amphipods – small crustaceans (such as shrimp, barnacles and water fleas) that are mostly aquatic and are members of the order *Amphipoda*.

Anatidae – the biological family, containing more than 140 species, that includes ducks, geese, and swans.

Anseriformes – the biological order that includes ducks, geese, and swans, as well as screamers and the Magpie Goose.

appendages – external parts attached to a body, such as wings or legs.

aquatic – living in or on the water.

aquatic invertebrates – animals without backbones that live in or on the water.

B

behavior – the actions or reactions of an organism to particular conditions or events.

biodiversity – a variety or richness of life on Earth. Biodiversity refers to the number of plants or animals within a single species, the variety of the species themselves, and the variety of ecosystems in a given area. It is a key part of healthy ecosystems.

biologist – one who is trained in the study of living organisms and the relationship of those organisms to their environment.

biomimicry – comes from the Greek words bios, meaning life, and mimesis, meaning to imitate. It refers to an organism that takes on a characteristic of another or a natural object in order to increase its chances of survival. Camouflaged coloration is an example of biomimicry.

biotic – living.

blind – a shelter for hiding hunters or wildlife watchers from wildlife, such as ducks, geese, or swans.

breeding – mating and producing offspring.

brood – the birds that hatch from a single clutch of eggs.

C

cavity nesters – birds and other wildlife that prefer to nest in spaces or cavities within living or dead trees or similar structures.

Centigrade – a scale of measuring temperature where zero degrees is the freezing point and 100 degrees is the boiling point of water. Also called Celsius.

characteristics – the combination of traits or features that distinguishes one thing from another. For instance, a goose’s webbed feet are characteristics that make it different from a turkey.

climate – the general weather conditions of a region, including temperature, air pressure, humidity, precipitation, sunshine, and cloudiness, as measured over a long period of time.

clutch – the number of eggs laid by a female bird in one nesting attempt.

conservation – the use of natural resources in such a way that ensures their continued availability.

conservation professional – a person that studies or manages the use of natural resources in such a way that ensures their continued availability.

contour feathers – special types of feathers with strong, central shafts that help birds fly more effectively.

control group – a component of a scientific research project comparing two groups, the control group and the experimental group. Both groups are studied, but only the experimental group is altered in some way by the researchers. Data collected about that change and compared with the control group data then tells researchers something about what they’re trying to measure.

control variables – characteristics or qualities of something that remains unchanged in a scientific study so it doesn’t change the outcome of the study.

correlative question – a question asked to determine how two things are related or connected.

crossbreed – to produce a hybrid by the mating of individuals of different varieties or species.

crustaceans – a group of animals with segmented bodies, hard exoskeletons (outside skeletons), and paired, jointed limbs, which include lobsters, crabs, shrimp, and other aquatic animals.

cygnet – young swans, swan chicks.

D

dabbling – to feed at the surface.

dabbling duck – a type of duck that feeds at the surface of the water instead of diving. Dabbling ducks tip forward to feed near the surface and often put their heads under the water to find food.

dependent variable – the characteristic of a scientific study that is measured but not changed during the course of the study.

diving duck – a type of duck that dives below the surface of the water to find food.

drake – a male duck.

drought – a long time without rain.

E

eclipse plumage – seasonal plumage that occurs in certain birds after the breeding plumage and before the winter plumage: characterized by dull coloration.

ecologist – one who studies the relationships between living organisms and their environments.

ecosystem function – a healthy ecosystem, like a wetland, provides many functions or services that are valuable to humans, plants, waterfowl, and other wildlife. For instance, wetlands can help control flooding, provide food for wildlife, and filter soil and other contaminants from polluted water.

emergent – various plants, such as cattails or pickerelweed, which root in shallow water but have much of their stems and leaves above the water.

estimate – to guess or make an approximate judgment about something.

evidence – the data on which a judgement or a conclusion may be based or by which proof of probability may be established.

excise tax – an indirect tax levied on the production, sale, or consumption of certain commodities such as hunting or fishing equipment.

exotic species – exotic or introduced species are living things that are out of place, growing in an area where they did not naturally evolve to exist. Some exotic species can be invasive, that is, they out-compete native species and damage ecosystems.

extinct – a species of living thing that no longer exists.

extinction – the disappearance of a species of organisms, the death of the last individual of a species.

F

Fahrenheit – a scale of measuring temperature where 32 degrees is the freezing point and 212 degrees is the boiling point of water.

fallow – land that has historically been used for agricultural crops but that is not currently in such usage.

feces – excrement or “poop.”

filoplume feathers – the smallest of a waterfowl’s feathers, these are attached to nerve endings and send messages to the brain to help arrange their feathers for flight, insulation, and preening.

flight feathers – the longest and strongest feathers, these are found on the wings and tails of waterfowl.

flight pattern – the shape or way a flock of birds moves in the air; Canada geese, for instance, often fly in a V shape.

foraging – searching for food.

G

gastropods – animals in the biological class called *Gastropoda*, which include snails and slugs.

geometric – the use of shapes (circles, squares, triangles) in design or decoration.

gizzards – muscular organs that are part of the digestive system of birds. A gizzard stores small stones eaten by the bird, which help break down food for digestion.

goslings – young geese.

H

habitat – the place where an animal makes its home and meets all its needs for survival. The components of a habitat are food, water, shelter, and space.

hen – a female duck.

hypothesis – the proposed answer to a question you want to investigate.

I

imprint – the act of learning to follow a parent or parent substitute, right after hatching.

imprinting – a behavior of young birds to follow a parent after hatching. Young waterfowl may imprint on another type of animal or human as well.

incubation – the act of keeping eggs warm until they hatch.

independent variable – a condition of a scientific study that can change naturally or by the scientist in order to observe what happens.

indicator species – a species of plant or animal that can help biologists notice changes in the environment.

insulation – preventing heat from escaping from a body, as feathers trapping heat to keep waterfowl warm.

invasive species – living things that can survive easily in a variety of environments and thus out-compete other species and take over an area, decreasing the biodiversity of that area. Invasive species are often from other geographic locations, but species native to an area can sometimes be invasive.

invertebrates – animals without backbones.

L

Laguna Madre – a protected coastal area in the Gulf of Mexico that is located between the coast of Texas and Padre Island, Texas. Seagrasses thrive in the lagoon and provide good sources of food and habitat for waterfowl.

M

macroinvertebrates – organisms without backbones, which can be seen with the naked eye, such as mussels, dragonfly larva, or snails.

manage – to direct the care of a habitat to make it more suitable for wildlife.

management – caring for habitats or wildlife populations to make them better able to survive/thrive.

migration – movement of a species from one place to another, often following a change of season.

Mississippi Flyway – the central portion of North America where the seasonal waterfowl migrations congregate along the Mississippi River drainage system as the route between breeding and wintering areas.

monogamous – an animal that stays with the same mate for life, year after year.

mounted specimen – an animal that has been killed, skinned, and stuffed for display.

movement – the act of moving or changing position.

N

national wildlife refuge – one of many areas of premier public lands, in a system managed by the U.S. Fish and Wildlife Service, which has been set aside to conserve America's fish, wildlife, and plants.

non-breeding – individual birds that are not engaged in mating and producing offspring.

nursery – a place where young waterfowl are raised.

nutrient – a substance that feeds or nourishes living organisms.

O

opinion – a belief or conclusion held with confidence but not substantiated by positive knowledge or proof.

ornithologist – one who engages in the scientific study of birds.

P

peer review – an evaluation by individuals with qualifications equal to those of the preparer.

phenologist – a person who studies seasonal changes in plant or animal life cycles.

phenology – the study of periodic biological phenomena such as flowering, breeding or migrations.

philopatric – being likely to return to the exact same breeding and wintering sites.

philopatry – tendency for an animal to settle in an area near the place where it was born, even if there has been an intervening migration movement. For example, many migratory birds after their first southward migration return and settle in the general vicinity (say, within 100-mile radius) of their natal area. This involves a rough homing ability.

pineal gland – a very small gland found at the base of the brain that is believed to help waterfowl navigate when migrating.

plumage – the layer of feathers that cover a bird and the pattern, color, and arrangement of those feathers.

polygamous – having more than one mate at a time.

posture – the way that an animal holds itself or positions its body.

prairie pothole – a shallow wetland or pond formed by glaciers. Potholes provide important habitat for waterfowl.

precocial – capable of moving around independently within hours of hatching.

predators – animals that live by hunting and eating other animals.

preening – the act of smoothing and rubbing oil on feathers with the beak.

preening gland – an oil-filled gland by a bird’s tail. Birds use their beaks to spread the oil across their feathers to make them waterproof.

puddle ducks – a type of duck that feeds at the surface of the water instead of diving. Dabbling ducks tip forward to feed near the surface and often put their heads under the water to find food.

R

radio telemetry – a method of collecting data about the activities of wild animals. Scientists place a small radio transmitter in a collar or other device that they attach to an animal. They are then able to use a receiver (somewhat like a radio) to collect signals from the tracking device to figure out where the animal is located.

reasoning – determining conclusions or assumptions from observations, hypotheses, and/or investigations.

restoration – the return of a damaged ecological system to a stable, healthy, and sustainable condition.

restore – bring back or re-establish. Natural resource professionals often try to restore wetland habitat to protect waterfowl species. For instance, they might restore native plants along a shoreline to increase habitat.

S

seine – a fishing net that hangs vertically in the water.

shorebirds – birds that spend most of their time in the shallow water on coastal or inland shores.

simulates – trying to mimic or imitate something else.

site tenacity – tendency of an adult animal to return to the exact home range/territory it occupied in the previous year. This requires very precise homing ability. There are many instances in which adult birds reoccupied a previously used site even when the habitat had been altered while they were away on migration.

staging areas – areas where waterfowl gather before migrating. Usually these are areas with abundant food for waterfowl to “fatten up” for the migration.

stewardship – caring for the environment so that species and habitats continue to exist for future generations.

T

tamarack – a tree with needle-like leaves and cones. Tamarack needles are green in the spring and summer, but turn bright yellow in the fall. Although they look like an evergreen tree, tamaracks shed their needles in the fall.

trends – a direction of movement; a course; flow; or a general inclination or tendency.

U

urophygial gland – is the more formal term for the preening gland, an oil-filled gland by a bird’s tail. Birds use their beaks to spread the oil across their feathers to make them waterproof.

V

variable – a factor that is being studied in a scientific investigation.

vertebrae – bones that make up the spinal column.

W

waterbirds – any birds that swim or wade.

waterfowl – a swimming bird, such as a duck, goose, or swan.

waterfowl conservation areas – places that are conserved because they are important for waterfowl habitat.

weather – the state of the atmosphere, which describes the degree that it is hot or cold, wet or dry, calm or stormy, and clear or cloudy, at a certain point in time.

western hemisphere – the part of the Earth that contains North and South America.