

Educator Guide

Federal Junior Duck Stamp Program

Connecting Youth with Nature Through Science and Art!

An opportunity to investigate what is fun, unique, and mysterious about waterfowl and wetlands in North America and in your community.

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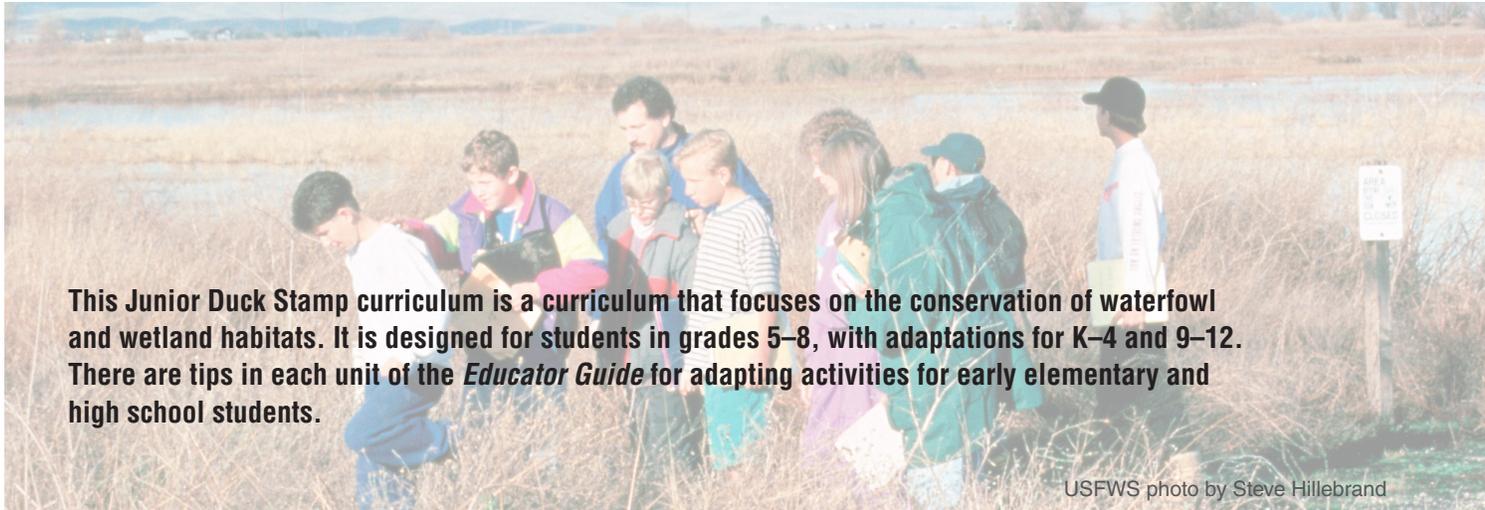
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This Junior Duck Stamp curriculum is a curriculum that focuses on the conservation of waterfowl and wetland habitats. It is designed for students in grades 5–8, with adaptations for K–4 and 9–12. There are tips in each unit of the *Educator Guide* for adapting activities for early elementary and high school students.

USFWS photo by Steve Hillebrand

I. Introduction

A. Purpose

The Junior Duck Stamp Conservation & Design Program (Junior Duck Stamp Program) provides a science-based arts curriculum emphasizing conservation of waterfowl (ducks, geese, and swans) and wetlands. It is designed to spark youth interest in habitat conservation through a variety of complementary academic disciplines: science, art, math, and technology. Through this interdisciplinary approach, students are able to choose activities that are meaningful and fun for them. Science is embedded throughout the learning activities, but each activity may emphasize math, reading, writing, social studies, art, or other forms of expression. Students are encouraged to explore, investigate, and express what they’ve learned through the arts, and then share their thoughts and feelings with other members of their communities.

This multidisciplinary structure combines information on biological and ecological sciences, conservation science careers, and math, as well as a variety of visual and language arts. This structure allows educators from different academic areas in one school to combine efforts to make an even greater impact on student achievement and engagement. In addition, it encourages the realization of common goals among non-traditional community partners (schools, scientists, land managers, other community members).

Whether you’re trying to support your standards-based K–12 curriculum or a nonformal educational opportunity, or are just trying to offer youth a fun science or art experience, the Junior Duck Stamp curriculum provides guidance, activities and resources.

The Junior Duck Stamp curriculum will engage and inspire youth by introducing them to the natural resource topics of waterfowl and wetlands, and to fun outdoor experiences. These topics and experiences will, in turn, bring new enthusiasm for traditional science, art and math learning.

B. Historical overview of the Duck Stamp and Junior Duck Stamp programs

1. What are Duck Stamps?

Federal Migratory Bird Hunting and Conservation Stamps, commonly known as “Duck Stamps,” are pictorial stamps produced by the U.S. Postal Service for the U.S. Fish and Wildlife Service. They are not valid for postage. Originally created in 1934 as the federal licenses required for hunting migratory waterfowl, federal Duck Stamps have a much larger purpose today.

Federal Duck Stamps are a vital tool for wetland conservation. Ninety-eight cents out of every dollar generated by the sales of federal Duck Stamps goes directly to purchase or lease wetland habitat for protection in the National Wildlife Refuge System. The federal Duck Stamp Program has been called one of the most successful conservation programs ever initiated and is a highly effective way to conserve America’s natural resources.

Besides serving as a hunting license and a conservation tool, a current year’s federal Duck Stamp also serves as an entrance pass for national wildlife refuges where admission is normally charged. Duck Stamps and the products that bear duck stamp images are also popular collector items.



Samples of Junior Duck Stamps

The first junior Duck Stamps were produced in 1989. Junior Duck Stamps are now the capstone of the U.S. Fish and Wildlife Service’s Junior Duck Stamp environmental education program, teaching students across the nation “conservation through the arts.” Revenue generated by the sales of junior Duck Stamps funds environmental education programs in all 50 states, the District of Columbia, and two territories (American Samoa and the Virgin Islands).

Today, many states also issue their own versions of duck stamps. In some states, the stamps are purely a collector’s item, but in others, the stamps have a similar role in hunting and conservation as federal Duck Stamps.

2. How do Duck Stamps benefit wildlife?

Since 1934, the sales of federal Duck Stamps have generated more than \$750 million, which has been used to help purchase or lease over 5.3 million acres of waterfowl habitat in the U.S. These lands are now protected in the U.S. Fish and Wildlife Service's National Wildlife Refuge System.

Waterfowl are not the only wildlife to benefit from the sale of federal Duck Stamps. Numerous other bird, mammal, fish, reptile, and amphibian species that rely on wetland habitats have prospered. Further, an estimated one-third of the nation's endangered and threatened species find food or shelter on refuges established using federal Duck Stamp funds.

People, too, have benefited from the federal Duck Stamp Program. Hunters have places to enjoy their hunting heritage and other outdoor enthusiasts have places to hike, watch birds, and visit. Moreover, the protected wetlands help purify water supplies, store flood water, reduce soil erosion and sedimentation, and provide spawning areas for fish important to sport and commercial fishermen.

NOTES:



II. Why choose the Junior Duck Stamp curriculum?

The purpose of the Junior Duck Stamp curriculum is to encourage wetland conservation by creating community collaborations (among wildlife specialists, land managers, nonformal and formal educators) to provide opportunities for youth to explore and investigate wetland areas. The curriculum provides interdisciplinary activities that will increase students' knowledge and heighten their curiosity about these migratory birds, as well as motivate students to take on active roles in conserving waterfowl and their wetland habitats. Through the processes of science inquiry and experiential learning, learners will enhance their knowledge of science and come to understand the importance of preserving and restoring wetland ecosystems.

The Junior Duck Stamp Program, initiated in 1989, focuses exclusively on waterfowl and wetlands conservation education, and the Junior Duck Stamp Art Contest. The Junior Duck Stamp Art Contest is a nationwide waterfowl arts competition for students in grades K–12.

The Junior Duck Stamp curriculum retains the original focus on an arts-based educational program. Many of the curriculum's art-related exercises in observation encourage students to interpret the natural world through artistic expression. An emphasis on journaling and art provides students with opportunities to sharpen observation skills, record these observations on a continual basis, ask questions, explore possible answers, and reflect on their work and community service activities. These elements are all necessary components of successful conservation education efforts.

By providing encouragement for participation in the Junior Duck Stamp Art Contest, the curriculum provides an opportunity for students to move beyond simply "learning about" wildlife and wildlife art to testing their abilities as investigators and wildlife artists. This will be the focus of both the *Express* and *Share* components of the curriculum. Art and science learning objectives are included with each activity. Students may choose to demonstrate their learning through a range of visual, dance, musical, dramatic, and language arts activities.

The Junior Duck Stamp curriculum incorporates a strong base in science education as well. Education about migratory birds provides an overall theme which can be used to teach science concepts of importance to educators as well as wetland and wildlife conservation managers. Through experiential learning techniques of observation and inquiry, students will develop new skills in interpretation, critical thinking, problem solving, and group interactions that complement classroom learning objectives.

Students will be engaged in using multiple intelligences to master these new art and science skills:

- Verbal and linguistic: dealing with words and language, both written and spoken
- Logical and mathematical: dealing with inductive and deductive thinking, numbers, abstract patterns, and the ability to reason
- Musical: dealing with the ability to recognize tonal patterns, pitch, melody, rhythms, and tone
- Kinesthetic: dealing with the ability to use the body skillfully and to handle objects adroitly



- Visual and spatial: dealing with the sense of observation
- Interpersonal: dealing with a person’s ability to understand work, and to communicate with people and maintain relationships
- Intrapersonal: dealing with self-knowledge, sensitivity to one’s own values, purpose, and feelings

In addition, all activities are correlated to their relevant national standards or guidelines such as National Science Education Standards, National Standards for Art Education, and the North American Association for Environmental Education Guidelines for Environment Education Learning (see Appendix A).

NOTES:



III. Why waterfowl and wetlands? Background information

Formal educators have many choices when determining teaching strategies for their science and art curricula. There are many natural resource, wildlife, and bird curricula and activities to further teaching objectives.

Why choose the topics of waterfowl and wetlands? The following section provides background information and touches on the importance of encouraging youth to focus on waterfowl and wetlands.

From the educator's perspective:

- Interest in waterfowl crosses cultural, ethnic, social, and geographic boundaries
- Studying waterfowl is a means of introducing or reconnecting youth with the outdoors
- Youth living in rural, suburban, and urban areas can participate in observing waterfowl
- Waterfowl science, history, and cultural importance help connect youth with subjects that are local and relevant

From the student's perspective:

- Waterfowl are appealing; among other things, they're beautiful, athletic, mysterious, and fun to watch

The multifaceted characteristics and behaviors of waterfowl are a good match for the multifaceted interests of middle-school students; whether their interests lie in science, math, history, art, or music, youth will find something to connect with in the Junior Duck Stamp activities.

NOTES:



A. What are waterfowl?

Waterfowl is a term used to describe the group of birds that include ducks, geese, and swans. It does not include shorebirds or waterbirds such as herons, cranes, gulls, and plovers. In this curriculum we focus on the waterfowl species from the western hemisphere that are listed below. These are the species that are eligible for inclusion in the Junior Duck Stamp Art Contest.

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, formerly Oldsquaw
(*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*)



B. What is a wetland?¹

Wetlands are so diverse that it is difficult for the scientific and regulatory communities to agree on a definition of the term. **Simply defined, wetlands are transitional areas between land and water, are covered by shallow water or waterlogged soils, have soil lacking in oxygen, and grow water-loving plants.** A wetland's abilities to absorb the force of floods, filter pollutants from runoff, recharge and discharge groundwater, and meter out water to streams and rivers are part of its hydrological cycle. These abilities are, of course, valuable functions provided to the communities in which wetlands are found.

Hydrological factors such as water depth, frequency and duration of flooding, and the amount of dissolved or suspended materials in the water determine a wetland's functions and plant and animal populations. Other hydrological factors that affect how fast water enters and the amount of sediment it carries are partly responsible for a wetland's shape, size, depth, and even location.

Wetlands provide a multitude of ecological, economic and social benefits. They provide habitat for fish, wildlife, and a variety of plants. Wetlands are nurseries for many saltwater and freshwater fish and shellfish of commercial and recreational importance. Wetlands are also important landscape features because they hold and slowly release flood water and snow melt, recharge groundwater, act as filters to cleanse water of impurities, recycle nutrients, and provide recreation and wildlife viewing opportunities for millions of people.

The U.S. Fish and Wildlife Service is the principal federal agency that provides information to the public on the extent and status of the nation's wetlands.

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¹ Adapted from <http://www.fws.gov/crescentlake/crescentlake/wetland.html>



The U.S. Environmental Protection Agency (EPA) defines four basic wetland types as follows:¹



Sabine Marsh
Cameron Prairie National Wildlife Refuge
USFWS photo

Marshes | are defined as wetlands frequently or continually inundated with water, characterized by emergent, soft-stemmed vegetation adapted to saturated soil conditions. There are many different kinds of marshes, ranging from the prairie potholes to the Everglades, coastal to inland, freshwater to saltwater. All types receive most of their water from surface water, and many marshes are also fed by groundwater. Nutrients are plentiful in marshes and the pH is usually neutral, leading to an abundance of plant and animal life. Marshes can be divided into two primary categories, tidal and non-tidal. Tidal marshes are all affected by the motion of ocean tides. Non-tidal marshes are usually

freshwater wetlands, which are distributed widely throughout North America and include wet meadows, prairie potholes, vernal pools, and playa lakes.

Swamps | are wetlands dominated by woody plants. There are many different kinds of swamps, ranging from the forested red maple swamps of the Northeast, to the extensive bottomland hardwood forests found along the sluggish rivers of the Southeast. Swamps are characterized by saturated soils during the growing season and standing water during certain times of the year. Shrub swamps, where shrubby vegetation is the dominant plant life, are found throughout the U.S.



Baldcypress swamp
Okefenokee National Wildlife Refuge
USFWS photo by Ryan Hagerty



Bog and Sporadic Spruce,
Koyukuk National Wildlife Refuge
USFWS photo

Bogs | are one of North America's most distinctive kinds of wetlands. They are characterized by spongy peat deposits (decayed plant material), acidic waters, and a floor covered by a thick carpet of sphagnum moss. Bogs receive all or most of their water from precipitation rather than from runoff, groundwater, or streams. As a result, bogs are low in the nutrients needed for plant growth, a condition that is enhanced by acid-forming peat mosses.

Fens | are peat-forming wetlands that receive nutrients from sources other than precipitation: usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. Fens differ from bogs because they are less acidic and have higher nutrient levels. They are therefore able to support a much more diverse plant and animal community. These systems are often covered by grasses, sedges, rushes, and wildflowers.



Fen
Photo by Chris Hoving, Michigan
Department of Natural Resources



Prairie Fen
Photo by kgNaturePhotography.com

¹ Adpated from http://water.epa.gov/type/wetlands/types_index.cfm

C. What do you need to know about waterfowl and wetlands to use this curriculum?¹

The following information provides a basic primer on waterfowl and wetlands that will enable any educator to use the curriculum effectively. Content describes major concepts and explains the importance of wetland habitat. The Unit-by-Unit section (page 32) provides unit-specific background information as well. Appendix B provides additional resources for those educators who want to learn even more about curriculum topics.

Wetlands occupy only a small part of the landscape that is now the continental U.S.—11% in 1780 and just 5% in 1980 (Dahl & Johnson, 1991). Nonetheless, wetlands are important to people, to wildlife, and particularly to waterfowl. During the past 20 years, policies and programs that encourage altering, draining, or filling of wetlands have decreased, and policies that encourage wetland conservation and restoration have increased. Among the wetland attributes society seeks to protect and conserve are those that benefit wildlife, particularly migratory birds. The Junior Duck Stamp curriculum highlights the benefits that wetlands provide for waterfowl and the effects of wetland losses on these and other birds.

One of the best known functions of wetlands is to provide habitat for birds. Humans have known of the link between birds and wetlands for thousands of years. Prehistoric people drew pictures of birds and wetlands on cave walls, scratched them onto rocks, and used them in the design of artifacts. Native American lore provides accounts of bird hunts in wetlands. Wetlands are important bird habitats and birds use them for breeding, nesting, and rearing young. Birds also use wetlands as a source of drinking water and for feeding, resting, shelter, and social interactions. Some waterfowl, such as grebes, have adapted to wetlands to such an extent that their survival as individual species depends on the availability of certain types of wetlands within their geographic range. Other species, such as the Northern Pintail or the American Wigeon, use wetlands only during some parts of their lives.

1. Wetland factors that affect birds

The relationship between wetlands and birds is shaped by many factors. These include the availability, depth, and quality of water; the availability of food and shelter; and the presence or absence of predators. Birds that use wetlands for breeding depend on the physical and

biological attributes of the wetland. Birds have daily and seasonal dependencies on wetlands for food and other life-support systems.

The geographic location of a wetland may determine how and when birds will use it.

The value of a wetland to a specific bird species is affected by the presence of surface water, and the duration and timing of flooding.

¹ Adapted from Wetlands as Bird Habitat, Robert E. Stewart, Jr. *National Biological Service, National Water Summary on Wetland Resources, United States Geological Survey Water Supply Paper 2425 Technical Aspects of Wetlands*. <http://water.usgs.gov/nwsum/WSP2425/birdhabitat.htm>. 2007.

WATER: The value of a wetland to a specific bird species is affected by the presence of surface water or moist soils and the duration and timing of flooding. Water might be present during the entire year, during only one or more seasons, during tidal inundation, or only temporarily during and after rainfall or snowmelt. At times water might not be present at the land surface, but might be close enough to the land surface to maintain the vegetation and foods that are needed by birds. Birds may use wetlands located in depressions in an otherwise dry landscape, along streams, or in tidally influenced areas near shorelines.

The availability or influence of water is a very important wetland feature to birds. It is not, however, the only feature that determines if birds will be present, how birds use the wetland, or how many kinds or numbers of birds may use the wetland. Other determining physical or biological factors include water depth and temperature, presence or absence of vegetation, patchiness or openness of vegetation, type of vegetation, foods, water chemistry, type of soils, and geographic or topographic location. Any variations in any of these wetland features will cause subtle, but distinct, differences in bird use.

Common Waterfowl Foods

(Not all ducks eat all these items.)

- aquatic plants
- wild rice
- seeds from grasses and other plants
- stems and roots of short grasses
- waste grain left in farm fields
- insects and other small invertebrates
- snails
- shellfish (sea ducks)
- fish (Mergansers)

FOOD: Wetlands provide food for birds in the form of plants, vertebrates, and invertebrates. Some birds forage for food in the wetland soils, some find food in the water column, and some feed on the vertebrates and invertebrates that live on submersed and emergent plants. Some birds eat fruits, tubers, and leaves of wetland plants. Water temperatures influence food production. Invertebrate production in the water column may ultimately depend on water temperature and the ability of a wetland to produce algae. Cold water might not be a hospitable environment for small animals and plants that some wetland birds eat. However, water that is too warm also might not produce foods that some birds prefer.

SHELTER: Wetland vegetation provides shelter from predators and from the weather. The presence or absence of shelter may influence whether birds will inhabit a wetland or a nearby upland area. Predators are likely to abound where birds concentrate, breed, or raise their young. Wetlands form an important buffer or barrier to land-based predators and reduce the risk of predation to nesting or young birds. However, some predators, such as the raccoon, are well adapted to both wetland and upland environments, and take large numbers of both young and nesting birds. Mink forage for nesting or sleeping birds along the edges and interiors of wetlands. Other animals, such as the snapping turtle, the alligator, or the large-mouthed bass, are effective water-based predators of young birds, particularly young waterfowl. Snakes take their toll as well. Many bird species that are highly adapted to feeding in a wetland environment also have genetic adaptations that lower their risk of becoming prey. The same vegetation that hides birds from predators also provides some shelter from severe weather. In spring, during cold and stormy weather, waterfowl such as Canvasbacks protect their young in a marsh shelter that is almost impenetrable to wind.



GEOGRAPHY: The geographic location of a wetland may determine how and when birds will use it or adjacent habitat. In the northern latitudes or at high altitudes, some wetlands are covered with ice in the winter and are temporarily “out of service” for birds adapted to a water environment, but emergent vegetation might still offer shelter and food for some species. Birds that eat fish, aquatic invertebrates, or submersed vegetation cannot forage for food because of the ice cover. Some wetlands are on the migration path of waterfowl and other migratory birds and provide stopover locations for traveling birds. These birds might feed in agricultural fields during the day and return to the shelter of wetlands during the night.

You’ll hear the term “prairie pothole” referred to in the curriculum. Prairie potholes are a special type of wetland, found in the north-central part of the U.S. These potholes are an example of a wetland type that is important to migrating waterfowl. Here the timing and duration of inundation and the salinity of the water are important factors in the production of plants and invertebrates used by birds. These, and many other wetland characteristics, are influenced by a number of things:

- Water-level fluctuations throughout the year, in response to rainfall and snowmelt, that maintain wetlands such as wet meadows and marshes.
- Short-term (years) and long-term (decades) climatic trends that cycle wetlands between a wet and dry state
- Interaction of surface and ground water
- Interaction of ground water with rocks and soils that influence salinity and other wetland water chemistry

2. The importance of wetlands to birds

Because of the great variety of wetlands, bird adaptation to and use of wetland environments differs greatly from species to species. Birds’ use of wetlands during breeding cycles ranges widely. Some birds depend on wetlands almost totally for breeding, nesting, feeding, or shelter during their breeding cycles. Birds that need functional access to a

Widespread draining and altering of wetlands has affected waterfowl populations.

wetland or wetland products during their life cycle, especially during the breeding season, can be called “wetland dependent.” Other birds use wetlands only for some of their needs, or they might use

both wetland and upland habitats. Of the more than 1,900 bird species that breed in North America, about 138 species in the conterminous U.S. are wetland dependent (American Ornithologists’ Union, 1983).

Many bird species use forested wetlands as well as forested uplands, feeding on the abundant insects associated with trees. These birds are not dependent on wetlands because they use both habitats equally well. Some birds, such as Wood Ducks, are found primarily in forested wetlands and are dependent on this wetland type.

Many migratory birds are wetland dependent, using wetlands during their migration and breeding seasons. Migratory birds may spend the winter in wetlands in the Southern U.S., or farther south. Throughout winter, these birds use southern wetlands for food and nutrients to sustain them for their return trip north and the breeding season.



Not all wetlands are of equal value to waterfowl and other birds. An inventory in the continental U.S. during the early 1950s showed that of 74.4 million acres of wetlands, 8.8 million acres had a high value for waterfowl, 13.6 million acres were of moderate value, 24.1 million acres were of low value, and 27.9 million acres were of negligible value (Shaw & Fredine, 1956). These categories were identified on a state-by-state basis and were ranked according to use by waterfowl, with “high” being most used. The primary focus of this inventory was waterfowl; thus these rankings might not reflect wetland values for other birds. Also, the inventory was for only natural wetlands that had been little altered by human activities. The three areas of highest value to waterfowl are the Mississippi River corridor southward from Cairo, Ill., and westward along the Texas gulf coast; the entire east coast from Maine southward through most of Florida; and the northern Midwest.

3. Effects of wetland loss and degradation on birds

About one-third of North American bird species use wetlands for food, shelter, and (or) breeding (Kroodsma, 1979). Thus, widespread draining and altering of wetlands has affected bird populations. Because most of the wetland drainage and alteration occurred between the 1930s and 1950, before scientific estimates of bird populations began, most estimates of population declines are inferred. Before the passage of the Migratory Bird Treaty Act in 1918, the reduction in waterfowl populations was blamed largely on excessive hunting and wetland drainage (Day, 1959). However, since 1930 most of the reduction has been attributed to the loss or degradation of wetlands (Bellrose & Trudeau, 1988) and the loss of suitable upland habitats that surround wetlands.

For most wetland-dependent birds, habitat loss in breeding areas translates directly into population losses. As wetlands are destroyed, some birds may move to other less suitable habitats, but reproduction tends to be lower and mortality tends to be higher. Hence, the birds that breed in these poorer quality habitats will not contribute to a sustainable population through the years (Pulliam & Danielson, 1991).

Many of the 585 animals that are federally designated as endangered or threatened are wetland dependent. Of these, 92 are bird species or subspecies. These birds are categorized as endangered or threatened because their populations are so low that the risk of their extinction is real and immediate. The circumstances that cause each species or subspecies to be endangered differ greatly.

Wetland loss due to draining, filling, or altering of surface-water and ground-water flow is a concern to many people. Wetland degradation also has a substantial effect on birds. Although wetland degradation is a serious problem, it is one that is more subtle and less understood than wetland losses. Degradation can take many forms:

- Amounts and periodicity of water supplies can be altered.
- The quality of water flowing into and through a wetland can be modified.
- The flows of sediments or freshwater to coastal marshes can be reduced.
- Water levels can be stabilized in wetlands that otherwise would undergo beneficial drawdowns or water-table fluctuations.

Many of the 585 animals that are federally designated as endangered or threatened are wetland dependent.



Wetland vegetation may be altered by harvesting or by introducing exotic species, making it of little or no value to wetland-dependent birds. An example of wetland degradation is found in the Chesapeake Bay region. Nutrients and sediments entering the bay from agricultural, urban, and industrial areas have caused increased algal blooms, decreased invertebrate production, and lowered oxygen levels. This degradation has reduced the acreage of seagrasses that form an important link in the food chain for invertebrates, fish, and wetland-dependent birds. The decline in the Canvasback population in this area is thought to be directly related to the decline in seagrasses.

Chemicals and sediments that move from agricultural areas into wetlands are two of the most pervasive sources of degradation. The shift in human populations from inland areas to coastal areas of the U.S. has caused problems in coastal wetlands through overloaded sewage treatment systems. The large and growing volume of industrial wastes that enter ground- and surface-water supplies also threatens to degrade wetlands. These threats, combined with habitat destruction, have a net negative effect on the population of wetland birds. Thus, if the amount and quality of wetland habitat is substantially reduced, populations of wetland-dependent birds in the area also can be expected to decrease.

It is apparent that there have been many changes in the distribution and numbers of wetland birds. Wetlands on breeding, migratory, or wintering areas are all important to sustain bird populations. As the wetland habitats in these areas are drained or altered, the ability of these areas to sustain bird populations decreases. Each species of wetland-dependent bird has a unique and complex set of needs for wetland habitats that makes it difficult to generalize about how loss or degradation of wetlands affects bird populations. It seems reasonable to expect, however, that as the numbers of wetlands in a region decline, so too will the numbers of wetland-dependent birds.

In some parts of the U.S., extensive wetland losses have displaced birds from large areas. Continued wetland losses probably will cause continued losses of wetland birds. However, recent recognition of wetland values, and the effects of their losses, have resulted in incentives to maintain and restore wetlands.

The best hopes for improving wetland habitat are continued research, education of the public, and collaboration among states, local governments, schools, tribes, and private citizens. Schools and youth groups (4-H, Scouts, YMCA) are vital points of intervention to introduce this significant subject.

The Junior Duck Stamp curriculum and Art Contest help natural resource professionals and K-12 educators address this crucial need to educate the public about protecting and managing waterfowl and wetland areas.

IV. What is in the Junior Duck Stamp curriculum? Tools for success!

A. Overview

Educators can help young people explore the environmental and social aspects of conservation science and can encourage them to work together to solve problems.

The *Junior Duck Stamp Youth Guide*, as a supplemental text, is a basic resource to help educators fulfill this important role. Collaboration with a local natural resource professional will be crucial for access to local information and general expertise.

The Junior Duck Stamp curriculum provides activities linked to biological sciences, visual and language arts, and math.

Educating young people, involving them in hands-on activities, and encouraging stewardship at the local level are critical steps toward achieving widespread waterfowl and wetland conservation and restoration.

The *Junior Duck Stamp Educator Guide* was written to help educators make the best use of the *Junior Duck Stamp Youth Guide*. Using the *Educator Guide* will help educators to:

1. Recognize opportunities to connect with natural resource professionals and public lands.
2. Integrate Junior Duck Stamp resources into existing curricula.
3. Accomplish one or more science, art, and/or math learning goals.
4. Enhance instructional success and enrich learning experiences with activities appealing to multiple intelligences by incorporating arts experiences in science, math or technology learning goals, and by integrating environmental stewardship concepts in language arts programs.

The Junior Duck Stamp curriculum includes the following education tools:

1. Junior Duck Stamp art contest and the curriculum guides

Junior Duck Stamp Art Contest

Encouraging students to participate in the Junior Duck Stamp Art Contest can spark a great deal of enthusiasm for learning. The Junior Duck Stamp Art Contest begins each spring when students submit their artwork to a state or territory contest. Students at the state level are judged in four groups according to grade level: Group I: K–3, Group II: 4–6, Group III: 7–9, and Group IV: 10–12. Three 1st, three 2nd, and three 3rd place entries, as well as 25 Honorable Mentions are selected for each group. A “Best of Show” is selected by the judges from the 12 first-place winners regardless of their grade group. Each state or territory Best of Show is then submitted to the Duck Stamp Office and entered into the national Junior Duck Stamp Art Contest. The first place design from the national contest is used to create a Junior Duck Stamp for the following year.



To further the interdisciplinary underpinnings of the program, students are now encouraged, but not required, to include a conservation message on their entry form with their art design. The conservation message is judged in some states and at the national level for Best of Show winners. The message should explain something the student has learned about wetlands habitat, conservation, or waterfowl. It may also be a statement used to encourage others to participate in conservation. For more on the Junior Duck Stamp Art Contest and to learn how your students can participate, see the Junior Duck Stamp website: <http://www.fws.gov/juniorduck/About.htm#Overview>.

Junior Duck Stamp Educator Guide

Educators will find a variety of information and resources in the *Educator Guide* to take the guesswork out of designing a Junior Duck Stamp program or to enhance an existing program. Resources from general waterfowl and wetlands information to standards correlations will help meet educator and student needs. Suggestions for adapting content to lower or higher grades are provided in the Unit-by-Unit guides starting on page 32.

Junior Duck Stamp Youth Guide

The *Youth Guide* includes all the information and instructions learners will need to explore waterfowl and wetlands in their communities.

Junior Duck Stamp Nature Notebook

The *Junior Duck Stamp Youth Guide* features a built-in method of involving youth in partnership roles during their waterfowl and wetland investigations—keeping a field or nature journal that we’re calling a Nature Notebook.

Learners are encouraged to include all their drawings, activity notes, observations, and thoughts in their notebooks. They might:

- Decorate them
- Add newspaper articles
- Create artwork
- Display photos of local waterfowl or wetland areas
- Make a collage with pictures of wetland animals and plants
- Write a poem inspired by their program experiences

Besides helping the participants process their experiences, these journals will help educators evaluate if the group understands the material presented and will also be helpful to youth in telling others what their group learned and accomplished.

2. Curriculum Concept Map

The Junior Duck Stamp curriculum is organized to provide sequential learning experiences for youth groups. The Curriculum Concept Map illustrates how the major concepts are broken down into topics that are explored in learning activities. Performance outcomes listed for each unit will help meld the curriculum activities into a more traditional science curriculum. The Junior Duck Stamp Curriculum Concept Map can be found in Appendix C.



3. Correlations of the Junior Duck Stamp curriculum to education standards

Appendix A provides correlations of Junior Duck Stamp activities to national education standards to assist educators in choosing activities that help meet classroom curriculum goals.

a. National Geography Standards

The National Geography Standards were developed by the National Geographic Society. More information can be found at: <http://www.nationalgeographic.com/xpeditions/standards/matrix.html>. Correlations of Junior Duck Stamp activities to these national education standards can be found in Appendix A1.

b. National Standards for the English Language Arts

The National Standards for the English Language Arts were developed by the National Council of Teachers of English. More information can be found at: <http://www.ncte.org/standards>. Correlations of Junior Duck Stamp activities to these national education standards can be found in Appendix A2.

c. National Mathematics Standards

The National Mathematics Standards were developed by the National Council of Teachers of Mathematics. More information can be found at: <http://www.nctm.org/standards/content.aspx?id=16909>. Correlations of Junior Duck Stamp activities to these national education standards can be found in Appendix A3.

d. National Science Education Standards

The National Science Education Content Standards, developed by the National Research Council, outline what youth should know, understand, and be able to achieve to be considered scientifically literate at different grade levels. The Standards help educators and administrators judge which concepts are essential for students to understand before moving on to other, more challenging, scientific topics. The Junior Duck Stamp curriculum activities have been correlated with the national standards for grades 5–9. More information on the NSES can be found in the “Science Content Standards” chapter on the National Academy Press website at http://books.nap.edu/openbook.php?record_id=4962&page=103. Correlations of Junior Duck Stamp activities to these national education standards can be found in Appendix A4.

When community members and employers consider what they want citizens and employees to know and be able to do, they often speak of broad areas of applied knowledge such as communication, thinking, problem solving, and decision making. These areas connect or go beyond the mastery of individual subject areas. As students apply their knowledge both within and across the various curricular areas, they develop the concepts and complex thinking of an educated person. ...Community members need these skills to function as responsible citizens.¹



e. National Standards for Arts Education

The National Standards for Arts Education outline what K–12 students should know and be able to do in the performing and visual arts. The Standards were developed by the Consortium of National Arts Education Associations. More information can be found at: <http://artsedge.kennedy-center.org/teach/standards/standards.cfm>. Corelations of Junior Duck Stamp activities to these national education standards can be found in Appendix A5.

f. The “Guiding Visions” for the National Standards for the English Language Arts

Published jointly by National Council of Educators of English (NCTE) and the International Reading Association (IRA), the Standards for the English Language Arts is designed to complement other national, state, and local standards and contributes to ongoing discussion about English language arts classroom activities and curricula. More information can be found at: <http://www.ncte.org/standards>. Corelations of Junior Duck Stamp activities to these national education standards can be found in Appendix A7.

g. NAAEE Excellence in Environmental Education—Guidelines for Learning

The *NAAEE Excellence in Environmental Education—Guidelines for Learning (K–12)* is another tool educators use to integrate environmental education activities into classroom curricula. For more than 35 years, the NAAEE has promoted environmental education and supported the work of environmental educators in North America and in more than 50 countries throughout the world. The organization has taken the lead in defining, through its guidelines, what makes a balanced, scientifically accurate, and comprehensive environmental education program. Appendix A6 includes correlations of the Junior Duck Stamp curriculum activities to NAAEE Guidelines for Learning. More information about NAAEE can be found at <http://www.naaee.org>. The Guidelines for Learning (K–12) are available online at: <http://www.naaee.org/programs-and-initiatives/guidelines-for-excellence/materials-guidelines/learner-guidelines>. Corelations of Junior Duck Stamp activities to these national education standards can be found in Appendix A8.

NOTES:

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¹ Fortier, J., S. Grady, & M. Rayala. *Wisconsin’s Model Academic Standards for Art and Design Education*, Milwaukee: WI Dept. of Public Instruction, Bulletin No. 00183. 2000.

V. About the Junior Duck Stamp curriculum

A. General advice

The Junior Duck Stamp curriculum was designed to be student-friendly. Young people should be able to use the *Youth Guide* with little adult direction. They may, of course, need help connecting with natural resource professionals, finding natural areas in their communities, and gathering materials for activities. They will also need assistance with some activities and with keeping on task throughout the activities.

Most of the details and instructions for curriculum activities are in the *Youth Guide*. That information, for the most part, is not repeated here. Instead, this *Educator Guide* gives an overview, with summaries of each activity, background information, and instructions that will help in completing activities.

It is not necessary to cover all the material in each unit before moving on. It is possible to pick and choose which units to cover according to time limitations, the abilities of the group, and the number of partners who have been recruited to help with the program.

1. Involve natural resource professionals and other community experts

A local natural resource expert can help ensure the success of this experience. Natural resource professionals and other experts can also help to validate learner interpretation of scientific information, and they can serve as role models, encouraging consideration of possible careers in the natural resource field.

Natural resource partners may be able to offer:

- Supplies such as water testing equipment and measuring devices
- Background information or explanations of scientific phenomena
- Information on community wetland and/or waterfowl successes or challenges
- Ideas for service projects
- Technical assistance in planning and completing a project
- Materials such as posters, maps, or videos
- Names of other community members/organizations that would like to help

If a partner organization has not been contacted, the organizations listed in the box on the next page and in Appendix B, page 163, should provide some leads. Also see Appendix D: An Example of a K-12 Partnership with Natural Resources Professionals. The local phone book or the Internet has information about these or other potential partners. It may be possible for your group to join a waterfowl or wetland service project already in progress.

Potential Partners

Federal, state and local government agencies

U.S. Department of the Interior:
Bureau of Land Management
U.S. Fish and Wildlife Service National
Wildlife Refuges
National Park Service

U.S. Department of Agriculture:
Natural Resources Conservation Service
U.S. Forest Service

U.S. Geological Survey
Colleges/Universities
Cooperative Extension/4-H (county)
County Environmental Management Councils
Soil and Water Conservation Districts (county)
Departments of Natural Resources, Environmental
Conservation, or Environmental Quality (state)

Non-Government Organizations

Conservancies or land trusts
Environmental or outdoor education centers
Wetland, lake or river associations
Local chapters of organizations such as Ducks
Unlimited or National Audubon Society
Local rod and gun clubs/hunting clubs

Community volunteers might include parents, retirees, service club members, and others. Older youth can also be effective project partners in working with younger groups.

2. Youth as partners

The Junior Duck Stamp curriculum is designed to enable youth to take the lead in learning about wetlands and their significance. The curriculum engages youth as partners in stewardship, rather than as subjects who need to be taught what to think or do. This proven education strategy is being promoted because youth are the educators of the future. New investments in youth water education can make it easy for youth to understand their roles as stewards of our natural resources. Educators and environmental managers can help youth develop the skills to implement creative solutions to environmental concerns in their own communities.

Why involve youth in environmental conservation and stewardship activities?

- Youth bring enthusiasm, energy, and creativity
- Youth grow as active citizens in the community
- Youth develop a sense of place and learn to take responsibility for their impacts on the environment
- Youth learn how to apply the process of problem solving in their lives
- Youth see how their environmental activities can lead to careers
- Youth will be future leaders

How to work with youth ages 10–15 years: primer for partners

The natural resource professional engaged as a partner in the Junior Duck Stamp activities may have no experience working with youth. It would be helpful to share the following information with any non-K–12 partners, including parents.



The key to successful youth science education and service projects is involving young people in developing, planning, organizing, and evaluating activities and projects. When youth lead the project, they gain a sense of ownership of the results. They learn more and work better. The youth service movement has learned much from young people themselves about how to involve youth as community resources.

The following strategies should be considered:

- Encourage youth to set activity goals
- Arrange opportunities for young people to reflect on what they learn and to apply lessons from their experiences
- Acknowledge and build on the skills, knowledge, and experiences young people already have
- Ask older students for help
- Involve youth as educators who have never before had the chance to lead
- Define and maintain accountability; group members must do what they promise
- Set responsibilities at appropriate levels
- Model the behaviors that are expected from young people. Expect the same from all staff, partners, and volunteers

Experiencing and observing the local environment is an essential part of environmental education. Understanding their surroundings helps learners build a strong foundation of skills and knowledge for reaching out further into the world and deeper into the conceptual understandings that environmental literacy demands. Direct experience in the environment also helps foster the awareness and appreciation that motivate learners to further questioning, better understanding, and appropriate concern and action.¹

3. Adapting the Junior Duck Stamp curriculum for different age groups

The Junior Duck Stamp curriculum was written for youth in grades 5 through 8. Students at any age will get the most out of the curriculum if they have an active voice in choosing what they will do and how to proceed.² To adapt the curriculum to younger audiences, it may be necessary to provide simpler, more directed processes for existing activities or to choose alternative activities from the resources list in Appendix B. This information includes the date when a curriculum was published, the targeted grade level, and what background information or activities it offers.

Older groups (high school or older) are ready for more in-depth questions and challenges. They could carefully document observations and tests, relate observations to a broader ecological and human context, explain/predict how factors have changed or will change over time, analyze and/or synthesize information and situations, develop alternative approaches, and use a broader range of information and experiences in tasks and discussion.

¹ 4-H Series Project (2005). *The Learning Cycle in 4-H Curriculum*. Davis: University of California Extension

² *Excellence in Education: Guidelines for Learning (K-12)*. 2010. North American Association for Environmental Education, www.naaee.org



Each Unit-by-Unit description (page 28) includes a section on suggestions for adapting concepts for early elementary and high school youth. In addition, the *Related Resources* section in each unit description lists a variety of print materials, activities, and Internet resources for a variety of age groups.

4. Approaches to science education

Science inquiry and “The Learning Cycle”

“During the past 30 years, science educators have identified a sequence known as the learning cycle that has proven to be an effective means for learning concepts and processes of science. The learning cycle also has been found effective for developing reasoning abilities and for reducing scientific misconceptions.”¹

The Junior Duck Stamp curriculum was designed to inform young people about the importance of conserving wetland areas, to help youth develop reasoning abilities in science, and to increase youth skills in practical science inquiry methods and interpretation. Both objectives are met in the curriculum through activities based on the learning cycle instructional model. Three concepts in the learning cycle are emphasized in this curriculum:

- **Exploration:** The curriculum and field trip activities present group members with experiences that will enable them to develop questions and their own frame of reference about wetland areas. The benefits of the exploration phase are maximized if educators provide only minimal guidance or expectation of specific accomplishments
- **Concept Introduction:** Concepts or principles of wetland science are introduced in activities or units that lead youth to apply new patterns of problem finding and problem framing to their experiences
- **Concept Application:** The focus of the curriculum is not just to provide information but to also develop scientific thinking and decision-making skills. This is done by encouraging learners to apply their newfound knowledge and skills²

5. Assessment/Reflection: Helping youth communicate results

What have youth learned by participating in the Junior Duck Stamp Program? What opportunities will they have to demonstrate and apply what they’ve learned in a meaningful way?

By guiding young people through the Junior Duck Stamp curriculum, the educator not only introduces them to waterfowl and wetland science but also to the processes of science, including inquiry, analysis, interpretation, and demonstration. As they use these processes in future studies, learners will be able to modify them and incorporate them into more sophisticated investigations in other environmental or problem-solving situations. Repeated experience in applying the scientific method of problem-solving enable youth to interact as informed citizens in the social and political arena of wetland management as well as

¹ 4-H SERIES Project. (2005). *The Learning Cycle in 4-H Curriculum*. Davis: University of California Extension

² Adapted from *From Ridges to Rivers: Watershed Explorations*, 4-H SERIES Project. Davis: University of California Extension, 1999.

with other environmental issues. Having learners actively show they can apply information presented in a curriculum in a meaningful way will show that youth not only know the material but that their knowledge is “usable,” too.

The students’ Nature Notebooks can be used as tools for assessing youth performance. Observing youth as they work and listening to youth responses in discussion serve as additional assessment opportunities.

Other means of reflection

There are many ways young people can express information they’ve learned from the activities and field trip. Art, English, computer, and math educators may want to get involved in an interdisciplinary Junior Duck Stamp project.

Youth might reflect on their experiences by:

- Creating and submitting a piece of art to the Junior Duck Stamp Art Contest
- Creating a poster, display, or sculpture for public display, possibly at a national wildlife refuge
- Making a video or short skit for a public message about waterfowl and wetlands
- Speaking to community groups or officials about what they’ve learned
- Writing an article or letter to the editor of the local newspaper
- Writing a project report or developing a PowerPoint presentation

B. How is the curriculum organized?

The Junior Duck Stamp curriculum is organized in five units described in Table 1. Each unit includes some activities for elementary, middle, and high school students. There is a Unit-by-Unit guide (page 32), which includes background information, learning objectives, materials needed, preparation tips, and a variety of activities that allow educators to select pieces most applicable to their interests and physical settings. Youth are encouraged to work as independently as possible to explore, investigate, and express their thoughts through art activities, and share the results with their schools, families, and members of their communities.

The Junior Duck Stamp curriculum engages students in asking the question, “why?”. Asking “why?” is the basis of *scientific thinking*; figuring out how to answer “why?” is the beginning of the *scientific process*.

The Junior Duck Stamp curriculum guides learners in investigating, measuring, and documenting characteristics of waterfowl and wetlands. The five units are described in the chart on the following page.



Table 1. Junior Duck Stamp Youth Guide units.

Unit	Unit title and description	Key themes
Introduction	The Call of the Wild Duck!	Introduction to waterfowl and to the Junior Duck Stamp curriculum and <i>Youth Guide</i>
Unit 1	What is... a Waterfowl?	Body shape and appearance/function
Unit 2	A Day in the Life—Preening, Dabbling, and Other Unusual Behaviors	Behavior
Unit 3	Raising a Family in a Wetland	Reproduction
Unit 4	Going the Distance: Migrating Across Continents	Migration
Unit 5	Learning from the Past; Taking Action for the Future	People, wetlands, and waterfowl

1. Time management

Educators are expected to pick and choose which activities complement their classroom goals. How much time they allow for activities will differ depending on those goals. For instance, identifying and sketching the details of a feather may be something that an art educator might want to allot a whole class period to so students can complete a drawing. In contrast, a science educator may be more interested in just having the students make a quick sketch and labeling the feather parts as the emphasis of the lesson.

For a comprehensive experience, it is recommended that youth complete at least four activities in each unit, choosing one from each of the unit segments: *Explore*, *Investigate*, *Express*, and *Share*. If possible, youth should have a strong role in selecting which activity to emphasize in each of the segments. Youth are expected to work independently through the materials and will be interested in spending more time on some activities than others. Allowing them to do so should result in a more engaged student experience.

It is recommended that educators read through the entire curriculum and then use the Unit-by-Unit Guide on page 32 to plan a schedule.

2. If time is short—

- Use the correlation tables (Appendix A) to choose activities that will enhance your particular needs: a science, language arts, or art curriculum, for example
- Skip activities that cover concepts previously covered in science or art classes
- Select topics that are relevant to waterfowl or wetland issues in the local community
- Allow the students to choose activities they will enjoy

Table 2 can be used to plan a program schedule suitable for any group

Table 2. Program Schedule Planning.

Unit	Concepts to cover	Activities to include	Time available
Introduction			
1			
2			
3			
4			
5			
Total			

3. Standard features

Units in the *Youth Guide* have a few standard features:

- *The Waterfowl Challenge Question*—Short, fun teasers, designed to get students interested in unit topics
- *Waterfowl Friends*—The *Youth Guide* includes conversations among a group of middle-school students as they explore, investigate, and share curious facts and information about ducks, geese, and swans. Conversations are included both to provide additional information about lesson content as well as to provide a format that will look familiar to youth who interact online
- *What Will You Learn; What Will You Do; What Will You Need*—Descriptions of what they'll learn, do, and need for the unit. Students will have opportunities throughout the guide, however, to make choices within this framework
- *Featured Scientist and/or Artist*—This section introduces students to people who chose careers in science or art and to the enthusiasm they bring to their work. Some took unlikely pathways to success and some, who believed themselves good in art or science, found they had considerable skills in both arenas. Maybe your students will find this to be true as well



- *Explore, Investigate, Express, Share*—A curriculum framework that is broken down into sections that allow youth to explore an important question, investigate possible answers, express what they’ve learned in art or writing, and share what they’ve learned with others. The framework is described in more detail in below:



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. Students are asked to create a *geo-duck*, *geo-goose* or *geo-swan* (short for geometric duck shape, geometric goose shape, or geometric swan shape). The purpose of these exercises is to warm-up the “why?” part of your students’ brains. Asking “why?” is the basis of scientific thinking; figuring out how to answer “why?” is the beginning of the scientific process.



Explore: Students will explore the kinds of places where waterfowl live, observe waterfowl and other creatures that share wetland habitats, and learn about some of the challenges to waterfowl survival.



Investigate: Students will learn questions that scientists are asking about waterfowl and see how they are going about trying to answer these questions. They will have a chance to ask their own questions and will devise plans to find the answers.



Express: Students will see how artists, past and present, have expressed the beauty and uniqueness of waterfowl. They will write, draw, paint, and use some more unusual forms of art to express thoughts and feelings about what they’ve learned.



Share: Working with their classmates, students will reflect on their activities and will share what they’ve learned through artwork and writing, by talking with others about their scientific findings, and by taking action to improve waterfowl habitat.



Pencil-to-paper Wrap-up: At the end of each unit students will briefly reconsider their *geo-duck*, *geo-goose*, or *geo-swan* drawings. This is an opportunity to apply what they’ve learned in the unit to make their drawings more realistic.

- *Curious Facts*—There is background information for youth in the “Curious Facts” box of each *Explore*, *Investigate*, and *Express* section. These are presented by a fictitious group of “waterfowl friends” who are presented in a social media context throughout the *Youth Guide*.

- *Mystery of the Labrador Duck*—Suggesting solutions to the “mystery” for each unit requires students to apply knowledge and skills they gained exploring unit topics and therefore also serves as an opportunity for reflection or evaluation.

There is only one waterfowl species known to have become extinct in North America—the Labrador Duck. In fact, the Labrador Duck was the second North American bird species ever to go extinct (the Great Auk was first). **The last Labrador Duck ever seen was in 1875 in Long Island, NY.** No one knows for sure what caused the extinction, but scientists have a few clues to answer these questions.

Clues to the mystery come mostly from observation by naturalists, such as John James Audubon. The only Labrador Ducks left to study are stuffed specimens. 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. The clues help students think about the mystery of the Labrador Duck, while at the same time reflecting on important unit concepts: Body shape and appearance, behavior, reproduction, migration, and people/wetland/waterfowl connections.

Throughout the curriculum, the Labrador Duck component allows you to include inquiry education approaches and encourages young people to build their own knowledge and fun, while completing the activities.

NOTES:



VI. Unit-by-Unit Guides

This section provides information on each unit that is designed to help educators plan their Junior Duck Stamp activities.

The following features are found in each unit:

- Purpose
- Learning Objectives (for the unit as a whole)
- Featured Scientist and/or Artist
- Activity Preparation Tips
 - Background Information
 - Pencil-to-Paper Warm-Up
 - EXPLORE/INVESTIGATE/EXPRESS/SHARE activity outlines
 - Learning Objectives (specific to this set of activities)
 - Activity-by-Activity Explanation
 - ◇ Description
 - ◇ Setting
 - ◇ Skills
 - ◇ Preparation
 - ◇ Materials
 - Mystery of the Labrador Duck Evidence
 - Pencil-to-Paper Wrap-Up
 - Adaptations for Early Elementary Students
 - Adaptations for High School Students
 - Related Resources

The following icons are used to identify activities of these types:



Explore



Investigate



Express



Share

At a Glance (brief overview)

Each unit starts with the “At a Glance” box, which provides a very brief introduction to these unit components:

Purpose:

Subjects:

Process skills:

Conservation concepts:

Vocabulary:

INTRODUCTION – THE CALL OF THE WILD DUCK!

Purpose

The purpose of the Introduction is:

- To prepare students for Junior Duck Stamp curriculum explorations and investigations
- To generate excitement about participating in wetland conservation activities and/or the Junior Duck Stamp Art Contest

Students should understand that they get to choose which activities to pursue; the guide is designed to help them but not give them all the answers; and they're going to have fun!

Learning Objectives

If learners choose to complete all the activities in this section, they will be able to —

- Use their *Junior Duck Stamp Youth Guide* effectively
- Create a plan to complete guide activities
- Find and communicate with natural resource professionals in the community
- Locate wetland areas in their communities that attract waterfowl
- Observe wildlife
- Describe wildlife features
- Describe living and non-living components of a natural area
- Practice writing in a nature journal as a means of exploring questions, recording responses and data, and reflecting thoughts about nature
- Develop field sketching techniques
- Reflect on their Junior Duck Stamp activities by sharing what they've learned with others

Introduction at a Glance

Purpose: To prepare students for curriculum activities

Subjects: Science, language arts, math, visual arts

Process skills:

- **Science skills**
 - Collecting information
 - Communicating
 - Describing
 - Gathering evidence
 - Identifying
 - Observing
 - Organizing information
 - Planning
 - Recording
- **Language arts skills**
 - Communicating
- **Visual arts skills**
 - Communicating

Conservation concepts:

- There are living and non-living components of wetland ecosystems
- Complex interactions exist among organisms in an ecosystem
- There are people who make their livings studying and managing natural resources

Vocabulary: biologist, conservation, ecologist, extinct, geometric, habitat, hen, hypothesis, indicator species, management, national wildlife refuge, ornithologist, radio telemetry, restore, seine, shorebirds, waterbirds, waterfowl, western hemisphere

Featured Scientist

Meet Jena Moon, wildlife biologist

As described in the *Youth Guide* (page 21), Jena Moon is a wildlife biologist with the U.S. Fish and Wildlife Service. Jena’s work provides a good example of how natural resource professionals and K–12 educators can work as partners to meet both conservation and educational goals.

Jena is investigating the Mottled Duck and its habitat at the McFaddin National Wildlife Refuge (NWR) and the Texas Point NWR, both on the Gulf Coast of Texas. In addition, she works with local school districts and other local conservation partners to



USFWS photo by Steve Hillebrand

combine on-line project information with class visits to the refuges. Tips on finding a local natural resource expert for this type of partnership effort are found on page 24 of this guide. For more on Jena Moon and other natural resource scientists see Appendix B.

KEY CONSERVATION MESSAGE OF THE JUNIOR DUCK STAMP CURRICULUM

From the Association of Fish and Wildlife Agencies

North America’s fish and wildlife belong to all of us, and we rely on state, tribal, and federal agencies to watch over them.

In North America, fish and wildlife are part of the public trust. This means that it is our responsibility to manage and take care of them and the places where they live. To do this, we look to the government agencies that manage these natural resource on a state-by-state and national level, and understand that these agencies rely on the involvement and support of the public. Fish and wildlife are valuable to our society.

Jena Moon’s story emphasizes the role of federal agencies in both understanding the needs of wildlife, in this case the Mottled Duck, and the roles educators can play in helping students understand specific conservation efforts.

Introduction. Activity Preparation Tips

EXPLORE

Learning Objectives:

On completing the *Explore* activities described below, learners will be able to:

- Gather evidence about natural systems using journaling and sketching
- Develop a plan for future activities
- Find local resources (natural resource areas and natural resources professionals/ organizations) to help with their activity interests
- Communicate with local natural resource professionals

Activities:



Start a Nature Notebook

Description: Nature journaling is a proven method of getting youth to reflect on what they see in nature. In doing so, they enhance their outdoor experiences and learning. Students will create or supply a journal for recording their thoughts, data, and sketches throughout the program. The journal is referred to as the Nature Notebook. Students should be encouraged to decorate their notebook covers.

Setting: Indoor

Preparation:

- Order binders or have each student bring a binder to class OR
- Provide paperboard, unlined paper, three-hole punch, yarn or string, and art supplies for students to create and decorate a Nature Notebook

Materials: Each student will need to supply a binder for a Nature Notebook (journal) or have one supplied. Or students can create journals using paper board for covers, 3-hole punched paper, and yarn or string to bind them. A variety of arts and crafts materials should be made available for decorating the covers of their Nature Notebooks. Nature Notebooks will be pulled in and out of backpacks, so they should be decorated with wear and tear in mind.

Make a Plan



Description: Students will quickly scan the *Youth Guide* and then develop a plan outlining the activities they might like to try along the way and when they think they could start the activity. A template for their plan is shown on page 16 of the *Youth Guide*. They should be encouraged to choose at least one activity from each of the *Explore*, *Investigate*, *Express*, and *Share* sections of the Introduction.

Setting: Indoor

Preparation: None

Materials: Students only need their Nature Notebooks and a pen or pencil for this activity.



Find Waterfowl Where You Live

Description: In this activity students begin to identify local natural areas as well as natural resource professionals and/or organizations in the community. This information will provide places to visit for waterfowl observations and contacts for natural resource partners that might help with curriculum activities.

Setting: Indoor

Preparation: Students will need access to a phone for a local call(s). You might want to ask them to make their call(s) at home after school, after they get permission from a parent or guardian. Students may need educator assistance in finding public natural areas and content information from the suggestions on page 16 of the *Youth Guide*.

Materials: Students only need their Nature Notebooks and a pen or pencil for this activity.

INVESTIGATE

Learning Objectives:

On completing the *Investigate* activities below, learners will be able to:

- Identify wildlife features
- Describe living and non-living components of a natural area

Activities:



Observe a Duck, a Goose, and a Swan

Description: Students will start learning waterfowl observation skills by describing the photos on page 17 of the *Youth Guide* and recording their thoughts in their Nature Notebooks. Remind students that their words should be descriptive and their drawings detailed. Ask them to describe the habitat, as well as the other living and non-living components shown in the photos.

Setting: Indoor

Preparation: None

Materials: Students only need their Nature Notebooks and a pen or pencil for this activity.



Visit a Natural Area, Park, or Zoo and Make Nature Observations

Description: Students are encouraged in this activity to devote free time each week to nature observation and the practice of keeping a nature journal.

Setting: Indoor or outdoor

Preparation: Using the list in the *Youth Guide* (page 16) and/or the contacts listed in the *Related Resources* section on page 30, find public natural areas where students can observe wildlife and natural resource professionals in your community who might provide assistance.

Materials: Students only need their Nature Notebooks and a pen or pencil for this activity.

EXPRESS AND SHARE

The *Express* and *Share* sections of the Introduction serve only as practice for Unit 1–5 activities.

Activities:



Express: Use Your Nature Notebook

Description: This “activity” is just a reminder for students to use their Nature Notebook whenever they’re collecting data, sketching, or writing responses to activity questions. It requires no additional action or materials.



Share: Tell Someone, Show Someone, or Take a Friend with You

Description: Students choose how they’re going to share what they’ve learned with families, friends, or educators. The activity requires no additional action or materials.

Adaptations for Early Elementary Students

1. Younger students will need more supervision in devising a plan of action and when visiting natural areas. Parents and other volunteers can often fill those roles.¹
2. Nature journaling is an activity that is age appropriate for early elementary students. Very young students, depending on their abilities, should feel free to use simple words, drawings, or pasting things (like a leaf or blade of grass) into their journals to describe their observations, instead of using sentences.

Additional Early Elementary Resources for Journaling

- (Pre K–8) Berkshire Museum: Living Landscapes – *Nature Journaling: Experience the Outdoors Through Writing and Drawing*. http://www.berkshireremuseum.org/living_landscapes/pdf/Berkshire_L1.pdf
- (K–4) Elementary GLOBE’s, A Learning Activity for The Mystery of the Missing Hummingbirds: All Year Long. <http://globe.gov/k-4/seasons>

Adaptations for High School Students

1. High school students might be encouraged to scan pages of the Nature Notebooks to share with others electronically. Could they establish an online social network of school and/or school district students that are interested in waterfowl and wetlands to share ideas and enthusiasm? Or join an existing waterfowl-related Facebook page?
2. High school youth should be expected to take more responsibility in using the Internet to find local natural areas and natural resource partners.

Additional High School Resources for Journaling

- (K–12) Smithsonian Education in your Classroom, *Introduction to the Nature Journal*: http://www.smithsonianeducation.org/educators/lesson_plans/journals/smithsonian_siyc_fall06.pdf

¹ *Excellence in Environmental Education: Guidelines for Learning (K–12)*. 2010. North American Association for Environmental Education, www.naaee.org



- (5–12) *Take Note!*, All About Birds, Cornell Lab of Ornithology. <http://www.allaboutbirds.org/NetCommunity/Page.aspx?pid=1852>
- (9–12) *Keeping a Nature Journal* by Bonnie Johanna Gisel, Ph.D. http://www.sierraclub.org/education/nature_journal.asp

INTRODUCTION – RELATED RESOURCES

Journaling

There are a number of how-to guides available on the Internet for learning how to keep a nature journal. Here are a few examples:

- (K–12th) Smithsonian Education in your Classroom, *Introduction to the Nature Journal*: http://www.smithsonianeducation.org/educators/lesson_plans/journals/smithsonian_siyc_fall06.pdf
- (5–12th) *Take Note!*, All About Birds, Cornell Lab of Ornithology. <http://www.allaboutbirds.org/NetCommunity/Page.aspx?pid=1852>

Finding natural areas and natural resource professional partners

- See the contact for ideas list on page 16 of the *Youth Guide*. Check *Potential Partners* on page 24 of this *Educator Guide* for suggestions for creating partnerships with natural resource experts.
- Many states have a state-wide environmental education (EE) association. Environmental education association memberships are made up of EE or nature centers, museums, zoos, and a variety of other non-profit organizations. They often have natural areas and public EE programs, and are a good source of resources to find people, places, and programs on wetlands and/or waterfowl in your area. Find contact information for your state's EE association at the North American Association of Environmental Education's, Affiliates Contacts by Regions page, <http://www.naaee.org/about-naaee/affiliates/affiliates-contacts-by-region>.
- Find public lands:
 - National Wildlife Refuge System, U.S. Fish and Wildlife Service. <http://www.fws.gov/refuges/>
 - U.S. Fish and Wildlife Service Refuge Locator Map <http://www.fws.gov/refuges/refugeLocatorMaps/index.html>
 - Find a Forest by State, USDA Forest Service http://www.fs.fed.us/recreation/map/state_list.shtml
 - Find a National Park, U.S. National Park Service <http://www.nps.gov/findapark/index.htm>
 - Public Lands Information Center: Your One-Stop Source for Recreation Information, Public Lands Interpretive Association. <http://www.publiclands.org/home.php>



UNIT 1. WHAT IS ...A WATERFOWL?

A March morning is only as drab as he who walks in it without a glance skyward, ear cocked for geese.

Aldo Leopold, *A Sand County Almanac*

In Unit 1 activities, students observe and identify details that characterize ducks, geese, and swans. Activities are designed to ensure that students have a basic understanding of the parts of a bird. The activities encourage students to apply this new understanding to add details to their waterfowl observations and drawings. Students will start with the basic components of waterfowl in mind and then adjust their mental picture for each type of waterfowl and situation they choose to sketch.

Purpose

In this unit, students will explore what makes a waterfowl a bird, how waterfowl are different than other birds, and how ducks, geese, and swans are different from one another. They'll also discover how specific characteristics and adaptations help waterfowl survive in their wetland habitats.

Learning Objectives

If learners choose to complete all the activities in this section, they will build skills and motivation to:

- Investigate how waterfowl keep their feathers dry.
- Investigate how waterfowl feet and the shape of their bills help them survive in the wild.
- Demonstrate an understanding of the differences between the shapes of waterfowl and birds, as well as the differences among the shapes of ducks, geese, and swans.
- Communicate with others about the unique characteristics of waterfowl.

Unit 1 at a Glance

Purpose:

- To investigate waterfowl behavior and the relationships among their behavior, habitat, and survival
- To examine waterfowl adaptations for surviving in wetland habitats

Subjects: Science, language arts, visual arts.

Process skills:

- **Science skills**
 - Collecting information
 - Communicating
 - Describing
 - Designing investigation
 - Gathering evidence
 - Identifying
 - Observing
 - Planning
 - Questioning
 - Recording
- **Language arts skills**
 - Communicating
- **Visual arts skills**
 - Communicating

Conservation concepts:

- Organisms have basic needs and can survive only in environments in which their needs can be met
- Different kinds of organisms are adapted for living in different environments
- There are people who make their livings studying and managing natural resources

Vocabulary: adapted, *Anatidae*, *Anseriformes*, appendages, biomimicry, characteristics, contour feathers, correlative question, cygnet, dabbling duck, drake, diving duck, filoplume feathers, flight feathers, habitat, hen, insulation, Laguna Madre, mounted specimen, pineal gland, plumage, preening glands, reasoning, tamarack, uropygial gland, vertebrae, waterfowl

Featured Artists

Meet the Hautman brothers, Wildlife Artists

Your students might be interested in learning more about the Hautman brothers of Minnesota, Joseph, James, and Robert. They are remarkably talented wildlife artists and successful Duck Stamp Contest participants. James Hautman, from Chaska, Minnesota, was named the winner of the 2010 federal Duck Stamp Art Contest. His winning acrylic painting illustrates a pair of White-fronted Geese. James has won the Duck Stamp Contest three other times — 1990, 1995, and 1999.

In 2010, of 235 entries, 11 entries made it through to the final round of judging. Robert, James and Joseph's brother, placed second with his acrylic painting of a White-fronted Goose. Robert is also a two-time previous Duck Stamp Contest winner and Joseph has won the contest three times. Read more about the Hautman brothers at <http://www.hautman.com/index.html>.

The Hautman brothers' work provides terrific examples of how the knowledge of scientific methodologies, such as the abilities to make detailed observations, can enrich the work of wildlife artists. Many students may be surprised to discover that artists and wildlife scientists might ask the same questions when studying waterfowl.



Note the great detail James Hautman captured in this 2010 winning Duck Stamp painting. It takes a keen eye and a significant knowledge of form and function to achieve this degree of realism in wildlife art.

If your students are interested in entering the Junior Duck Stamp Art Contest, make sure they read *Have Fun Painting Ducks: For duck stamp contest winner, painting ducks is serious business and fun* by Joe Hautman (On the Minnesota Department of Natural Resources, Minnesota Conservation Volunteer website: http://www.dnr.state.mn.us/young_naturalists/painting_ducks/index.html) In this colorful article, Hautman explains how he became interested in the Duck Stamp Contest and gives youth tips on creating Junior Duck Stamp entries. A companion Educators Guide, "*Have Fun Painting Ducks*" *Multidisciplinary Classroom Activities* is available at http://files.dnr.state.mn.us/education_safety/education/educators/activities/volunteer_studyguides/painting_ducks_studyguide.pdf

Unit 1. Activities Preparation Tips

Background information

What Makes a Bird a Bird?¹

There are more than 9,000 species of birds in the world. Birds are warm-blooded vertebrates. They have three characteristics which distinguish them from other animals: feathers, hard-shelled eggs, and hollow bones.

- **Warm-Blooded:** Like mammals, birds are warm-blooded. This means their body temperature stays the same no matter how hot or cold it is outside. This characteristic allows birds to maintain high levels of energy needed to fly.
- **Feathers:** Birds use their feathers in many ways; for flight, regulation of body temperature (thermoregulation), protection of the body, attraction of mates, and identification of species. Contour feathers cover the body of a bird and have a strong, hollow shaft and network of hooks. Down feathers are small and are located under the contour feathers. The purpose of these feathers is to insulate the bird from the cold.
- **Hard-Shelled Eggs:** Birds lay hard-shelled eggs. The hard shell keeps an egg from drying out and allows the parents to sit on the eggs during incubation. Even though bird eggs are hard-shelled, they have microscopic pores which allow oxygen to enter and carbon dioxide to exit the shell. Eggs come in a variety of colors, patterns, shapes and textures. Colors and patterns on eggs vary depending on the need for camouflage. The shape of the egg depends on where the bird nests. Most eggs are oval. Birds that lay their eggs on ledges need eggs with a pointed end so they will not roll off the ledge. The texture of an egg may vary from smooth (hummingbird) to coarse (chicken).
- **Hollow Bones:** It takes more than feathers to make birds creatures of the sky. Extremely lightweight bones are also necessary for flight. Bird bones are strong and hollow with inside supports.

What Makes a Bird a Waterfowl?

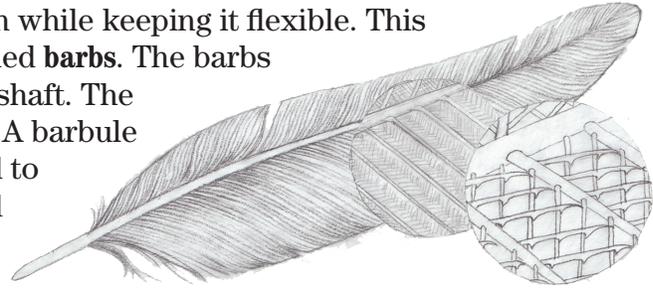
Waterfowl can be distinguished from other birds by characteristics that maximize their ability to survive in a wet environment. These include specialized feather structure (including waterproof external feathers), a body shape designed for swimming, feet and foot webbing distinctive from other water birds, unique positioning of feet and legs on the body in a way that is adapted to food gathering and other activities, shapes of the bill that are adapted to food gathering and eating, and characteristics pertaining to flight.

Feathers²

What do all birds have in common? They all have feathers. Feathers have many uses. They help insulate a bird against the cold and the heat. They are aerodynamic, giving the birds the ability to fly. Their colors provide camouflage for protection or bright patterns that help

^{1,2} Adapted from *Birds—Our Feather Friends: What Makes a Bird a Bird?*, Wildlife Loves Refuges, J.N. “Ding” Darling NWR, Environmental Education Guide, USFWS: <http://www.fws.gov/dingdarling/pdf/MASTER%20ACTIVITY%20GUIDE%20BOOK2.pdf>

birds attract mates. Feathers can do all of these things and more because of their special structure. They are lightweight but strong, delicate but durable. They are truly fascinating. Feathers are made of a protein called keratin, which is the same material found in our hair and fingernails. The **shaft**, which is the central white part of the feather, provides support. The **quill**, which is the hollow base of the shaft, anchors the feather in the skin. Point out the broad, flat surfaces on either side of the shaft. These are called vanes. The **vanes** are a sort of mesh that gives the feather strength while keeping it flexible. This mesh is made up of interlocking strands called **barbs**. The barbs are like arms that extend outward from the shaft. The barbs are held together by rows of **barbules**. A barbule consists of a series of single cells linked end to end. Some have hook-like projections called **barbicels**. The barbs can be spread apart to see the barbules, which appear like fuzzy projections on the barb. You can “zip” the vane back together by running your fingers along the grain. Explain that birds do this also; cleaning, straightening, stretching, and coating their feathers—this is called **preening**.



Laura Maloney, DJ Case & Associates

Feathers and oil¹

Ducks keep their feathers waterproof by spreading oil from a special gland onto their feathers. However, if crude oil gets into streams, lakes, or oceans, as in an oil tanker spill, it can be harmful to ducks and other water birds.

When ducks and other waterfowl come in contact with oil floating on top of the water, their feathers

become matted. Oily, matted feathers lose their ability to insulate. Because of this, the birds can die from the cold. Also, when the bird tries to clean the oil off of its feathers, it may swallow some of the oil which can lead to stomach ulcers. The only way to save the oil covered birds is to scrub them with detergent, like you might scrub a greasy pan. But this is not a perfect solution. It is very expensive and takes a long time to clean birds.

Oil is one of the most common pollutants in our water. Most of the oil in oceans gets there when oil tanks on ships are rinsed while at sea. Large spills can occur during drilling, refining, and transport of oil. You have probably heard of the Exxon Valdez oil spill, which happened in 1989 at Prince William Sound in Alaska. Scientists have learned a great deal studying the effects of this event on waterfowl and their habitats. The 2010 Deepwater Horizon oil spill occurred in a very different ecosystem, the Gulf of Mexico. Scientists will be studying the impacts on waterfowl populations and habitat for a very long time.

See the Unit 1 *Related Resources* list (page 53) to find more information on the impacts of oil pollution on waterfowl.

Webbed Wonders²

Waterfowl use their feet for much more than just standing and swimming. The legs and

¹ Adapted from *No Water off a Duck's Back, Darby Duck, the Aquatic Crusade: Activities 5–7*, Polluted Runoff for Kids, U.S. EPA and Franklin Soil and Water Conservation District (Ohio).

² Adapted from Checkett, J. Michael. *Webbed Wonders. Ducks Unlimited*. <http://www.ducks.org/conservation/waterfowl-biology/webbed-wonders>

feet of waterfowl play a vital role in many important activities, including locomotion (walking and flying) and thermoregulation (maintaining body temperature). Features such as webbing of the feet arose over time as the birds adapted to make the most of their wetland environments. For example, researchers recently discovered that while swimming, waterfowl push both backward and downward with each stroke of their webbed feet. This provides a combination of lift and thrust, propelling the birds through the water with remarkable speed and efficiency.

The feet of water birds are all structurally similar but vary among species. The most common difference is in the amount of webbing between the birds' toes. Cormorants and Boobies have totipalmate feet, where all four of the birds' toes are connected by webs. Ducks and geese have palmate feet, where only the three front toes are webbed and the hind toe (called the hallux) is small and elevated. Coots have lobate feet, where the toes have a series of webbed lobes that open when the foot is pushed backwards—much like the base of a push pole used by duck hunters to traverse the marsh. Lastly, some waterfowl such as the Australian Magpie Goose and the Hawaiian Goose (or Nene) have half-webbed semipalmate feet, an adaptation that is useful for occasional swimming and walking on soft surfaces.

The legs and feet of waterfowl also play an important role in maintaining body temperature. Ever wonder how a Mallard can stand comfortably on ice? A unique heat-exchange system in the birds' legs known as counter-current circulation makes this possible. The large, flat feet of waterfowl are natural radiators, so to minimize heat loss, the arteries and veins in the birds' legs work in tandem to retain heat. Arteries supplying blood to the feet pass alongside the veins removing blood. The warm arterial blood flowing to the feet is cooled by venous blood flowing back to the body where it is warmed again. Consequently, very little of a duck's body heat is lost through its extremities. Thus, while the core body temperature of a duck standing on ice is near 100 degrees Fahrenheit, the temperature of the bird's feet may be just above freezing.

Where legs and feet are positioned on the bodies of waterfowl also influences how the birds interact with their environment. In dabbling ducks and geese, the legs are located near the middle of the body, providing the birds with good balance for standing and walking. This offers many advantages, including the ability to feed on dry land and in very shallow water, nest in upland habitats, and spring almost vertically into flight to escape predators.

The feet of diving ducks are located near the back of their body. This makes walking difficult, but is beneficial for diving and swimming. These adaptations allow diving ducks to frequent large bodies of water and feed by diving, often at considerable depths. Their excellent diving and swimming abilities also help them escape predators. The trade-off is that diving ducks can't spring vertically into flight like dabbling ducks and must instead make a running start across the water to achieve flight speed.

A final activity where the feet of waterfowl play an important role is flight. All waterfowl use their feet as rudders while flying. And as all waterfowl hunters have seen, ducks and geese lower their feet and spread the webbing between their toes right before they land. This creates a little extra drag that helps the birds slow down. Conversely, when waterfowl want to achieve maximum flight speed and efficiency, they pull their feet into their flank feathers just like retractable landing gear on an airplane.

A Duck Dinosaur?

Recent scientific discoveries indicate that a waterfowl-like bird lived among the dinosaurs. Information from a newly discovered avian species called *Vegavis iaai* indicates that these birds lived about 65 million years ago in the Cretaceous period and must have survived the Cretaceous/Tertiary mass extinction event that included the disappearance of all other dinosaurs. For more about *Vegavis* see the *Youth Guide*, page 35, and the *Educator Guide*, Appendix E.

Waterfowl Feet and Coloration

More from J. Michael Checkett, Ducks Unlimited ...

Have you ever heard that you can tell where a Mallard is from by the color of its feet? As the story goes, the legs and feet of northern Mallards are redder than their southern cohorts because low temperatures in higher latitudes cause more blood to flow to the birds' extremities. These Mallards are also thought to be larger and hardier than Mallards raised in southern parts of the species' range. Old-timers called these big, late-migrating Mallards "redlegs."

In reality, the brightly colored feet and bills of Mallards and other ducks are caused by changes in hormone levels during late fall and winter while the birds are pairing. The feet of both male and female Mallards turn bright orange—almost red—in December and January as they go through courtship and pairing. Heavier adult Mallards typically develop breeding plumage and display brightly colored feet earlier than younger, lighter birds, giving rise to the mistaken belief that "redlegs" are a different race or subpopulation of larger Mallards. In summer, hormone levels in ducks decrease, and their feet and bills become drab in color again, which helps camouflage the birds while nesting and molting.

PENCIL-TO-PAPER WARM-UP



Description: Students brainstorm words to describe the shape of ducks, geese, and swans in geometric terms (circle, oval, cylinder). They then make a quick sketch of a duck, goose, or swan in their Nature Notebooks incorporating using only geometric shapes.

Setting: Indoors

Skills: Communicating, describing, developing visual ideas, explaining

Materials: Nature Notebook, art pencil or charcoal stick

EXPLORE

Learning Objectives:

On completing the *Explore* activities described below, learners will be able to:

- Name characteristics of birds that make them different from other animals
- Name characteristics of waterfowl that make them different from other birds
- Describe the skeletal shapes of waterfowl and how duck, goose, and swan skeletons are alike or different

Activities:**What Traits do Birds Share?**

Description: Students will explore the ways that birds are alike or unlike other animals by making a list of bird characteristics.

Setting: Indoors

Skills: Describing, explaining

Materials: Nature Notebook and a pen or pencil.

**What Shape Is a Waterfowl?**

Description: Students focus on the shape of waterfowl. They examine photos of birds and try to discern waterfowl characteristics from non-waterfowl characteristics.

Setting: Indoors

Skills: Communicating, describing, explaining, observing

Materials: Photos on page 33 of the *Youth Guide*, Nature Notebook, and a pen or pencil.

**Telling the Difference by Shape**

Description: Students consider the skeletons of waterfowl and how the skeletons of ducks, geese, and swans are alike or different. Drawing #1 is a goose; #2 is a duck; #3 is a swan.

Setting: Indoors

Skills: Comparing, developing visual ideas, connecting art to other subjects

Materials: Three skeleton outlines from page 34 of *Youth Guide*, Nature Notebook and a pen or pencil.

**Which of These Feet Belong to a Duck, Goose, or Swan?**

Description: Students examine photos of waterfowl feet and describe the characteristics they see that make waterfowl feet different than the feet of other birds. Drawing #1 is a grebe; #2 is a beaver; #3 is a duck; #4 is a heron.

Setting: Indoors

Skills: Comparing, describing, observing

Materials: Nature Notebook and a pen or pencil.

**Bird Songs**

Description: “Quack” and “honk” are usually the ways we describe duck or goose calls. Waterfowl calls, however, can be very surprising. Some duck calls, for example, sound much like frogs. In this activity students work with a partner to listen to waterfowl sounds on the Internet or a CD. They listen to calls from at least three different waterfowl species and then try to distinguish how the calls are alike or different.

Setting: Indoors

Skills: Comparing, describing, listening

Preparation: Check the *Related Resources* section (page 53) for waterfowl call recordings available on the Internet; provide students with computers, Internet access, and headphones. If Internet access is not an option, check local libraries for CDs of waterfowl calls or search online to purchase a call CD.

Materials: Access to Internet sites on a computer with speaker or headphones or a CD of waterfowl calls and CD player with speakers or headphones, Nature Notebook and a pen or pencil.



A Duck Dinosaur?

Description: In this activity students are introduced to the work of paleontologist Dr. Julia A. Clarke. Dr. Clarke discovered fossil evidence of *Vegavis*, a cousin of today's waterfowl species. Students compare characteristics of *Vegavis* to modern day waterfowl species and explore questions with a partner about how the two are alike or different.

Setting: Indoors

Skills: Comparing, describing, observing

Materials: Nature Notebook and a pen or pencil

INVESTIGATE

Learning Objectives:

On completing the *Investigate* activities described below, learners will be able to:

- Describe how certain waterfowl features (beaks, color, feathers, and feet) help ducks, geese, and swans survive in wetland habitats
- Use Internet tools to gather and synthesize information about waterfowl
- Create ideas and questions for science inquiry activities
- Gather evidence based on observations

Activities:



Feathers

Description: Students examine a feather through a microscope or hand lens and sketch it in detail. They compare different types of feathers from the same bird and learn that different feathers have different functions.

Setting: Indoors

Skills: Comparing, connecting art to other subjects, describing

Preparation: Students may need help finding feathers for this activity. Check with your natural resource partner, a rod and gun club, a local farmer that raises chickens, local natural history museum, or an art/craft store for sources.

Materials: Nature Notebook, drawing pencil, enough feathers for each student to work alone or with a partner. The activity will be more meaningful if you can provide students with different types of feathers from the same bird.



Water Off a Duck's Back?

Description: Students drop water on a feather to determine if the water soaks into the feather or runs off the surface of the feather.

Setting: Indoors

Skills: Comparing, connecting art to other subjects, describing

Preparation: Students may need help finding feathers for this activity. Check with your natural resource partner, a local hunter, a farmer that raises chickens, a natural history museum, or an art/craft store for sources.

Materials: Nature Notebook, drawing pencil, enough feathers for each student to work alone or with a partner. The activity will be more meaningful if you can provide students with different types of feathers from the same bird.



The Right Bill for the Job

Description: Students explore the differences among a variety of birds' bills and think about how these variations correlate with the types of food the birds eat. They then match photos of waterfowl bills to photos of different types of bird food. Answers: a - 3; b - 4; c - 1; d - 2

Setting: Indoors

Skills: Comparing, describing,

Materials: Nature Notebook and pen or pencil



The Winner by a Foot

Description: Students compare how waterfowls' feet are alike and different.

Setting: Indoors

Skills: Comparing, describing, observing

Preparation: Read *Webbed Wonders* on page 43. Find more photos on the Internet, which illustrate variations of waterfowl feet, to share with students. Try to find some photos that demonstrate how webbed feet are used. In the photos of feet on page 41 of the *Youth Guide*, the photo in the middle shows feet of a duck that spends most time on land. The photo on the right is the bird that spends most time in the water. The latter has much more webbing.

Materials: Nature Notebook and pen or pencil



True Colors

Description: Students investigate waterfowl coloration and its significance and implications for survival in wetland habitats.

Setting: Outdoors or indoors

Skills: Comparing, describing

Materials: Nature Notebook and pen or pencil



More Exploring and Investigating

Description: By now students have thought a lot about different waterfowl adaptations for survival. In this activity they get to choose something that interests them the most about waterfowl to investigate and explore on their own.

Setting: Outdoors or indoors

Skills: Comparing, describing, researching

Materials: Nature Notebook and pen or pencil



Investigate Your Question

Description: As a follow-up to “More Exploring and Investigating” students will apply the processes of inquiry to questions they have about waterfowl and/or their habitat.

Setting: Outdoors or indoors

Skills: Comparing, describing, gathering evidence, measuring, observing, recording

Materials: Nature Notebook and pen or pencil



Telling the Difference

Description: Students hone their skills in observation, bird identification, and nature journaling.

Setting: Outdoors or indoors

Skills: Comparing, describing, gathering evidence, identifying, observing, recording

Materials: Nature Notebook and pen or pencil

EXPRESS

Learning Objectives:

On completing the *Express* activities described below, learners will be able to:

- Describe the characteristic shape and features of waterfowl through sketching and sculpture
- Explain how a famous artist or writer communicated personal feelings and experience in his/her work

Activities:



Simple Shapes

Description: Students begin to work on their skills in observation and nature journaling while developing an understanding of waterfowl anatomy. This is meant to be a short, geometric sketching activity, which will prepare students to participate in outdoor waterfowl journaling.

Setting: Indoors

Skills: Describing, observing, sketching and journaling techniques

Materials: Nature Notebook and pen, pencils, charcoal sticks



Shape Sculpture

Description: Students transform their simple shape drawing into a 3-dimensional structure to further explore the basic anatomical features of waterfowl heads, necks, and bodies.

Setting: Outdoors or indoors

Skills: Describing, modeling, observing, sculpture techniques

Materials: Nature Notebook, pen or pencil, camera, access to photo printer, tape, photos from page 50 of the *Youth Guide*, modeling clay and/or paper mache.



What's in a Name?

Description: Students create a quick sketch in their Nature Notebook of one of the following species: Blue-winged Teal, Green-winged Teal, Canvasback, Redhead Duck, or Northern Shoveler. They will then use markers to add color to their drawing according to the clues provided in the species' name.

Setting: Indoors

Skills: Describing, identifying, sketching and journaling techniques

Materials: Nature Notebook, pen or pencil, charcoal stick, colored pencils, markers or crayons, access to the Internet or to waterfowl field guides



Scientists or Artists or Writers?

Description: Students briefly explore the works of Sigurd Olson, John James Audubon, and Beatrix Potter and learn how interests in science led them all to great accomplishments in the arts (language and visual).

Setting: Outdoors or indoors

Skills: Connecting art to other subjects, describing, observing, sketching

Materials: Nature Notebook, pen or pencil, charcoal stick, access to library or Internet resources on Olson, Audubon, and Potter



Artist's Techniques and You

Description: Students experiment with sketching waterfowl appendages (feet, wings, feathers, bills) in great detail.

Setting: Outdoors or indoors

Skills: Describing, observing, sketching

Materials: Nature Notebook, pen or pencil, charcoal stick, waterfowl appendages to observe in detail from photos, live specimens, or mounted specimens

Confidence in drawing depends on careful, repeated observation. By sketching a subject frequently, students ... will gradually build up a store of visual information about physical types, expressions and poses in a variety of situations.

Sketch Types, DrawingProfessor.com¹

¹ http://www.drawingprofessor.com/tutorials/sketch_types/index.html



Waterfowl in the Arts

Description: Students explore the works of famous bird and waterfowl artists to study how the artists portrayed the habitats of their subjects. Students then use words to describe the habitats in a very life-like fashion.

Setting: Indoors

Skills: Describing, observing, writing

Materials: Nature Notebook, pen or pencil, access to library or Internet resources on famous bird and waterfowl artists.

SHARE

Learning Objective:

On completing the *Share* activities described below, learners will be able to:

- Employ strategies to communicate how waterfowl characteristics are mimicked by human technologies or design

Activities:



Biomimicry

Description: The term “biomimicry” means to imitate life. Leonardo da Vinci and the Wright brothers were inspired to think about human flight by observing birds in flight. In this activity, students create a cartoon that shows human technologies (real or imaginary) that mimic waterfowl adaptations. Students are encouraged to share their images with friends, classmates, and family, conveying to their audiences what they’ve learned about waterfowl appendages.

Setting: Indoors

Skills: Communicating, connecting art to other subjects, describing, developing visual ideas, modeling

Materials: Nature Notebook, pen or pencil, charcoal stick, access to library or Internet resources



Dressed for Work!

Description: This is also a biomimicry activity, but in this case students use an odd assortment of props to dress someone up like a duck, goose, or swan.

Setting: Indoors

Skills: Communicating, connecting art to other subjects, describing, developing visual ideas, modeling

Preparation: Large garbage bag to hold props. Encourage students to gather items from home for their group’s bag of waterfowl-like appendages, such as swim fins (webbed feet), boa (feathers), or Japanese fan (tail).

Materials: Nature Notebook, pen or pencil, camera, access to a photo printer, tape



Mystery of the Labrador Duck – Evidence about body shape and appearance

Description: Students read a short piece describing the bill and legs, habitat, and food of the Labrador Duck. They then list in their Nature Notebook any clues from the story about why they think the Labrador Duck became extinct.

Setting: Indoors

Skills: Communicating, creating evaluation strategies, describing

Materials: Nature Notebook, pen or pencil



PENCIL-TO-PAPER WRAP-UP

Students revisit the *geo*-bird created in the *Warm-Up* section of this unit (page 44). Encourage them to think about what they learned in Unit 1 about the special characteristics of waterfowl that help them survive. Encourage students to change their drawing to reflect their new knowledge about waterfowl appendages, adaptations and habitat.

Adaptations for Early Elementary Students

In these early years of formal education, learners tend to be concrete thinkers with a natural curiosity about the world around them. Environmental education can build on these characteristics by focusing on observation and exploration of the environment—beginning close to home.

The NAAEE Excellence in Environmental Education: Guidelines for Learning (K–12) suggests the following strategies for examining environmental issues with fourth graders:

- Keep it simple
- Keep it local
- Make close links with what they're observing and learning about the local environment¹

For K–1 students: Provide each student a sheet of drawings of different animal and waterfowl parts: bills, feet, wings, tails. Let kids color and cut out the parts. Children must choose the proper animal parts to assemble their duck, goose and swan. They can paste and create their waterfowl on a separate sheet of paper and then staple it into their Nature Notebooks.

¹ *Excellence in Environmental Education: Guidelines for Learning (K–12)*. 2010. North American Association for Environmental Education, www.naaee.org

For K–6 students: *Adapt the Get to Know the Shorebirds Puppet Show*, Migration Science and Mystery

http://migration.pwnet.org/pdf/Get_to_Know_the_Shorebirds_Puppet_Shows.pdf

Change this shorebird activity to a waterfowl activity for younger students. By creating waterfowl puppets and putting on a waterfowl puppet show, students learn the physical and behavioral characteristics that make a bird a waterfowl. Follow the lesson plan suggestions that are appropriate for your group, such as choosing to make paper bag puppets, stick puppets, or paper plate puppets for younger children; older students might want the challenge of making marionette puppets.

Check the *Related Resources* list on page 53 for curricula, activities, and materials that are appropriate for grades K–4.

Adaptations for High School Students

By the end of twelfth grade, learners are well on their way to environmental literacy. They should possess the basic skills and dispositions they need to understand and act on environmental problems and issues as responsible citizens—and to continue the learning process throughout their lives. In the ninth through twelfth grades, environmental education can promote active and responsible citizenship by challenging learners to hone and apply problem-solving, analysis, persuasive communication, and other higher level skills—often in real-world contexts.

UNIT 1 – RELATED RESOURCES

Activities

Adaptations

- *Adaptations*, Lesson 4 (4–6th), Wetland Ecosystems I, Ducks Unlimited Canada.
<http://www.epa.gov/gmpo/education/pdfs/DUEducators4-6.pdf>
Students identify and describe adaptations that allow plants and animals survive in wetland habitats.
- *Diversity and adaptations*, Lesson 5 (9–12th) Wetland Ecosystems III, Ducks Unlimited Canada.
<http://www.epa.gov/gmpo/education/pdfs/DUEducators9-12.pdf>
Students explore the diversity of structural and behavioral adaptations.

Birds

- *What Makes a Bird a Bird?*, Educator Guide and Student Guide. Illinois Natural History Survey, <http://www.inhs.illinois.edu/resources/virtualbird/educator/lespl1.html>
 - *What Makes a Bird a Bird?* (4–7th) Background information and activities focusing on four defining characteristics of birds.
 - *Natural Tools* (3–6th) Background information and activities about bird beaks and the foods for which they are adapted.

Feathers

- *No Water off a Duck's Back* (4–8th), *Darby Duck, the Aquatic Crusade: Experiment 7*, Polluted Runoff for Kids, U.S. EPA. <http://www.epa.gov/owow/NPS/kids/darbyduck.html>

...and Oil

- *Exploring the Effects of Oil Spills on Birds* (K–2nd), Minnesota Science Educators Education Project <http://serc.carleton.edu/sp/mnstep/activities/26016.html>
Students examine feathers and then dip feathers in oil to compare and describe the differences.
- *No Water Off a Duck's Back* (5–8th), Project WILD <http://www.projectwild.org/NoWateroffaDucksBack.pdf>
Students investigate how oil spills can harm waterfowl.

Feet

- *The Swimming Secrets of Duck Feet* (K–4th), Science Buddies http://www.sciencebuddies.org/science-fair-projects/project_ideas/Aero_p014.shtml
This activity compares the efficiency of different types of feet for swimming and could provide background information for older students as well.

Scientific Investigation

- *Investigating Evidence, Educator's Guide – Bird Sleuth*. (5–8th). Cornell Lab of Ornithology <http://www.birds.cornell.edu/birdsleuth/about/resources/birdsleuth-modules>
This module provides five activities designed to help educators guide students through the processes of science inquiry.

Print material

Birds

- Garelick, May. *What Makes a Bird a Bird?*, [city]: Mondo Publishing, 1995. (K–5th)
- See *What Makes a Bird a Bird*, (K–4th), Cornell Lab of Ornithology’s activity guide for the book at <http://www.birds.cornell.edu/education/educators/whatmakesabird>
- Sill, Cathryn. *About Birds: A Guide for Children*, Atlanta: Peachtree Publishers, Ltd. 1997. (Pre-K–2nd)
- Boring, Mel. *Birds, Nests & Eggs* (Take-Along Guides). Minnetonka, MN: Northword Press. 1996. (K–8th)

Bills

- Davies, J. *The Boy Who Drew Birds: A Story of John James Audubon*, Houghton Mifflin, 2004, page 32. (2nd–4th)
- Collard, Sneed B. *Beaks!* MA: Charlesbridge Publishing. 2002. (K–4th)

Sigurd Olson

- Olson, S. *Runes of the North*. NY: Knopf. 1963, page 119.
- Olson, S. *The Singing Wilderness*. NY: Knopf, 1956, page 174.

Web resources

Birds

- All about Birds, KidZone. (K–3rd) <http://www.kidzone.ws/animals/birds1.htm> [commercial site]
- *Amazing Birds*. (K–4th) Neal, Brenda, et al. NY: Cornell Lab of Ornithology. 2009. <http://www.birds.cornell.edu/education/educators/physics/elementary/files/tm>
This set of lesson plans and activities introduces how the structures and behaviors of birds help them survive in their particular habitats. *Physical Adaptations of Birds* (Lesson 2), *Bird Beaks* (Lesson 5) and *Flight and Feathers* (Lesson 6) would serve well as supplemental materials for Unit 1.
- *Patuxent Bird Identification InfoCenter*, USGS: <http://www.mbr-pwrc.usgs.gov/Infocenter/infocenter.html>
See the section on Swans, Geese & Ducks — Order: *Anseriformes*/Family: *Anatidae* for identifying characteristics, photos, and in some cases, songs.

Calls/vocalizations

- Kross, Jennifer. *Waterfowl Vocalizations: Interpreting their odd assortment of whistles, grunts, quacks, honks, coos, clucks, and trills*. Ducks Unlimited. <http://www.ducks.org/conservation/waterfowl-biology/waterfowl-vocalizations>
- *Cornell Lab of Ornithology* Web pages: <http://www.allaboutbirds.org> and http://www.allaboutbirds.org/guide/browse_tax.aspx?family=6.
Find any species, photos, sound recordings and, for many species, videos.

Color, Feet, Feathers, and Flying

- *Bird Identification*, Salt Plains, National Wildlife Refuge, USFWS. <http://www.fws.gov/southwest/refuges/saltplains/kidsbirdid.html>
Bird identification is broken down into the following subtopics: Size and shape, color, legs/feet and bill shape.
- *Part of a Duck Diagram*, California Waterfowl Association. http://www.calwaterfowl.org/waterfowl_draw/water_draw14.htm
This site offers tips to youth for drawing waterfowl.
- *Feathers and Plumages*, *All About Birds*, Cornell Lab of Ornithology: <http://www.birds.cornell.edu/AllAboutBirds/studying/feathers/>
This resource has sections on feather structure, color, plumage variations and molting.
- *Flying Machines: Like high-performance aircraft, waterfowl are built to fly*. Coluccy, John M. Ducks Unlimited. <http://www.ducks.org/conservation/waterfowl-biology/flying-machines>
This article provides background information for educators and high school students on two important waterfowl adaptations, wings and feathers.
- *Flyways.US*: <http://flyways.us>
This website provides many resources for bird identification and learning about form and function. Check the *Waterfowl Identification* pages at <http://flyways.us/duck-identification-resources> as well as the information on feathers and plumage at <http://flyways.us/duck-identification-resources/ducks-at-a-distance/eclipse-plumage>
- *FWS Deepwater Horizon Oil Spill Response*, U.S. Fish and Wildlife Service <http://www.fws.gov/home/dhoilspill/factsheets.html>
This fact sheet provides general information about the U.S. Fish and Wildlife Service response to the Deepwater Horizon oil spill (2010).
For information of the impacts on wildlife and the environment see: *Effects of Oil on Wildlife and Habitat*, USFWS <http://www.fws.gov/home/dhoilspill/pdfs/DHJICFWSOilImpactsWildlifeFactSheet.pdf>
- *Young Naturalists: Minnesota Ducks Dabble or Dive For Dinner* by Janice Welsh. Minnesota Conservation Volunteer, MN Department of Natural Resources. http://www.dnr.state.mn.us/young_naturalists/ducks/index.html
Offers background information and photos on duck foods, behaviors, bills, feet, feathers and raising a family.
- *Young Naturalists: The Nature of Feathers—Teaching Guide* by Val Cunningham. Minnesota Conservation Volunteer, MN Department of Natural Resources. http://www.dnr.state.mn.us/young_naturalists/feathers/index.html
Provides an overview of the structure and function of feathers.

USFSW National Wildlife Refuge System <http://www.fws.gov/refuges/>

Check the national wildlife refuges in your state for the latest waterfowl information and educational resources that might be more specific for your area of the country.



NOTES:



UNIT 2. A DAY IN THE LIFE – PREENING, DABBLING, AND OTHER UNUSUAL BEHAVIORS

Bird species don't just look unique, they have unique ways of acting, moving, sitting, and flying. When you learn these habits, you can recognize many birds the same way you notice a friend walking through a crowd of strangers.

Birding Basics: Behavior, Cornell Lab of Ornithology

Purpose

In Unit 1, students became familiar with the physical traits of waterfowl. In Unit 2, students engage in a variety of science and art activities to discover distinctive behavioral traits of waterfowl, which help them survive in wetland habitats.

- To provide opportunities for students to observe waterfowl behaviors
- To have students discover what waterfowl do on a day-to-day basis
- To have students explore the unique behavioral characteristics of waterfowl
- To encourage students to investigate the relationships among waterfowl behavior, habitat, and survival

Students should understand that they get to choose which activities to pursue; the *Youth Guide* is designed to help them but not give them all the answers; and they're going to have fun!

Unit 2 at a Glance

Purpose: To investigate waterfowl behavior and the relationships among their behavior, habitat, and survival

Subjects: Science, language arts, math, visual arts

Process skills:

- **Science skills**
 - Communicating
 - Describing
 - Designing a solution or process
 - Gathering evidence
 - Identifying
 - Investigating
 - Modeling
 - Observing
 - Organizing information
 - Planning
 - Predicting
 - Questioning
 - Recording
- **Language arts skills**
 - Communicating
 - Creating evaluation strategies
 - Developing research capabilities
 - Evaluating
 - Reading for perspective
 - Understanding the human experience
- **Math skills**
 - Analyzing data
 - Collecting data
 - Formulating questions
 - Connecting math with other subjects
 - Understanding numbers and operations
- **Visual arts skills**
 - Communicating
 - Connecting art to other subjects
 - Developing visual ideas
 - Exploring
 - Experimenting
 - Modeling
 - Recording

Conservation concepts:

- Species differ in their ability to adapt
- All living things depend on habitat that includes adequate supplies and suitably arranged food, water, shelter, and space
- There are people who make their livings studying and managing natural resources

Vocabulary: adaptations, aggression, altricial, behavior, blind, control group, control variables, dabbling, dependent variable, flight pattern, geometric, gizzards, goslings, habitat, hypothesis, imprint, imprinting, independent variable, movement, posture, precocial, preening, puddle ducks, variable

Learning Objectives

If learners choose to complete all the activities in this section, they will be able to:

- Describe and explain common waterfowl behaviors
- Explain how waterfowl behavior is related to habitat characteristics
- Describe common tools used by humans to attract waterfowl (decoys, calls, and blinds) that mimic specific waterfowl behaviors
- Share how waterfowl behaviors are described in the oral traditions and writing of other cultures
- Apply aspects of waterfowl behavior into their language and visual arts projects to make their work more realistic

Featured Scientist

Meet Dr. Konrad Lorenz (MD, PhD)

Dr. Konrad Lorenz was a medical doctor and zoologist who had a keen interest in ethology, the study of animal behavior. We would be remiss, when talking about animal behavior, if we failed to mention the contributions of this Nobel Prize-winning scientist.

The fact that birds, including waterfowl, imprint on non-bird species was fascinating to Dr. Lorenz and may be equally fascinating to some of your students. The concepts to be stressed while students read about Dr. Lorenz are twofold. 1) It is important to recognize the connections between waterfowl behaviors like imprinting and waterfowl habitats and survival. 2) Science is an iterative process—scientific knowledge builds on the discoveries of the past.

Today's wildlife biologists learn from and build on Dr. Lorenz's work about animal behavior and imprinting. This has resulted in new ways to work with young birds, such as the cranes pictured on page 62 of the *Youth Guide*, to increase their chances of survival by decreasing their dependence and familiarity with people.

Background information on Dr. Lorenz, and photos from his work, are easily found on the Internet.

Unit 2. Activities Preparation Tips

Background information

WATERFOWL BEHAVIORS

Flock Maneuvers¹

Flock maneuvers in the air can be used as clues to identify waterfowl. Mallards, Northern Pintails, and American Wigeons form loose groups; Teal and Shovelers flash by in small, compact bunches; at a distance, Canvasbacks shift from waving lines to temporary V's.



© Alan Grinberg

Diving Ducks²

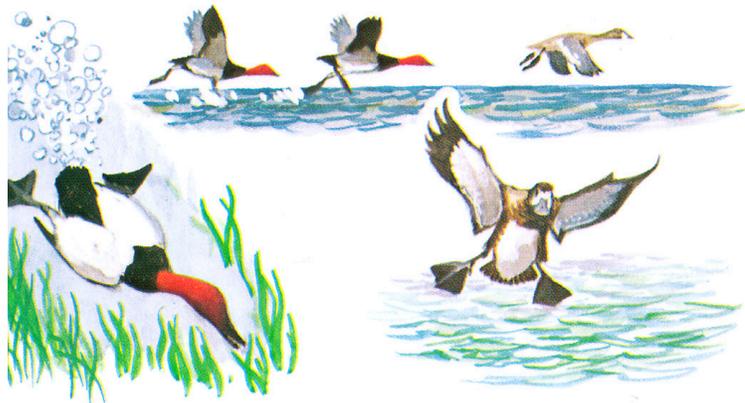
Diving ducks frequent the larger, deeper lakes and rivers, and coastal bays and inlets.

The colored wing patches of these birds lack the brilliance of the speculums of puddle ducks. Since many of them have short tails, their huge, paddle feet may be used as rudders in flight, and are often visible on flying birds. When launching into flight, most of this group patten along the water before becoming airborne.

They feed by diving, often to considerable depths. To escape danger, they can travel great distances underwater, emerging only enough to show their head before submerging again.

Their diets of fish, shellfish, mollusks, and aquatic plants make them second choice, as a group, for sportsmen.

Canvasbacks and Redheads fattened on eel grass or wild celery are notable exceptions.



Illustrations by Bob Hines

Since their wings are smaller in proportion to the size and weight of their bodies, they have a more rapid wingbeat than puddle ducks. See list of diving ducks on page 11.

.....

¹ From: <http://flyways.us/duck-identification-resources/ducks-at-a-distance/what-to-look-for>

² From: <http://flyways.us/duck-identification-resources/ducks-at-a-distance/diving-ducks>

Puddle Duck Behavior¹

Puddle ducks are typically birds of fresh, shallow marshes and rivers rather than of large lakes and bays. They are good divers, but usually feed by dabbling or tipping rather than submerging.

The speculum, or colored wing patch, is generally iridescent and bright, and often a telltale field mark.

Any duck feeding in croplands will likely be a puddle duck, for most of this group are sure-footed and can walk and run well on land. Their diet is mostly vegetable, and grain-fed Mallards or Northern Pintails or acorn-fattened Wood Ducks are highly regarded as food.



Illustrations by Bob Hines

Precocious Youngsters

In Unit 2, students learn that waterfowl young are precocious – after hatching they are quickly able to walk, swim, and feed themselves. Imprinting is another waterfowl behavior students explore in this unit. Both behaviors, as illustrated in the following piece, increase the abilities of ducklings, goslings, and cygnets to survive in wetland habitats.

Like a Duck Out of Water by John M. Coluccy and Kurt A. Anderson, Ducks Unlimited²

When departing the nest, upland-nesting hens often travel overland with their young to reach brood-rearing wetlands. Family units also travel overland when hens lead their broods in search of undisturbed wetlands with ample cover and food resources. Surprisingly, duck families often don't travel to the nearest wetland and may waddle considerable distances (a mile or more) along paths, roadways, trails, or watercourses and through dense vegetation or wide-open areas. Ducklings are especially susceptible to predation during overland travel and may also become exhausted or disoriented, resulting in separation from the brood.

For more on issues that affect the survival of young waterfowl, see *Duckling Survival: A variety of factors influence how many young ducks fly south each fall* by John M. Coluccy and Kurt A. Anderson, Ducks Unlimited.

¹ From: <http://flyways.us/duck-identification-resources/ducks-at-a-distance/puddle-ducks>

² From: <http://www.ducks.org/conservation/waterfowl-biology/duckling-survival>

Swans and Geese¹

Swans and geese are the largest members of the waterfowl family, and swans are among the largest of all flying birds. Swans are larger in size and have proportionally larger feet and longer necks than geese, which are closely related. The plumage of both sexes of swans and geese are similar, although males in both groups are generally larger than females.

Swans eat mostly plant materials, which they find in the water and on land. They do most of their foraging in the water, by tipping up or dabbling, much like dabbling ducks. They do occasionally eat small aquatic animals. Swans form tight pair bonds that often last for life. Bonded pairs stay together year-round.

Geese have shorter necks and longer legs than swans. They spend much more time on land than swans, and they graze on grasses and other land plants, in addition to eating some aquatic plants. Geese generally mate for life and both parents care for the young.

For more on swans and swan behavior see: Trumpeter Swan, (*Olor buccinator*), Wildlife Species Information, USFWS, http://www.fws.gov/species/species_accounts/bio_swan.html

Wildlife Viewing and Photography Blinds²

Viewing or photographing wildlife is made easier if you are stationary and let the wildlife come to you. It is easy to attest to that if you've ever fed birds in your back yard at a feeding station. The same approach should be used if you travel out-of-doors to view or photograph wildlife. Wildlife subjects are just that—wild, and normally won't allow you to approach closely. A little more time will be required to construct, place, and maintain a blind, but the time involved will be far less than the time spent in frustrating pursuit of wary wildlife.

There are as many types and shapes of blinds as there are inventive minds who build them. The main point is that the blind be large enough to make you comfortable, made of dark material so light cannot penetrate and reveal your shadow, made sturdy and anchored to the ground to prevent it from blowing away, and placed in the correct habitat and camouflaged to maximize your chances of seeing wildlife.

Choosing the correct habitat to place the blind is easier and more effective if you know your subjects' habitat and characteristics. Every species of wildlife act relatively the same from day to day or season to season and a pattern can usually be established if you do your research.

Other useful tips that may enhance your success include pre-positioning a blind for some time before you plan to use it. Time for the wildlife to get used to the presence of the blind is important.

Movement within the blind should be minimal and loud talking prohibited. Bringing a stool or short chair will make the stay more comfortable as patience is often a virtue when sitting in a blind.

Instructions for building a low-profile, A-frame blind can be found on the Northern Prairie Wildlife Research Center website at http://www.npwrc.usgs.gov/resource/wildlife/ndblinds/a_frame.htm.

¹ From: <http://flyways.us/duck-identification-resources/ducks-at-a-distance/swans-and-geese>

² Adapted from Building Nest Structures, Feeders, and Photo Blinds for North Dakota Wildlife, North Prairie Wildlife Resource Center, U.S. Geological Survey, <http://www.npwrc.usgs.gov/resource/wildlife/ndblinds/blinds.htm>





PENCIL-TO-PAPER WARM-UP

Description: Students brainstorm words to describe what waterfowl do (behaviors). They then incorporate one of the behaviors into a simple drawing of a waterfowl. They compare their new geo-bird behavior sketch with their *geo*-bird drawings from Unit 1. Then they incorporate one of the behaviors into a simple drawing of a waterfowl following instructions found on page 30 of the *Youth Guide*.

Setting: Indoors

Skills: Communicating, describing, developing visual ideas, explaining

Materials: Nature Notebook, art pencil or charcoal stick

EXPLORE

Learning Objectives:

On completing the *Explore* activities described below, learners will be able to:

- Describe why having precocial young promotes waterfowl survival
- Explain why imprinting on parents is an important behavior adapted by waterfowl young

Activities:



Right Out of the Egg! Precocious Youngsters!

Description: Students focus on the behavior of young waterfowl (ducklings, goslings, and cygnets) and how these behaviors help these youngsters survive.

Setting: Indoors

Skills: Describing

Materials: Photos on page 65 of the *Youth Guide*, Nature Notebook, and a pen or pencil



Parenting Tricks?

Description: Students consider how waterfowl parents, who care for large numbers of chicks each breeding season, keep their young together and safe.

Setting: Indoors

Skills: Describing, analyzing

Materials: Nature Notebook and a pen or pencil

INVESTIGATE

Learning Objectives:

On completing the *Investigate* activities described below, learners will be able to:

- Observe, identify and gather evidence about essential waterfowl characteristics (behaviors) and wetland habitats using photography, journaling, sketching, or measurements, such as charting times for specific behaviors
- Create ideas and questions for science inquiry activities

Activities:**Identifying Birds by their Behaviors**

Description: Students practice waterfowl observation by describing the behavior of the waterfowl pictured on page 67 of the *Youth Guide*. They illustrate waterfowl behaviors (posture, movements, flight patterns) in their Nature Notebooks.

Setting: Indoors

Skills: Connecting art to other subjects, developing visual ideas, describing, observing

Materials: Nature Notebook, drawing pencil and/or charcoal stick

**Observing Behavior of Birds**

Description: Students find an outdoor place to observe waterfowl behaviors. They work with partners to record the behaviors they identify in a 10-minute period.

Setting: Outdoors

Skills: Comparing, describing, developing research capabilities, identifying, recording, collecting data

Preparation: This activity could be a classroom field trip or a homework assignment. Simplify the lesson for younger students by making a worksheet with photos of different waterfowl behaviors. Have the students put X's next to the photo each time they see something similar. They can then count the X's at the end of their observations and decide which behaviors were the most frequent and least frequent. Which did they enjoy watching the most? Why?

Materials: Nature Notebook, pen or pencil, watch with second hand or stopwatch

**Animal Behavior Research**

Description: Students practice the art of asking questions, an important start to the scientific process.

Setting: Indoors or outdoors

Skills: Comparing, describing, observing, recording

Materials: Nature Notebook and pen or pencil

**Investigate Your Question**

Description: Students choose one of their questions from Animal Behavior Research and then develop a hypothesis and a brief investigative project plan as modeled on page 73 of the *Youth Guide*. Students are encouraged to reflect on the waterfowl management or conservation implications for their research plan.

Setting: Indoors

Skills: Describing, developing research capabilities, planning

Materials: Nature Notebook and pen or pencil

**Fact or Fantasy?**

Description: Students read children's books about swans and other birds. They are then asked to speculate whether the portrayal of the birds' behaviors in the stories is based on fact or if it is all fiction.

Setting: Indoors

Skills: Communicating, comparing, creating evaluative strategies, describing, evaluating

Preparation: Ask the school librarian to set aside books related to waterfowl that are appropriate for your group's reading levels.

Materials: Nature Notebook and pen or pencil

**Native American Stories about Waterfowl**

Description: Story telling is an art form that is used in many cultures throughout the world to teach lessons about nature and people. Students read two stories, provided and interpreted by Fawn Youngbear Tibbits of the White Earth Band of Minnesota Ojibwe, to discover how waterfowl are portrayed by Native Americans of the upper Midwest.

Setting: Indoors

Skills: Comparing, describing

Materials: Nature Notebook and pen or pencil

EXPRESS**Learning Objective:**

On completing the *Express* activities described below, learners will be able to:

- Explain how a famous artist or writer communicated personal feelings and experience in his/her work

Activities:**What Does Behavior Look Like?**

Description: Students view photos (from page 78 of *Youth Guide*) of waterfowl and describe, with words or drawings, the behavior the bird(s) is exhibiting and the habitat in which the bird is pictured.

Setting: Indoors

Skills: Communicating, connecting art to other subjects, describing, observing, sketching and journaling techniques

Materials: Nature Notebook and pen, art pencils, and/or charcoal sticks

**Take your Own Photos**

Description: Students use photography to capture different types of waterfowl behaviors. They make a collage with their photographs and label the behaviors they witnessed.

Setting: Outdoors and indoors

Skills: Connecting art to other subjects, describing, modeling, observing, recording

Materials: Nature Notebook, pen or pencil, camera, access to photo printer, tape, poster board



The World from the Point of View of a Dabbling Duck

Description: Students consider the underwater world of dabbling ducks from the duck's point of view. Students research the underwater world of wetlands using the Internet, school, or community resources. They use watercolors to capture what a dabbling duck's view may be and to illustrate the variety of life found in aquatic ecosystems.

Setting: Indoors

Skills: Connecting art to other subjects, describing

Preparation: Encourage students to visit a national wildlife refuge or other wetland and explore underwater life there. They might also visit a zoo, aquarium, museum, or nature center to view an underwater wetland exhibit. At the very least, there is the Internet, where students can find photos and drawing of underwater life. Each student will need a sheet of watercolor paper, access to watercolor paints and brushes, and a place and tools for cleaning up. Their paintings should be taped or stapled in their Nature Notebooks.

Materials: Watercolor paper, watercolor paints, brushes, tape or stapler



Observe and Study Waterfowl – A Blind to Help you See

Description: Developing an effective blind for hunting or waterfowl observation or photography demands attention to the details of both bird behaviors and bird habitat. For this activity students consider these factors and incorporate them into a blind design that they capture in a drawing or in a three-dimensional model. Ideally, students would build a blind with the help of a conservation partner or volunteer and use it to observe waterfowl in a nearby wetland.

Skills: Connecting art to other subjects, describing, modeling, observing, sketching

Preparation: If students choose to build a blind, they may need help finding a conservation professional or volunteer in the community to assist with the project and placement of the blind. Make sure students have permission to place the blind on public or private land before they create their blind.

Materials: Nature Notebook, pen or pencil, markers, and as needed, modeling materials (shoe boxes, paints), construction materials



Observe and Study Waterfowl – Make a Decoy

Description: Decoys are effective waterfowl observation and hunting tools because waterfowl are attracted to groups of their own species. Students consider the use of waterfowl decoys as a means of attracting waterfowl for hunting or observation.

Skills: Connecting art to other subjects, describing, modeling, observing, researching

Preparation: This activity can be a simple art exercise (as described in the *Youth Guide*, page 82) or a more in depth research project for students, particularly older students. Materials and preparation will need to be planned according to the choices student make about the extent of their involvement. Some students may want to make real decoys and

rig them to see if they can attract waterfowl. The Internet provides many resources for instructions on how to make, rig, and place decoys.

Materials: Nature Notebook, pen or pencil, markers, paints, crayons.



Observe and Study Waterfowl – Duck Calls

Description: Students learn about the sounds different ducks make by studying duck calls, instruments used to attract ducks. Can they use duck calls successfully to attract ducks?

Setting: Indoors and outdoors

Skills: Describing, listening, observing, recording

Preparation: Borrow or buy duck calls for students to use. Your natural resources partner, local chapter of Duck Unlimited, or local hunting clubs may be able to provide sources for duck calls. Check the Internet for sites that provide directions for making duck calls. Locate a site where there are ducks so students can experiment with their calls.

Materials: Materials and tools as needed to make duck calls.

SHARE

Learning Objective:

On completing the *Share* activities described below, learners will be able to:

- Employ strategies to describe waterfowl behaviors and to communicate how waterfowl behaviors are related to habitat and survival.

Activities:



Create a Mural with Your Group

Description: Students use both visual and language art skills to create a mural illustrating waterfowl behaviors and information cards explaining those behaviors to exhibit in the classroom, school, library, or other public space.

Setting: Indoors

Skills: Communicating, connecting art to other subjects, describing, developing visual ideas

Preparation: Explore opportunities for places to exhibit the students' mural.

Materials: Art pencils, butcher or freezer paper, paints, brushes.



Play Waterfowl Charades

Description: Students create and play a game of Waterfowl Charades, which involves mimicking waterfowl behaviors.

Setting: Indoors

Skills: Communicating, describing, developing visual ideas

Preparation: Provide a package of 3" x 5" index cards.

Materials: Pen, marker, or pencil, 3" x 5" index cards.



Mystery of the Labrador Duck – Evidence about Behavior

Description: Students read a short piece Audubon recorded in his nature journal that describes behavior of the Labrador Duck. They try to determine if there are clues in the description to indicate why the duck may have become extinct.

Setting: Indoors

Skills: Communicating, describing

Materials: Nature Notebook, pen or pencil



PENCIL-TO-PAPER WRAP-UP

Students revisit the *geo*-bird created in the *Warm-Up* section of this unit page 62. Encourage them to think about what they learned in Unit 2 about the behavior of waterfowl that help them survive in wetland habitats. Encourage students to change their drawing to reflect their new knowledge about waterfowl behavior.

Adaptations for Early Elementary Students

As suggested by the *NAAEE Excellence in Environmental Education: Guidelines for Learning (K–12)*, strategies for examining environmental issues with early elementary students should be simple, local, and make close links between what they’re observing and learning about the local environment.

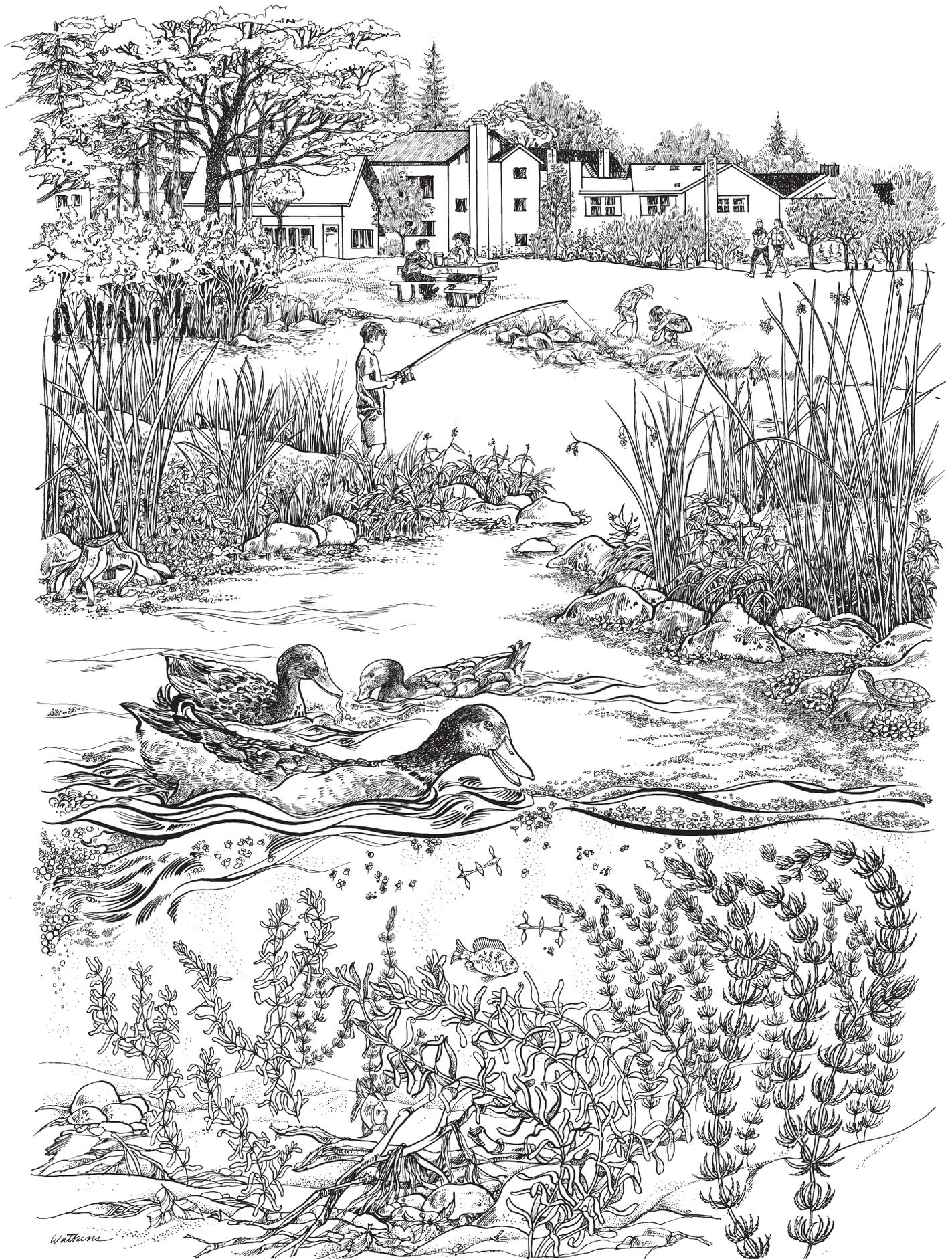
Unit 2 activity, *The World from the Point of View of a Dabbling Duck*, can be adapted for very young children by having them first observe ducks dabbling in a natural area. Then ask them to imagine what the ducks are doing under the water. What do they think the ducks are seeing underwater? Give each student a copy of the wetland scene from page 68 in the *Educator Guide*. Ask students to discuss what they see underwater in the wetland scene. Ask them to compare how it is alike or different from the scene they imagined. Students should be encouraged to color the drawing and add any additional components they think might be found in their local waters. Third and fourth grade students should be encouraged to draw the underwater scene themselves.

Check the *Related Resources* list on page 69 for curricula, activities, and materials that are appropriate for grades K–4.

Adaptations for High School Students

Older students could investigate how the knowledge of waterfowl behavior has led to the use of different types of decoys and strategies for deploying decoys in the field to attract waterfowl for hunters, photographers, or observers. Solicit the help of a natural resource professional or skilled hunter to demonstrate techniques used for attracting waterfowl. Then challenge the students to try the techniques as well. If students can’t get into the field, they can see a number of videos online that illustrate decoy strategies. Search for “decoy rigging tips” on the Ducks Unlimited site, <http://www.ducks.org/> or on YouTube for videos.

Check the *Related Resources* list on page 69 for curricula, activities, and materials that are appropriate for grades 10–12.



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

UNIT 2 – RELATED RESOURCES

Activities

- *Clay Duck Decoys* (K–4th), Favecrafts.com. Students create a sculpture of a duck decoy. See page 71 for activity details.
- *Bird Behavior Scavenger Hunt* (6–8th), Flying WILD: An Educator’s Guide to Celebrating Birds, Council for Environmental Education. <http://www.flyingwild.org/guide.htm>
Students identify different behavior patterns of bird and explain their functions.
- *Diversity and adaptations, Lesson 5* (9–12th), Wetland Ecosystems III, Ducks Unlimited Canada. <http://www.epa.gov/gmpo/education/pdfs/DUEducators9-12.pdf>
Students explore the diversity of structural and behavioral adaptations.
- *Get to Know the Shorebirds Puppet Show* (K–6th), *Migration Science and Mystery* http://migration.pwnet.org/pdf/Get_to_Know_the_Shorebirds_Puppet_Shows.pdf
By creating shorebird puppets and putting on a shorebird puppet show, students learn the physical and behavioral characteristics that make a bird a shorebird.
- *Young Naturalists*, Minnesota Conservation Volunteer, MN DNR <http://www.dnr.state.mn.us/volunteer/index.html>
This website has youth activities with Educator’s Guides for the following related topics:
 - *What are portable, durable, dependable, convertible, and altogether incredible? Eggs!*
 - *That’s in a Bird Song?*

Print resources

Children’s books that illustrates the use of waterfowl in literature and fairy tales:

City Geese, by Ron Hirschi and Galen Burrell

The Goose that Laid the Golden Egg, from Aesop’s Fables

The Snow Goose, (Wildlife Habitats and Habitat Series), by Mark Ahlstrom

Swan Lake, by Mark Helprin and Chris Van Allsburg

The Mishomis Book: The Voice of the Ojibwe by Edward Benton-Benai (1988) Red School House, Indian Country Communications <http://nativeauthors.com/index.php?productID=1367>

This book explores the history, philosophy, and teachings of the Ojibwe people, as passed down to the present generation by parents, grandparents, and elders of the Lac Court Oreilles Reservation (Wisconsin).

Web resources

Investigation and science inquiry

BirdSleuth: Investigating Evidence (6–8th), Cornell Lab of Ornithology

<http://www.birds.cornell.edu/birdsleuth/inquiry-resources/we-want-to-support-you-as-your-students-become-scientists>

This curriculum includes lesson plans, journal pages, and online resources that will help your students ask scientific questions, craft and test hypotheses, collect and organize data, draw meaningful conclusions, and publish their work.

Waterfowl behavior, young, parenting

Adopt-a-Swan Curriculum (9–12th), Blackfoot Challenge

http://www.blackfootchallenge.org/SwanProject/Docs/Curriculum/Background_Information_for_Educators.pdf

Background information provided for educators on swan behavior, sizes, shapes, calls, food habits, migration, and raising a family.

The Parenting Game (K–12th). Welsh, Jan. Minnesota Department of Natural Resources.

http://files.dnr.state.mn.us/publications/volunteer/young_naturalists/parenting/baby_animals.pdf

This article discusses wildlife parenting techniques for a variety of species including Wood Ducks and Mallards.

Why Do Geese Fly in a V?, *Everyday Mysteries*, Library of Congress

<http://www.loc.gov/rr/scitech/mysteries/geese.html>

This site offers fun science facts for students about the flight pattern of geese.

Young Naturalists: Minnesota Ducks Dabble or Dive For Dinner (4–12th). Welsh, Janice. Minnesota

Department of Natural Resources. http://www.dnr.state.mn.us/young_naturalists/ducks/index.html

This piece offers background information and photos on duck foods, behaviors, bills, feet, feathers, and raising a family.

Young Naturalists: Baby Birds of Minnesota (K–12th). Welsh, Janice

http://www.dnr.state.mn.us/young_naturalists/babybirds/index.html

This article highlights nesting behaviors and features a photo comparing different egg sizes from a Hummingbird egg to a Trumpeter Swan egg.

Waterfowl calls and decoys

There a variety of Internet sites that offer instructions for making duck calls out of simple materials like straws and milk jugs. We are not listing their URLs because they are commercial sites. You can discover them easily by searching “how to make a duck call” or “how to make a decoy.”

NOTES:



Clay Duck Decoys¹**Target Group:** Grade K**Goal (Terminal Objective):** Sculpture, Collage**Objective:** Students will identify the different ways artists make their ideas visual, using memory, observation, and imagination. Students will create a three-dimensional sculpture of a duck decoy and place it in an environment.**National Standards:**

- Visual Arts Grades K–4 Content Standard 1: Understanding and applying media, techniques, and processes
- Visual Arts Grades K–4 Content Standard 2: Using knowledge of structures and functions
- Visual Arts Grades K–4 Content Standard 3: Choosing and evaluating a range of subject matter, symbols, and ideas

Purpose: Students will identify line, shape, and color as art elements. Students will identify sculpture as an art form. Students will identify the characteristics of clay building. Students will identify decoy carving as a utilitarian craft that has grown into a form of art. Students will explore ways artists record their impressions of a natural environment. Students will create a three-dimensional sculpture of a duck decoy and place it in an environment.**New Vocabulary:** form, artist, sculptor, shape, texture, environment, art form, craft, two-dimensional artwork, three-dimensional artwork**Materials:**

- Sargent Sculpt-It® sculpting material
- White Glue
- Construction paper
- Scissors
- Shoe box lid or small container
- Found natural objects

Time: This lesson may be modified from one to five hours, depending upon the size and complexity of expectations.**Introduction and Motivation (Set):**

- View referenced websites to analyze examples of a variety of artworks using animals and the natural environment. Focus on the work of Audubon or contemporary artist Basil Ede. Compare and contrast the work of Audubon with art examples from Japan (screen paintings).
- View photos of duck decoy carvers and carvings, as well as photos of duck decoys in use.

¹ Adapted with permission from Sargent Art from original found at <http://www.favecrafts.com/Lesson-Plans/Clay-Duck-Decoys#>



- Discuss how Native Americans used cattails and other grasses and rushes for items of construction for the essential hunting tool duck decoys. Etchings of decoys being used as hunting tools were found on primitive carvings.
- Colonial Americans carved decoys and painted them very realistically. In present times, duck decoy collectors compete to purchase hand-painted duck decoys.

Instruction:

- Students will view original art such as work by John James Audubon
- Students will observe ducks in their environment
- Students will observe duck decoys being constructed and in use in the water
- Students will discuss the purpose of a duck decoy
- Students will identify interesting patterns and textures in nature

Activities:

(1) Guided Practice:

1. View example of original artwork.
2. Compare scientific illustrations with nature studies.
3. Use pinch-pull technique to demonstrate forming basic shapes with clay. Start with an egg shape (1) for the body and a small circle (2) for the head.
4. Pull a bit of the egg-shaped body at the rear for tail features and part of the ball shape head for the beak.
5. Demonstrate how to attach head to body using scoring technique.
6. Discuss textures used in providing details for the duck. Allow clay to dry.
7. View photos of decoys to prompt a color discussion; demonstrate painting the decoy.

(The decoy may be made out of clay, fired, and glazed. The environment may be constructed during clay firing time.)

8. Discuss the environment for the duck decoy.
9. Demonstrate gluing strips of a variety of shades of green construction paper to a shoe box lid.
10. Cover the bottom inside of the box with blue to illustrate water.

(2) Independent Practice and Check for Understanding: Educator circulates among working students visually recording students demonstrating understanding of objectives and provides reinforcement.

Educator will assist them in focusing on the idea of modeling main shapes and main



structural lines of objects.

1. Mold forms for duck body and attach.
2. Add texture using a pencil point.
3. Paint sculpture.
4. Glue blue paper to inside base of container.
5. Cut paper strips to simulate grasses and glue to outer edge of container.
6. Glue in duck.

(3) Closure: Students share with a partner how their decoy is like the example and how it is different. How did they express their creativity in their composition?

Evaluation: Educator/student critique.

- Identify ways in which personal style is reflected in a variety of examples
- How did the artwork progress from idea to completion?
- Identify the use of pattern in the artwork
- Describe what lines and materials were used

Extension: Discuss the addition of natural materials to the decoy environment. Small stones, shells, raffia, natural grasses, sand. Teach paper construction techniques for rolling brown paper to form a log to float in the water.

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UNIT 3. RAISING A FAMILY IN A WETLAND

Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

National Science Education Standards

In Unit 1, students focused on the physical traits and adaptations of waterfowl. In Unit 2, the activities emphasized the distinctive behavioral traits of waterfowl, which help them survive in wetland habitats. In this unit, waterfowl reproduction and survival are the subjects being investigated by the students.

Purpose

- To provide opportunities for students to observe waterfowl behaviors specifically related to courtship, mating, nesting, and rearing young.
- To encourage students to investigate the relationships among waterfowl reproductive behaviors, habitat, and survival.

Students should understand that they get to choose which activities to pursue; the guide is designed to help them but not give them all the answers; and they're going to have fun!

Unit 3 at a Glance

Purpose: To explore waterfowl adaptations and behaviors related to reproduction and survival in wetland habitats

Subjects: Geography, language arts, science, visual arts

Process skills:

- **Geography skills**
 - Using maps and other geographic tools
- **Language arts skills**
 - Communicating
 - Creating evaluation strategies
 - Developing research skills
 - Evaluating data
 - Questioning
 - Participating in the community
 - Understanding the human experience
- **Science skills**
 - Analyzing
 - Comparing
 - Designing a solution or process
 - Explaining
 - Gathering evidence
 - Interpreting
 - Investigating
 - Observing
 - Organizing information
 - Planning
 - Predicting
 - Questioning
 - Recording
- **Visual arts skills**
 - Communicating
 - Connecting art to other subjects
 - Designing
 - Developing visual ideas
 - Expressing
 - Interpreting
 - Sketching

Conservation concepts:

- All living things depend on habitat that includes adequate supplies and suitably arranged food, water, shelter, and space
- Living things tend to reproduce in numbers greater than their habitat can support. Populations are limited by the quality of food, water, shelter, space; also disease, predation, and climatic conditions

Vocabulary: aggression, amphipods, aquatic, aquatic invertebrates, biodiversity, brood, cavity nesters, clutch, conservation professional, control group, control variables, crustaceans, cygnets, dabbling, dabbling duck, dependent variable, drake, drought, ecosystem functions, emergent, estimate, gastropods, goslings, habitat, hen, hypothesis, incubation, independent variable, invertebrates, macroinvertebrates, monogamous, national wildlife refuge, nursery, nutrient, philopatric, philopatry, polygamous, prairie pothole, precocial, predators, preening, shorebirds, stimulates, waterbirds

Learning Objectives

If learners choose to complete all the activities in this section, they will be able to:

- Describe common waterfowl behaviors related to reproduction
- Explain how changes in food and habitat can affect the survival of waterfowl young
- Describe nesting materials and behaviors of a specific waterfowl species
- Explain the importance of the Prairie Pothole Region to waterfowl reproduction¹

Featured Scientist

Meet Michelle McDowell, Wildlife Biologist

As described on page 90 of the *Youth Guide*, Michelle McDowell is a wildlife biologist with the U.S. Fish and Wildlife Service, at the Rice Lake National Wildlife Refuge in Minnesota. Michelle and her colleagues study the past and current conditions of wild rice in the refuge, so management efforts can be employed to conserve this grass, which has great cultural, wildlife, and economic value. One of Michelle's recent studies examined pickerelweed (an invasive species) removal techniques used to allow wild rice plants to thrive.

The paper, *Rice Lake National Wildlife Refuge Historic Wild Rice Mapping (1983–2004)*¹, describes wild rice in detail, its habitat, and the scientific methods employed by these scientists (with the help of Michelle) to record the distribution of wild rice over time. This piece could be used as a case study for high school students on how GIS and other technologies are used in natural resource management. The study presents a baseline picture of wild rice distribution in the Refuge, so that over time the effects of disturbances and invasives may be monitored more carefully.



Photo courtesy of Michelle McDowell



pickerelweed
Clarence A. Rechenthin
© USDA-NRCS PLANTS Database



wild rice, © Eli Sagor

¹ Gonsoski, J., Burk, E., Bolstand, P.V., & Balogh, M. (2005). *Rice Lake National Wildlife Refuge Historic Wild Rice Mapping (1983–2004)*. Staff paper series No. 181. Department of Forest Resources, UMN, & USFWS, Region. http://www.forestry.umn.edu/prod/groups/cfans/@pub/@cfans/@forestry/documents/asset/cfans_asset_184646.pdf

Featured Scientist

Meet Heath Hagy, Wildlife Biologist

Heath Hagy is a student of wildlife biology (Ph.D. candidate at Mississippi State University) who mentors younger students in wildlife studies at the university.

The following descriptions of the students' work serve two purposes:

- Project information relates directly to the importance of availability of high-quality food to waterfowl survival; it is particularly important that females have access to high-quality foods during the reproductive cycle.
- Each piece illustrates the scientific processes in practice; each describes a question the student wanted to explore and the process developed to investigate the problem or opportunity.

Aquatic bug communities and waterfowl food availability (Student Justyn Foth)¹

Abstract: Historically, the Mississippi Alluvial Valley (MAV) was covered by extensive bottomland hardwood forests; however, today less than 25% of the lowland forested area remains. Additionally, hydrology in the MAV has changed by human influences, and landscape flooding no longer results only from natural overbank flooding from rivers. To promote consistent flooding of forested wetlands for wintering ducks, wildlife managers began building levees around portions of hardwood bottomlands in the 1930s. These impounded bottomlands are named green-tree reservoirs, because intended management is to flood bottomlands only during winter dormant periods so as not to impact trees. Aquatic invertebrates are abundant in these forested wetlands during winter and provide protein-rich foods for waterfowl, other birds, and fish, as well as provide important ecosystem functional services, such as nutrient exchange between leaf litter and heterotrophs. A heterotroph is an organism that cannot manufacture its own food and instead obtains its food and energy by taking in organic substances, usually plant or animal matter. All animals, protozoans, fungi, and most bacteria are heterotrophs. An autotroph is an organism capable of synthesizing its own food from inorganic substances, using light or chemical energy. Green plants, algae, and certain bacteria are autotrophs (<http://www.thefreedictionary.com/Heterotrophs>).

Few studies of abundance and community composition of invertebrates have been conducted in the MAV. Therefore, Foth used sweep nets to collect 532 samples of aquatic macroinvertebrates in flooded hardwood bottomlands in Delta National Forest (Mississippi), Mingo National Wildlife Refuge (Missouri), and White River NWR (Arkansas) during winters 2008–2010. The objective was to estimate precisely and compare biomass (dry weight) of aquatic invertebrates between naturally flooded forests and green-tree reservoirs in the MAV. Across sites and years, invertebrate biomass in naturally flooded forests was 3.4 times greater than masses in green-tree reservoirs in all winter months except February. Invertebrate biomass in naturally flooded forests also was more variable than in green-tree reservoirs. The combined estimate of invertebrate biomass from naturally flooded forests and green-tree reservoirs was 8.3 kg/ha. Although green-tree reservoirs provide consistent hydrology, our data suggest secondary production and thus invertebrate abundance for waterfowl is greater in naturally flooded forests than green-tree reservoirs. Managers should, therefore, attempt to emulate natural hydrological regimes in flooding green-tree reservoirs.

¹ Adapted from: *Winter aquatic macroinvertebrate communities in Mississippi River Alluvial Valley forested wetlands*. Student: Justyn R. Foth, MS Thesis Status: Completed December 2010.



Waterfowl and red oak acorn food availability (Students Jacob Straub and Alan Leach)¹

Bottomland hardwood forests in southeastern United States and the Mississippi Alluvial Valley (MAV) are among the most diverse and productive ecosystems in North America. However, only about 20% of the original acreage of hardwood bottomlands remains. These hardwood bottomlands provide critical fall and winter foods for migratory and resident waterfowl, passerines, and large and small mammals. Many birds and mammals rely on red oak acorns (*Quercus* spp.; Subgenus *Erythrobalanus*) during winter as a primary energy source. There is a critical need to understand spatio-temporal production, abundance, and distribution of red oak acorns in the MAV for planning and implementation of continued bottomland hardwood conservation. In autumn 2009, the team initiated a sample survey to estimate red oak acorn production (i.e., sound mast from trees) and fall-winter abundance (i.e., number of acorns on the ground) along a latitudinal gradient in the MAV. They collected intact acorns from 240 1m² traps positioned under cherrybark (*Q. pagoda*), Nuttall (*Q. texana*), pin (*Q. palustris*), water (*Q. nigra*), and willow oaks (*Q. phellos*) at five study sites in the MAV during fall–winter 2009–2010. Acorn production varied among sites and was greatest and most variable at Delta National Forest, Mississippi (39.1 acorns/m², SE = 16.8) and least at Chickasaw NWR, Tennessee (5.0 acorns/m², SE = 0.7). Acorn abundance differed among sites during all months (November – February) and peaked in January at Delta National Forest, Mississippi (114,583 acorns/ha). The initial results suggest red oak acorn production and abundance are spatially and temporally variable across the MAV. Nonetheless, current and continuing surveys of acorn abundance are vital to establishing baselines for future monitoring and conservation planning concurrent with ongoing lowland forest afforestation associated with USDA's Wetlands and Conservation Reserve Programs and the emerging USFWS National Landscape Conservation Cooperatives initiatives among public and nongovernmental partners.

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¹ Adapted from *Red oak acorn dynamics in bottomland hardwood forests in the Lower Mississippi River Alluvial Valley* Student: Jacob N. Straub, Dissertation; Alan Leach, MS Thesis Status: In Progress, (J. Straub); Completed December 2010 (A. Leach)



Featured Scientist

Meet Joseph Marty, Wildlife Biologist¹

Joseph Marty's work, the Louisiana Coastal Prairie and Texas Mid-Coast Rice Research Project, which measured the availability of waste rice for waterfowl, is described below.

The Gulf Coastal Prairies of Louisiana and Texas are major rice producing regions of North America and are important ecosystems for numerous species of waterfowl and shorebirds. Post-harvest and idle rice fields are priority foraging habitats for waterfowl and are necessary to support the feeding habits and life-cycles of waterfowl, waterbirds, and shorebirds. In cooperation with the Gulf Coast Joint Venture, Mississippi State University is conducting an ongoing waste rice research project in the Louisiana Coastal Prairies and the mid-coast of Texas.

This study focuses on estimating abundance of waste rice and moist-soil seeds in harvested rice and fallow fields as foods for waterfowl wintering in the coastal prairies in Louisiana and the Texas Mid-Coast. Soil cores will be taken from Texas mid-coast and the Louisiana coast prairie rice and fallow fields in mid-August to coincide with the arrival of early migrating waterfowl, and again in November to coincide with the arrival of the later migrating waterfowl.

The soil cores will be washed through a series of sieves to separate the rice and moist-soil seeds from the remainder of the soil sample. The seed will be dried and then weighed, which will eventually lead to an estimate of total amount of seed available within the field. Estimates will aid in determining the amount of energy available to waterfowl. Results from his project will help managers make decisions on farming practices and landscape conservation for migrating and wintering waterfowl in this region.

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¹ Marty, J. *Louisiana Coastal Prairie and Texas Mid-Coast Rice Research Project*. College of Forest Resources, Mississippi State University.



Unit 3. Activities Preparation Tips

Background information

WATERFOWL REPRODUCTION AND HABITAT CONSERVATION

General Overview of Waterfowl Reproduction¹

Waterfowl are normally monogamous and solitary nesters. The size of the nesting territory is determined by the aggressiveness of the particular pair of birds. Pair formation in geese and swans tends to be permanent until one of the pair dies; the remaining bird will often re-mate. Ducks seek a new mate each year.

Ducks and the Ross's Geese generally lay one egg each day until the clutch is complete. Most other geese and probably all swans lay an egg every other day until the clutch is complete. Incubation is not started until the last or next-to-the-last egg is laid, thus all the eggs hatch at about the same time. There is a slight correlation between the length of incubation and the size of the adult bird. Incubation periods range from about 23 days for Cackling Geese, 28 days for giant Canada Geese and Mallards, to 38 days for Trumpeter Swans. Young waterfowl are precocial and begin foraging shortly after hatching. The nest site is abandoned 1 to 2 days after hatching.

The Prairie Pothole Region (PPR) and Waterfowl Reproduction at a Glance²

- The millions of wetlands and associated grasslands in the U.S. PPR make it one of the most unique habitats in the world.
- The habitat in the PPR is critical for nesting, but also plays a very important role as migration habitat, particularly for shorebirds.
- Small wetlands attract higher densities of breeding duck pairs than large wetlands.
- Duck breeding population in the U.S. PPR is estimated at 4.25 million pairs.
- Seven prairie waterfowl species, 76% of the U.S. duck harvest, depend on PPR habitat.



Ducklings in nest
USFWS photo

The Prairie Pothole Region – The “Duck Factory” of North America³

The U.S. Fish and Wildlife Service Small Wetlands Program uses funds from the sale of federal Duck Stamps to permanently protect some of the most threatened and productive migratory bird habitat in the U.S. Since its creation 50 years ago, the program has protected nearly three million acres of habitat, mainly in the Prairie Pothole Region of the U.S. These protected areas are called Waterfowl Production Areas (WPAs), and they are part of the National Wildlife Refuge System.

¹ *Waterfowl: General Biology, Reproduction, and Behavior*, <http://www.extension.org/pages/Waterfowl>

² Adapted from *Facts*, Prairie Pothole Joint Ventures, USFWS: <http://www.ppjv.org/facts.htm>

³ Adapted from *The Small Wetlands Program: A Half-Century of Conserving Prairie Habitat*, USFWS <http://www.fws.gov/refuges/smallwetlands/>

History

The impetus for developing the Small Wetland Program began in the 1940s when Waubay National Wildlife Refuge Manager, Fred Staunton, began documenting significant reductions in waterfowl populations. Staunton, and many others, believed these reductions were the direct result of massive wetland drainage programs across America's prairie.

In an April 1949 article in *Field & Stream* magazine titled "Good-By Pot-Holes," Clay Schoenfeld brought the plight of waterfowl and the loss of wetlands to the attention of the rest of America. As a result of this raised awareness, Congress acted to permanently protect waterfowl habitat in the Prairie Pothole Region, which encompasses lands in the upper Midwest.

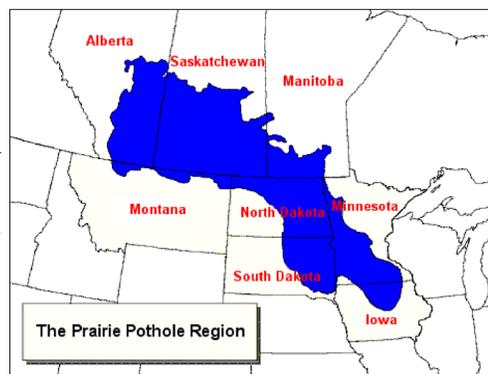
Congress officially created the Small Wetland Program in 1958 to allow proceeds from the sale of federal Duck Stamps to be used to protect waterfowl habitat. The habitat protected through the Small Wetland Program consists of small wetlands and surrounding grassland habitat, primarily in the U.S. portion of the Prairie Pothole Region. These WPAs are protected in perpetuity through fee-title acquisition or easement.

Prairie Pothole Region

The Prairie Pothole Region of North America was once the greatest expanse of grasslands and small wetlands on earth. The southern reach of the region is in central Iowa and it extends northwest through Minnesota, South Dakota, North Dakota, Montana and into Canada.

Before a massive network of agricultural drain tiles were installed under the fertile soil, the area was covered with small wetlands called "prairie potholes," created when glaciers advanced and retreated over the area.

The original density of small wetlands across the region averaged an astonishing 83 wetlands per square mile.



Prairie Pothole Region

Because of these small—often seasonal—wetlands, and the grasslands associated with them, the Prairie Pothole Region is an ideal nursery for waterfowl and has long been called the "Duck Factory" of North America.

Even today, with much of the wetlands and grasslands of the Midwest converted to agriculture, and just 2% of the land base part protected within the National Wildlife Refuge System, the Prairie Pothole Region still produces 50% of North America's breeding waterfowl population.

Waterfowl Production Areas (WPAs)

WPAs are wetlands and the surrounding uplands that provide breeding, resting, and nesting habitat for millions of waterfowl, shorebirds, grassland birds, and other wildlife. WPAs also protect native plants, provide habitat for resident and migratory wildlife, help filter groundwater, control runoff and flooding, and capture carbon from the atmosphere.

With more than 36,000 separate fee and permanent easement tracts covering nearly three million acres, WPAs account for 18% of National Wildlife Refuge System lands in the lower 48 states. Approximately 95% of these WPA lands are located within the Prairie Pothole states of North Dakota, South Dakota, Minnesota, and Montana.

The Future

The Small Wetland Program took time during its 50th anniversary celebration in 2008 to reflect on all that had been accomplished; however, the main reason for celebrating is to raise awareness of the program and guide it toward another successful 50 years.

The Prairie Pothole Region continues to face many challenges today, just as it did in the 1940s. Wetlands are still being drained and grasslands are being plowed under. Increased grain prices and modern agricultural practices create incentives to put marginal farm land into agricultural production. Land prices have increased rapidly and because of this, the U.S. Fish and Wildlife Service is often unable to protect valuable wildlife habitat.

What can you and your students do to help in this effort? Engage in wetland stewardship efforts in your community with the help of local natural resource professionals. In addition, you and your students can buy a federal Duck Stamp and encourage your friends and other members of your community to do the same.

Food Habits and Reproductive Characteristics of Trumpeter Swans¹

Food Habits

In the Yellowstone ecosystem, dominant foods (over 10% in at least one season) included *Chara spp.*, commonly known as muskgrass, stonewort, or muskwort (21.7%), *Elodea canadensis*, commonly known as American waterweed (11.4%), *Potamogeton spp.*, broad-leaf pondweeds (32.2%), and *Potamogeton pectinatus* tubers (15.7%) (Squires and Anderson, 1995); In 1981, however, Hampton reported up to 10% of food was animal matter, primarily invertebrates and fish.

Poor nutrition in females can cause increased mortality of hatchlings and young.

Poor nutrition in females can cause increased mortality of hatchlings and young. At Red Rocks National Wildlife Refuge, for example, the population increased until 1954 and has declined steadily since, possibly due to a decrease in American waterweed, or to lack of migration and the resultant poor nutritional gain, producing inviable eggs/young (Hampton, 1981).

¹ Adapted from the Montana Field Guide website (http://fieldguide.mt.gov/detail_ABNJB02030.aspx), which offers a good overview of Trumpeter Swans and U.S. Fish and Wildlife Service monitoring activities in Montana.

Nesting

Nesting begins in late April or early May in the intermountain western U.S. Clutch size is two to nine eggs (usually about five). In Yellowstone National Park and environs, clutch size is about four (Shea, 1979). Incubation, mainly conducted by the female, lasts 33 to 37 days (Harrison, 1978). Hatching occurs in June in the intermountain western U.S. In Yellowstone National Park, the hatching rate is approximately 49%. Fifty-four percent of nests hatched at least one egg. The average brood size at hatching is 3.3 and 2.0 at fledging (Shea, 1979). Nestlings are precocial but remain with adults until the subsequent spring. Fledging occurs at 100 to 120 days. Young remain with parents through winter; siblings may stay together for a few years and may rejoin parents after the nesting period. Trumpeter Swans first nest at four to five years (may form pair bonds earlier) and form a life-long pair bond. Rarely does more than one pair nest on a single body of water.

The U.S. Fish and Wildlife Service, with biannual Trumpeter Swan Surveys of the Rocky Mountain Population, monitors Trumpeter Swan reproduction in Montana closely (USFWS, 2003). Every September and February since 1972, surveys have been initiated across southern Montana to document the presence of Trumpeter Swans. These surveys also separate the number of white birds (adult or subadult) from gray birds (cygnets). February surveys have shown some fluctuation of the wintering swan population in Montana over the last 30 years, with a record high number of 704 birds (600 white and 104 gray) in 2002 and a low of 214 birds (153 white and 61 gray) in 1995 (USFWS, 2003). Overall, the wintering Rocky Mountain Population has increased drastically from about 609 birds in 1973 to over 4,400 in 2002. It appears the population in Montana is remaining steady, where increasing populations in Idaho and Wyoming are the cause for the overall increase in the Rocky Mountain Population (USFWS, 2003).

The Importance of Wintering Habitat: Food availability on the wintering grounds may have a significant impact on waterfowl populations¹

Habitat management for wintering waterfowl dates back 130 years to when California established the first state refuge at Lake Merritt, Oakland. As early as the 1930s, state and federal wildlife agencies began efforts to protect winter habitat in all four flyways using duck stamp funds, license fees, and excise taxes on sporting arms and ammunition. To a great extent, then, our efforts to manage waterfowl habitat originated south of the breeding grounds.

Despite a long tradition of meeting the needs of wintering ducks and geese, it's not clear how conditions on the wintering grounds influence the size of North America's waterfowl populations. At the heart of the debate is food. During winter, food energy is the key requirement for ducks and geese. In theory, food availability on the wintering grounds can influence mortality and reproduction, the linchpins for population growth.

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¹ Petrie, Mark, Ducks Unlimited Research Scientist: <http://www.ducks.org/conservation/waterfowl-biology/importance-of-wintering-habitat>

For example, birds faced with food shortages in winter may be more susceptible to the effects of natural predation, hunting, and disease. From a reproductive standpoint, a lack of winter habitat may prevent some birds from storing body fat and protein that is used in spring to produce eggs and meet the energy demands of incubation. The result is that winter food shortages could result in fewer birds returning to the breeding grounds, as well as reducing the success of birds that do breed.

That's the theory. But what real evidence do we have that conditions outside of the breeding season play a major role in regulating North American waterfowl populations? Let's start with geese. Historically, some species like Snow Geese were confined to narrow bands of coastal salt marsh during winter.

Intensive foraging within these limited habitats resulted in depletion of food resources prior to spring migration. As a result, population size was limited by overwinter survival, because many birds succumbed to the effects of food shortages. In addition, many of the birds that did survive the winter likely returned to the breeding grounds in poor shape and thus reproduction suffered.

Agriculture changed all that. As farming practices intensified, geese gained access to tremendous amounts of waste grains throughout winter and during migration. This energy subsidy reduced competition for food resources and increased survival rates outside of the breeding season. Moreover, birds were better able to store the body fat and protein used in reproduction. Agriculture not only increased the number of geese that returned to the Arctic, it has also increased the reproductive success of those birds.

Waterfowl life cycles and foods¹

Waterfowl experience an annual cycle that includes several stages, generally dependent on the season. In the winter they bond with a mate, and in the spring they migrate, breed, nest, and rear their brood. In the summer molting occurs, and in the fall they migrate again.

As a result of this cycle, waterfowl depend on a mix of wetlands and associated uplands throughout the year as their cover and food needs differ. Cover needs vary as waterfowl breed, nest, and rear broods. Food needs also vary with season. At times, waterfowl may feed extensively on aquatic insects, but at other times their diet may shift to seeds and other plant materials. Egg production, molting, and migration all require high-energy foods, while brood rearing requires an area with an abundance of insects. Because waterfowl have such varying needs, a diversity of wetlands with a mix of adjacent upland nesting cover is most beneficial.

¹ Adapted from the *Landowner's Guide: Waterfowl*. Michigan Department of Natural Resources http://www.dnr.state.mi.us/publications/pdfs/huntingwildlifehabitat/landowners_guide/species_mgmt/Waterfowl.htm



Available food attracts migrating waterfowl to stop and feed in Michigan each spring. Marshes, shallow lakes, ponds, river bays, beaver floodings, and seasonal wetlands such as flooded pastures and seasonal pools are all important because they usually contain food. The seeds of smartweed, wild millet, curly dock, and beggars tick can be found at these locations. These plants and their decaying material from the previous year attract snails, beetles, midges, caddisflies, fairy shrimp, water fleas, and scuds, which are high-energy foods for migration.

Spring migrating waterfowl eat these invertebrates in large quantities because they are rich in protein and calcium. Waterfowl need a lot of protein and lipids to replenish fat reserves, especially in spring when they are flying long distances, and to help produce eggs. Seasonally flooded wetlands are important because they warm faster than deeper, permanent wetlands and thus produce preferred food earlier.

After waterfowl feed in the spring, some stay for the summer as residents. These birds use the wetland area to rest, loaf, preen themselves, pair bond, and breed. Pairs that stay in the wetland complex often nest in surrounding uplands, then lead their offspring to water where the young also feed primarily on protein-rich invertebrates.

Throughout the summer and fall, waterfowl acquire as much protein as possible. Molting, the three- to five-week-long summer period when the adult birds shed their wing feathers and grow new ones, requires a large amount of protein intake. Likewise in the fall, resident birds put on as much fat as possible to prepare for migration, and those waterfowl that nested farther north also rely once more on local wetlands as a crucial stopover.

Waterfowl foods do not only vary seasonally, but they also vary substantially among species. For example, Wood Duck females eat mostly acorns and other plant food in fall and winter, then rely more and more on invertebrates during the nesting season, with plant life furnishing about 20% of their needs during the egg-laying period. By contrast, Gadwalls use half plant food and half animal food in both spring and summer. Canada Geese are grazers and will feed mainly on vegetation.

As you can see, a variety of wetlands and uplands are needed to meet the seasonal needs of waterfowl. A wetland complex with different types of habitat is most desirable because it will provide different food and cover at different times of the year. Wetlands that feature secure cover and food production for brood rearing are critical for the welfare of waterfowl. However, each species has different specific needs.

Life cycles of three common waterfowl

Wood Ducks arrive in Michigan from southern wintering areas typically in March. Because females lack the fat and protein reserves needed for egg production, they disperse into forested and stream bottom areas where they feed heavily on acorns and aquatic seeds. Water depths averaging 8 inches are ideal for foraging Wood Ducks, and loafing and roosting sites can be maintained where water is deeper. During this time, nesting pairs also begin searching for suitable nesting cavities mostly along forested waterways, although they may select trees a mile or more from water. Trees with diameters at least 14 inches at chest height produce most of the suitable nesting cavities. Average clutch size is 12 eggs, and incubation takes about 28 days. Hens and their broods are highly mobile from nesting sites

to wetlands, occasionally moving up to 2-1/2 miles. Shallow, flooded habitat with good overstory cover are important brood rearing areas. Button bush, willow, and emergent vegetation such as cattails can provide this cover.

Breeding pairs of **Blue-winged Teal** prefer seasonally or temporarily flooded, shallow wetlands. They usually feed in those portions with less than eight inches of water. In dry years, gently sloping basins that provide shallow water all summer are important. The hen typically nests in upland grasses or wet meadow sedges near such water, although nests may be located as far away as one mile. Areas with short grasses have the highest nesting success. Clutch size averages ten eggs, which the hen incubates for 23 days. Semi-permanent wetlands located near nesting areas are important for brood rearing. Livestock ponds with well-developed emergent vegetation provide locally important brood habitat. Seasonal wetlands also provide excellent brood habitat, but because Blue-winged Teal are relatively late nesters, seasonal wetlands are often unavailable when ducklings leave nests.

The breeding range of **Mallards** is the most extensive of any duck species in North America. Like other ducks, female Mallards are influenced by their homing instinct when returning to the breeding grounds. Because hens and drakes form bond pairs during fall and on the wintering grounds, the drakes follow their mates back to the hen's breeding site. In the spring, females seek midges, crustaceans, mollusks, and other aquatic invertebrates rich in nutrients needed for egg production. Hens normally like grassy areas, including hayfields, in which to lay their eggs. Nest sites may be up to a mile away from wetlands, but are typically within 500 ft. The hen lays one egg each day for nine or ten days until the clutch is complete. After the last egg is laid, the hen will incubate her clutch for about 25 days. After hatching, the hen leads her ducklings to water. Mosquitoes, dragonflies and other insect larvae are among the types of protein-rich foods that the ducklings eat. The young are able to fly in 50 to 60 days. Fall and winter foods of Mallards consist mostly of high-energy seeds from aquatic or emergent wetland plants and farm crops. Native foods include seeds, leaves and roots from sedges, millet, smartweed, coontail, duck potato, duckweed, and mast from nut-producing trees. Cultivated grains include corn, sorghum, wheat, barley, and oats.

Waterfowl Breeding Population and Habitat Survey¹

The Waterfowl Breeding Population and Habitat Survey is the most extensive and most important of North America's waterfowl population surveys. It was started experimentally in 1947, became operational in 1955, and has been conducted every year since then.

This survey is a cooperative effort of the U.S. Fish and Wildlife Service, the Canadian Wildlife Service, and state, provincial, and tribal agencies. It currently covers more than 2.1 million square miles of the northern U.S. and Canada, and includes most of the primary duck nesting areas in North America.

Each year, air crews (a pilot biologist and an observer) fly fixed-wing aircraft at low altitude (150 ft) over transect lines through waterfowl habitat areas. Over 55,000 miles of transects are flown every year. That's like counting ducks in a single line over two times around the world!

¹ *Waterfowl Breeding Populations and Habitat Survey*, from <http://www.flyways.us/surveys-and-monitoring/waterfowl-population-surveys/may-breeding-population-and-habitat-survey>

Because some birds cannot be seen from the air, ground crews conduct similar counts in some survey areas. Using the difference in the two counts, biologists develop visibility correction factors to apply to aerial counts.

Estimates of breeding populations for all waterfowl species observed are derived by taking the aerial counts, adjusting them based on the visibility correction factors, and expanding them over the survey area.



PENCIL-TO-PAPER WARM-UP

Description: Students brainstorm words to describe waterfowl life cycles and reproduction activities. They then incorporate some of the activities described into a simple *geo*-bird drawing. They compare their new sketch with their *geo*-bird drawings from Units 1 and 2.

Setting: Indoors

Skills: Communicating, describing, developing visual ideas, explaining, illustrating, sketching

Preparation: Students, particularly younger students, may need to see photos, diagrams or videos depicting waterfowl reproductive behaviors (nesting, courting, caring for young) before initiating this activity. Search the Internet for “waterfowl courtship photos” and find resources in the Unit 3 *Related Resources* list, page 95, particularly the Johnsgard article.

Materials: Nature Notebook, art pencil or charcoal stick

EXPLORE

Learning Objectives:

On completing the *Explore* activities described below, learners will be able to:

- Describe why having precocial young promotes waterfowl survival
- Explain why imprinting on parents is an important behavior adapted by waterfowl young

Activities:



How Do Waterfowl Find Mates?

Description: This is a field activity designed to provide students with the opportunity to observe waterfowl courtship behavior. Students will record their observations, using words and drawing, in their Nature Notebooks.

Setting: Indoors or outdoors

Skills: Describing, investigating, observing, recording

Preparation: Check with a local natural resources professional to calculate when and where the best opportunities will be for students to observe waterfowl courtship behavior. Make arrangements for students’ transport to the site and for volunteers for supervision. An indoor experience is a poor substitute for an outdoor observation, but if a site is not

within walking or busing distance, check the Internet for videos or photos of waterfowl reproductive behavior.

Materials: Nature Notebook and a pen or pencil. If an outdoor trip is planned, students will also need proper clothing and footwear, snacks and/or lunch, water, and binoculars



Mating for Life

Description: Students consider a number of questions about waterfowl courtship in this three-part activity.

Setting: Indoors

Skills: Describing, developing research skills, investigating, observing

Materials: Nature Notebook and a pen or pencil; access to the Internet or library to watch videos and see photos of waterfowl courtship behaviors



The World's Largest Nursery

Description: Students research the Prairie Pothole Region of North America and its importance to waterfowl in this two-part activity.

Setting: Indoors

Skills: Describing, researching

Materials: Nature Notebook and a pen or pencil; access to the Internet to watch videos and see photos of waterfowl courtship behaviors



Where to Build a Nest?

Description: Students explore waterfowl nesting habits and the habitats where they choose to nest.

Setting: Indoors

Skills: Describing, observing, researching

Materials: Nature Notebook and a pen or pencil; access to a library or the Internet to see photos of waterfowl nests



How to Build a Nest?

Description: In this three-part activity, students visit a wetland to see waterfowl nests, try to build a waterfowl nest based on their observation, and observe the nests of other birds to compare their building techniques.

Setting: Indoors or outdoors

Skills: Describing, modeling, observing, planning, questioning, researching, comparing

Preparation: Make arrangements for students' transport to a wetland site and for volunteers for supervision. An indoor experience is a poor substitute for an outdoor observation, but if a site is not within walking or busing distance, check the Internet for videos or photos of waterfowl nests and nesting behaviors.

Materials: Nature Notebook and a pen or pencil; access to a wetland area, or to a library or Internet access to observation



Transformation

Description: Students use the Internet and library resources to explore the characteristics of waterfowl eggs: incubation, size, and color.

Setting: Indoors

Skills: Describing, observing, researching, comparing

Materials: Nature Notebook and a pen or pencil; access to a wetland area, or to a library or Internet access to observation

INVESTIGATE

Learning Objectives:

On completing the *Investigate* activities described below, learners will be able to:

- Describe how coloration and other adaptations are related to waterfowl reproduction and survival of young
- Observe and record waterfowl reproductive behaviors (courtship, nesting, mating, rearing young)
- Communicate with a conservation professional to find local waterfowl nesting areas

Activities:



True Colors

Description: Students compare waterfowl colors and markings and consider the importance of these characteristics to waterfowl reproduction.

Setting: Indoors

Skills: Comparing, describing, evaluating, questioning

Materials: Nature Notebook and pencil or pen



Visit a Waterfowl Nesting Site

Description: Students find an outdoor place to observe a waterfowl nesting site, complete a habitat assessment of the site, and record any nesting or courtship behaviors they observe during the field trip.

Setting: Outdoors

Skills: Communicating, comparing, describing, developing research capabilities, diagramming, identifying, planning, recording

Preparation: This activity could be a classroom field trip or a homework assignment. Younger students will need more supervision than older, and instead of just using words to describe the behaviors observed they should be allowed to draw what they observe. Educators might also develop a worksheet of photos of behaviors for young students to use as a checklist to record data in the field.

Materials: Nature Notebook and pencil or pen



Food for a Growing Family

Description: The quantity and diversity of macroinvertebrates in a stream is an indication of water quality. Healthy wetlands, with an abundance of macroinvertebrates, are important for the survival of hatchlings and young waterfowl. In this activity, students will work in groups to practice monitoring the water quality of a stream using macroinvertebrates as biotic indicators of stream health.

Setting: Indoors and/or outdoors

Skills: Comparing, describing, gathering evidence, observing, recording

Preparation:

- Make copies of the Macroinvertebrate Tally Sheet (Appendix F, Macroinvertebrates Biotic Index) – one for each team.
- Make the critter cubes. Cut blocks of wood 4–6 cm square or use toy building blocks or plastic cubes of similar sizes. Make a copy of the macroinvertebrate drawings on the Tally Sheet in the Critter Cube count (Appendix F). Cut out each of the drawings. Don't worry about cutting along lines, just cut out a circle or oval around each drawing. Glue the pictures onto the sides of the cubes making sure each cube has critters from each of the four groups pasted on it. Students will use the cubes to practice the monitoring techniques and data recording process before they monitor outside.
- Display the “Key to Macroinvertebrate Life in the River” chart for group members.

Materials: Nature Notebook and pen or pencil, Tally Sheet, and Key to Macroinvertebrate Life in the River (page 185), four critter cubes for each group (see instructions in “Preparation”), an ice cream bucket or similar container for each group, a clear, flat surface like a card table or a clear area on the floor.



Find Some Duck Food Yourself

Description: Students use the same techniques as those practiced in last activity to find duck food and to monitor the water quality of a local stream. Mosquitoes, dragonflies and other insect larvae are among the types of protein-rich foods that Mallard ducklings eat.

Setting: Outdoors

Skills: Describing, developing research capabilities, gathering evidence, identifying, recording

Preparation: Ask a natural resource professional and/or local outdoor education organization to find nets the students might use during this activity, or check the Internet for directions for making nets. Other materials are simple household items students can gather from home.

Materials: Nature Notebook and pen or pencil, a fine mesh net with a long handle, a white or light-colored dishpan, white ice cube trays, turkey baster or eyedroppers, hand lens, and the Key to Macroinvertebrate Life in the River (page 185) and the Macroinvertebrate Tally Sheet (page 183).



The Food that Grows on the Water

Description: Mallards eat a variety of native foods including seeds, leaves, and roots from sedges, millet, smartweed, coontail, duck potato, duckweed, and mast from nut-producing trees. They will also eat cultivated grains including corn, sorghum, wheat, barley, and oats. Students learn about the importance of an additional plant, wild rice, to waterfowl survival and get a chance to taste this ancient grain themselves. Students will describe the taste of the wild rice in their Nature Notebooks.

Setting: Indoors

Skills: Describing, investigating

Preparation: Educators will need to gather the ingredients to make the Native American recipe for wild rice described on page 108 of the *Youth Guide*: Turkey broth, sage, “something crunchy” like cattail buds or roots or water chestnuts, wild rice, cranberries, salt and pepper. In addition, the class will need a crockpot to cook the soup in the classroom, and bowls and spoons for all the students to have a taste.

Materials: Nature Notebook and pen or pencil



Buy a Duck Stamp—Save Some Habitat

Description: Students investigate where the closest national wildlife refuge(s) and other public lands to their homes or school are located.

Setting: Indoors

Skills: Identifying, researching

Materials: Nature Notebook and pen or pencil, access to the Internet



Investigate Your Question

Description: Students choose questions that they would like to investigate about any of the topics on waterfowl reproduction covered in Unit 3. After they choose a question, they propose a hypothesis and a means of testing that hypothesis.

Setting: Indoors

Skills: Describing, developing research capabilities, planning, questioning

Materials: Nature Notebook and pen or pencil

EXPRESS

Learning Objective:

On completing the *Express* activities described below, learners will be able to:

- Describe waterfowl courtship, nesting, or other reproduction behavior through a visual art medium of their choice

Activities:



Practice Drawing Waterfowl Behaviors

Description: In this activity, students may choose one or more ways to practice drawing waterfowl courtship or nesting behaviors, or what waterfowl look like at various stages of life.

Skills: Communicating, connecting art to other subjects, describing, developing visual ideas, observing, sketching

Materials: Nature Notebook and pen, art pencils and/or charcoal sticks, colored pencils, paints, or other art materials as requested by students

SHARE

Learning Objectives:

On completing the *Share* activities described below, learners will be able to:

- Communicate with natural resources professionals to gather evidence about land use practices and their effects on waterfowl habitat in the local community.
- Contribute to a habitat restoration effort in their community by building waterfowl nest boxes.

Activities:



Who Took My Home?

Description: Students conduct an interview with a local conservation professional or land use planner about community activities that might impact local wetlands, positively or negatively. They then share what they've learned with others.

Setting: Indoors

Skills: Communicating, developing research capabilities, describing

Preparation: This might be done as a small group activity. Educators will need to help students find natural resource professional or land use planners who are willing to participate in this activity.

Materials: Nature Notebook, pen or pencil, access to contact information for natural resource professional or land use partners, access to a phone or email account



Build a Nesting Structure!

Description: In this stewardship activity, students build an artificial nesting structure to help restore nesting opportunities for waterfowl. They are encouraged to explore opportunities for conservation projects in their communities.

Setting: Indoors and outdoors

Skills: Communicating, describing, developing visual ideas, modeling, planning

Preparation: Find a local natural resources professional to help provide expertise for this activity. Nest box building instructions for different species are found in the *Related Resources* section (page 95) or are easily found on the Internet.

Materials: Pen, marker, or pencil, building materials as described in the instruction above



Mystery of the Labrador Duck – Evidence about Reproduction

Description: Students read a short piece on page 116 of the *Youth Guide* about speculations about the nesting habits of the Labrador Duck; we might assume it has characteristics similar to other sea ducks. Students try to determine if there are clues in the general descriptions of sea ducks that indicate why the Labrador Duck may have become extinct.

Setting: Indoors

Skills: Communicating, describing

Materials: Nature Notebook, pen or pencil



PENCIL-TO-PAPER WRAP-UP

Students revisit the *geo*-bird created in the *Warm-Up* section of this unit (page 87). Encourage them to think about what they learned in Unit 3 about the behavior of waterfowl associated with reproduction. Encourage students to change their drawing to reflect their new knowledge about waterfowl nesting or courtship behavior.

Adaptations for Early Elementary Students

As suggested by The *NAAEE Excellence in Environmental Education: Guidelines for Learning (K–12)*, strategies for examining environmental issues with early elementary students should be simple, local, and make close links between what they’re observing and learning about the local environment.¹

Breaking Out: Very young students will enjoy watching the video of a duckling hatching from an egg on the Ducks Unlimited webpage, Egg Hatch, http://www.greenwing.org/newgreenwing/activities/egg_hatch%20copy/egghatch.htm.

Fun Zone Crossword Puzzle: Puddler Magazine Activity, Ducks Unlimited http://www.greenwing.org/dueducator/spring04insertweb/spring04elem_4.pdf. Students can complete this puzzle to learn more about ducks raising their young.

Duckling Differences: Do a Web search for “images of wild ducklings.” Have students examine a number of photos of different species of ducklings and describe in words how the different species are alike or different in size, shape, color, and other physical characteristics. Have students choose a duckling from the photos to draw, asking them to keep these special characteristics in mind.

Check the *Related Resources* list on page 95 for curricula, activities, and materials that are appropriate for grades K-4.

Adaptations for High School Students

Family Photos: Divide the class into three groups. Assign each group to be either a duck group, goose group, or swan group. Ask students to search the Internet of images of their assigned waterfowl at three stages of life—eggs, young, and adults. If possible, they should search for waterfowl species that might nest, winter, or pass through their community. Each group should find at least four different species. Ask each group to work together to describe how each life stage of each of their species is alike or different than the other species. Which waterfowl had the most interesting egg? Nest? Which had the best camouflaged ducklings? What did they find surprising about their comparisons? They should write their answers in their Nature Notebooks. Then have each group report out to the entire class.

Check the *Related Resources* list below for curricula, activities, and materials that are appropriate for grades 9–12.

¹ *Excellence in Environmental Education: Guidelines for Learning (K–12)*. 2010. North American Association for Environmental Education, www.naaee.org

UNIT 3 – RELATED RESOURCES

Activities

- *Bird Behavior Scavenger Hunt* (6–8th), Flying WILD: An Educator’s Guide to Celebrating Birds, Council for Environmental Education.
<http://www.flyingwild.org/guide.htm>
 Students identify different behavior patterns of birds and explain their functions.
- *Diversity and adaptations, Lesson 5* (9–12th) Wetland Ecosystems III, Ducks Unlimited Canada.
<http://www.epa.gov/gmpo/education/pdfs/DUEducators9-12.pdf>
 Students explore the diversity of structural and behavioral adaptations.
- *Migration Science and Mystery: A Distance Learning Adventure*
 - *Colorful Changes* (3–12th)
http://migration.pwnet.org/pdf/Colorful_Changes.pdf
 Students discover that some shorebirds have dramatically different breeding and nonbreeding plumage. They then create an artistic representation of a shorebird species in both seasons.
 - *Guard Your Nest* (3–12th)
http://migration.pwnet.org/pdf/Guard_Your_Nest.pdf
 Students, pretending to be shorebirds, must guard their nests from a multitude of predators and threats. They discover that camouflage and distraction displays are two strategies that increase a shorebird’s chance of nesting success.
- *Young Naturalists*, Minnesota Conservation Volunteer, MN DNR
<http://www.dnr.state.mn.us/volunteer/index.html>
 - *What are portable, durable, dependable, convertible, and altogether incredible? Eggs!*

Web resources

Nest Boxes

- *Nest Structures for Ducks and Geese: A Guide to the Construction, Placement, and Maintenance of Nest Structures for Canada Geese, Mallards, and Wood Duck*¹, Northern Prairie Wildlife Research Center, USGS
<http://www.npwrc.usgs.gov/resource/birds/neststru/index.htm>
- *How to Build a Wood Duck Nest Box*, MDC Discover Nature, Missouri Department of Conservation
<http://mdc.mo.gov/discover-nature/how/woodworking/how-build-wood-duck-nest-box>
- *Wood Duck Boxes*, South Carolina Department of Natural Resources
<http://www.dnr.sc.gov/wildlife/waterfowl/woodduck/BoxInstructions.pdf>

Songs

- *Webber and Maude McMallard*, Billy B. The Natural Science Song and Dance Man, <http://billybproductions.com/main/albums/romp-in-the-swamp/webber-and-maude-mcmallard>
 This song tells the tale of Webber and Maude McMallard’s migration to and raising young in a prairie pothole in the Great Plains.

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¹ Zenner, Guy G., Theodore G. LaGrange, and Alan W. Hancock. 1992. *Nest structures for ducks and geese*. Iowa Department of Natural Resources, Des Moines, IA. Jamestown, ND: Northern Prairie Wildlife Research Center. Online. <http://www.npwrc.usgs.gov/resource/birds/neststru/index.htm> (Version 16JUL97).

Swans

- *Mute Swan (Cygnus olor): Invasive Species in the Chesapeake Watershed*, Maryland Sea Grant and the Chesapeake Bay Program.
http://www.mdsg.umd.edu/issues/restoration/non-natives/workshop/mute_swan.html
The Mute Swan, an invasive species, is a concern to waterfowl biologists because of its capacity to overgraze on submerged aquatic vegetation. This site outlines the characteristics of Mute Swans and their impacts in the Chesapeake Bay.
- *Trumpeter Swans Questions and Answers*, USFWS
<http://www.fws.gov/mountain-prairie/species/birds/trumpeterswan/TSwan%20QandA.htm>

Investigation and science inquiry

- *BirdSleuth: Investigating Evidence (6–8th)*, Cornell Lab of Ornithology
<http://www.birds.cornell.edu/birdsleuth/inquiry-resources/we-want-to-support-you-as-your-students-become-scientists>
This curriculum includes lesson plans, journal pages, and online resources that will help your students ask scientific questions, craft and test hypotheses, collect and organize data, draw meaningful conclusions, and publish their work.

Waterfowl courtship and nesting behavior

- Johnsgard, P. A. (1955). *Courtship Activities of the Anatidae in Eastern Washington*, Papers in Ornithology, University of Nebraska, Lincoln.
<http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1065&context=biosciornithology>
Although this article is dated, it offers very good descriptions and drawings of waterfowl courtship behaviors.
- *Adopt-a-Swan Curriculum (9–12th)*, Blackfoot Challenge.
http://www.blackfootchallenge.org/SwanProject/Docs/Curriculum/Background_Information_for_Educators.pdf
Background information provided for educators on swan behavior, sizes, shapes, calls, food habits, migration, and raising a family.
- *The Parenting Game (K–12th)*. Welsh, Jan. Minnesota Department of Natural Resources.
http://files.dnr.state.mn.us/publications/volunteer/young_naturalists/parenting/baby_animals.pdf
This article discusses wildlife parenting techniques for a variety of species including Wood Ducks and Mallards.
- *Waterfowl Mating Systems: “Until death do us part”—A statement that is generally true for geese, but not ducks*. Ducks Unlimited.
<http://www.ducks.org/conservation/waterfowl-biology/waterfowl-mating-systems>
This article describes monogamous bonds in waterfowl.
- *Young Naturalists: Minnesota Ducks Dabble or Dive For Dinner (4–12th)*. Welsh, Janice. Minnesota Department of Natural Resources. http://www.dnr.state.mn.us/young_naturalists/ducks/index.html
This piece offers background information and photos on duck foods, behaviors, bills, feet, feathers and raising a family.
- *Young Naturalists: Baby Birds of Minnesota (K–12th)*. Welsh, Janice.
http://www.dnr.state.mn.us/young_naturalists/babybirds/index.html



This article highlights nesting behaviors and features a photo comparing different egg sizes from a hummingbird egg to a Trumpeter Swan egg.

Water Monitoring

- *Citizens Monitoring Biotic Index* (6–12th), Wisconsin Action Volunteers
<http://watermonitoring.uwex.edu/pdf/level1/FactSeries-Bugs.pdf>

This fact sheet provides basic information about and activity outline on stream monitoring, including macroinvertebrate (bug) monitoring.

NOTES:

NOTES:



UNIT 4. GOING THE DISTANCE: MIGRATING ACROSS CONTINENTS

Migratory birds are some of nature's most magnificent resources. They play a significant role in the health of the environment, economy, and culture, both in the U.S. and internationally.

U.S. FWS Migratory Bird Program

Purpose

In Units 1–3, students explored the unique characteristics and adaptations that make waterfowl such interesting subjects for scientists and artists alike. The focus of Unit 4 is waterfowl migration and the complexities migration brings to the study of waterfowl, their habitat, and their management.¹

Students should understand that they get to choose which activities to pursue; the guide is designed to help them but not give them all the answers; and they're going to have fun!

Learning Objectives

If learners choose to complete all the activities in this section, they will be able to:

- Describe basic characteristics of waterfowl migration:
 - **Why** waterfowl migrate

Unit 4 at a Glance

Purpose: To investigate waterfowl migration and its implications for conservation management

Subjects: Geography, language arts, math, science, and visual arts

Process skills:

- **Geography skills**
 - Using maps

¹ Adapted from US FWS Migratory Bird Program website, <http://www.fws.gov/migratorybirds/AboutUS.html>

• Language arts skills

- Applying knowledge to language
- Applying language skills or process
- Communicating
- Creating evaluation strategies
- Developing research skills
- Evaluating data
- Gathering data
- Reading for perspective
- Understanding the human experience

• Math skills

- Analyzing data
- Collecting data
- Computing
- Connecting math with other subjects
- Designing studies
- Formulating questions
- Measuring
- Predicting

• Science skills

- Analyzing
- Describing
- Designing investigation
- Explaining
- Gathering evidence
- Interpreting
- Investigating
- Organizing information
- Questioning

• Visual arts skills

- Applying knowledge to art
- Connecting art to other subjects
- Designing
- Developing visual ideas
- Experimenting
- Modeling
- Sketching

Conservation concepts:

- Ecosystems change over time
- Changes in environmental conditions can affect the survival of individual organisms and entire species
- Species can become extinct because of habitat change or loss
- The impact of the human species has major consequences for other species

Vocabulary:

breeding, Centigrade, climate, conservation, Fahrenheit, foraging, habitat, managed, management, migration, nonbreeding, phenologist, phenology, restoration, staging areas, waterfowl conservation areas, weather

- **Where** different species of waterfowl go and what paths they take
 - **How** they know when and where to go
 - **What** some threats are to waterfowl survival and how students can help minimize those threats
- Explain the possible impacts of climate change on Mallard migration

Featured Scientist

Meet Dr. Michael Schummer, Waterfowl Ecologist

As described on page 124 of the *Youth Guide*, Dr. Michael Schummer works with a team of scientists to explore waterfowl conservation issues. In the activity “Meet a Waterfowl Ecologist” presented in the *Investigate* section of this unit (page 106), students will step into Michael’s shoes to investigate the question: **Will climate change have an impact on waterfowl migration?**

Featured Scientist

Meet Dr. Mike Eichholz, Waterfowl Ecologist

Dr. Mike Eichholz is introduced to students on page 125 of the *Youth Guide*. Mike works at Southern Illinois University to understand waterfowl migration. Migration creates a great deal of complexity to the study of waterfowl species and their conservation needs. This section illustrates some of those complexities and how they are being addressed by Mike’s team as well as by waterfowl scientists in general.

Understanding distributions of migrating waterfowl in space and time is critical to develop targeted conservation strategies that allocate resources effectively. Myriad studies have investigated the ecology of breeding and wintering waterfowl, but ecologists have only recently begun research on waterfowl during the spring and fall migration periods. Nonetheless, these portions of the annual cycle may be particularly important, especially spring. Substantial evidence indicates that birds in better body condition may nest earlier and produce more offspring than those that nest later. Unfortunately, basic information on the natural history of spring-migrating waterfowl is lacking, in particular the rate of migration (e.g., time spent at stopover sites, distances moved between stopovers). Reliable estimates of these parameters are needed to improve conservation planning through Joint Ventures (JVs) under the *North American Waterfowl Management Plan*.

In the past, reliable data on abundance and distribution of waterfowl foods during the nonbreeding season were lacking. However, substantial data now exists for estimating nutritional requirements of ducks during winter and spring migration. For example, most migratory and wintering regions of North America have estimates of the area of foraging habitat available to spring- and fall-migrating ducks as well as estimates of food abundance per unit area, that allow for model parameterization. However, provision of adequate foraging habitat also requires knowledge of what proportion of a population will pass through a given region and how long they will stay there. Procedures for estimating waterfowl distribution among the JV projects are currently being developed and refined to estimate population levels and set objectives for JV projects that focus on wintering habitats.

Developing estimates of distributions of wintering ducks has been challenging; however, deriving unbiased estimates of the temporal and spatial distributions of ducks during spring migration will likely be considerably more difficult. In the past, mid-migration JV projects set population objectives using data from band recoveries or other harvest estimates from fall, which may not reflect the abundance and distribution of spring-migrating ducks. An alternative approach at estimating the spatial and temporal duck distributions would be to estimate the proportion of birds transitioning from each of the wintering JV projects to each of the spring migratory JV projects.

The first step to apply this approach broadly is to derive a reliable estimate of the wintering distribution of ducks. If we assume current estimates are adequate, then the next step is to somehow estimate the probability that a duck will transition between winter and spring JV project areas. The technology to track individual waterfowl migration, however, has not been perfected, so Mike's team is investigating the use of light-level geolocators to track birds.

Geolocators function by recording the ratio of day to night, with respect to the time of day, to generate rough, two-dimensional estimates of marked individuals. A geocator uses GPS technology to link a geographic location with meaningful information such as an address. Geolocators were originally designed to understand the wide-ranging migration patterns of colonial-nesting seabirds, but have since been used successfully on a variety of avifauna.

Over the past decade, geolocators have been used to successfully study spring-migrating barnacle geese and many other birds. They have the distinct advantage of being very light (e.g., 0.6–2.5 g) and relatively inexpensive (e.g., ~\$150). Further, they can record data for exceptionally long times—up to 5 years for heavier (2.5g) models. Thus, this technological advance has the potential to greatly improve our understanding of bird migration while minimizing bias due to the marker itself.

It is worth noting that geolocators are not a panacea for bird-migration studies and come with their own unique challenges. Despite the challenges, geolocators are promising tools for understanding duck migrations in North America.

NOTES:

Unit 4. Activities Preparation Tips

Background information

WATERFOWL MIGRATION... AND COLLABORATIVE MANAGEMENT

U.S. Fish and Wildlife Service Joint Ventures

In the mid-1980s, waterfowl populations were in crisis. A 10-year-long drought and the draining of wetlands for agricultural and other uses were taking their toll on the birds' habitats and subsequently on them. Because waterfowl were then (and are now) North America's most prominent and economically important group of migratory birds, the U.S. and Canadian governments took action. Scientists, from inside and outside the government, were asked to identify "waterfowl habitat areas of major concern" across the continent and to develop a conservation plan. The *North American Waterfowl Management Plan* was signed by the U.S. Secretary of the Interior and the Canadian Minister of the Environment in 1986.

The scope of the conservation effort needed left no room for doubt: acting alone, the two federal governments did not have the resources needed to save these vital habitats. It was from this dilemma that the concept of conservation joint ventures was born: private- and public-sector partners working together to conserve the continent's waterfowl populations and their essential habitats.

Conservationists concerned about other migratory bird groups—landbirds, shorebirds, colonial waterbirds—saw the success of the Plan model and adopted it as they developed conservation strategies for their species of concern. Rather than reinvent the wheel, they looked to the Plan's joint ventures to help implement their plans. Within their established geographic areas, the Plan's habitat joint ventures, when possible, have integrated the conservation of shorebirds, landbirds, and other waterbirds into their planning processes.

But "white spaces" remained on the map of North America—areas of habitat needing conservation attention where Plan joint ventures did not exist. New joint ventures, not associated with the Plan, have formed. To ensure a logical and coordinated approach to the development and support of these new joint ventures, the U.S. Fish and Wildlife Service issued Director's Order No. 146 to define joint venture.

What is a Joint Venture?

A Joint Venture (JV) is a self-directed partnership of agencies, organizations, corporations, tribes, or individuals that has formally accepted the responsibility of implementing national or international bird conservation plans within a specific geographic area or for a specific taxonomic group, and has received general acceptance in the bird conservation community for such responsibility.

What Do Joint Ventures Do?

Working both collectively and independently, JV partners conduct activities in support of bird conservation goals cooperatively developed by the partnership. These activities include:

- biological planning, conservation design, and prioritization;
- project development and implementation;
- monitoring, evaluation, and applied research activities;
- communications and outreach; and
- fundraising for projects and activities.

Wetland and Waterfowl—Management Collaboration¹

One of the first things waterfowl managers learned from their early waterfowl banding efforts was that waterfowl follow distinct, traditional migration corridors or flyways in their annual travels between breeding and wintering areas.

Since 1948, waterfowl have been managed by four administrative flyways that are based on those migration paths: the Atlantic, Mississippi, Central, and Pacific Flyways. Each flyway has a flyway council which is a formal organization composed of one member from each State and Province in that flyway. Recently, Mexico has also provided representation at Pacific and Central Flyway meetings and discussions.

Each of the flyways also has a technical committee composed of waterfowl biologists from the states and provinces in the flyways. The technical committees meet several times annually to review the biological data from monitoring programs and provide recommendations to their respective flyway councils. Recommendations that are adopted by the Flyway Councils are presented to the U.S. Fish and Wildlife Service's Regulations Committee for consideration in the setting of waterfowl hunting regulations and management programs.

The flyway councils and technical committees are involved in many aspects of migratory game bird management, including development of recommendations for hunting regulations and assisting in research and habitat management activities. Some of the important waterfowl hunting regulations that are set each year, including season length and daily bag limits, are specific to these individual flyways.

See *General Flyways Info*, <http://www.flyways.us/flyways/info>, for information on each of the four administrative flyways.

¹ Adapted from *General Flyways Info*, <http://www.flyways.us/flyways/info>

How Ducks Navigate¹

By Tina Yerkes, Ph.D.

Duck and goose migrations raise as many questions as there are answers. Another beautiful weekend has arrived, and we set off on a canoe trip to a river that we have never visited. The conversation in our car is predictable and goes something like is: To my husband I say, “Do you have the map and the directions?”

His reply: “Kind of.” My retort: “What do you mean ‘kind of’? You don’t have directions, do you?” “I know where I’m going” is his reply. I quietly hold my tongue because in an hour I know we will be lost and he will refuse to stop at a gas station and ask for directions.

If we cannot find our way across the state without a map, how do birds navigate such long distances from their wintering grounds to their breeding areas and back again to the wintering grounds? How do some return to the exact same place where they had a nest the previous year, or to the exact same wintering ground? Are ducks and geese different in their navigation behavior?

Birds use several visual and nonvisual orientation mechanisms to navigate. Some of the visual cues include the sun, polarized light, the stars, and even landmarks. How many of us wear polarized sunglasses when we fish? Do you realize that birds can use the axes of polarized light to determine the position of the sun and perform sun compass orientation? Birds that navigate at night obviously cannot use polarized light, but the stars can provide a good road map for nighttime migrants, and many waterfowl species do utilize star orientation for navigation.

Because of crafty experiments performed in planetariums, scientists know that some birds actually use the stellar map. Presented with the normal night sky in a planetarium, a caged spring migrant bird will orient itself to the north. If you switch the orientation on the planetarium so that the North Star is actually south, the bird moves toward the south instead of moving in the direction of true north as it should.

Landmarks may be important for navigation, not as compasses, but as directional cues. If asked how to get to Ducks Unlimited’s national headquarters in Memphis, I would say: “Turn right at Starbucks and make a left at that good Mexican restaurant.” If you ask my husband, he would tell you: “Go west on Wolf River Road and head south on One Waterfowl Way.”

Using landmarks to give directions makes sense to me and is probably common among nighttime migrants, which respond to major topographic features, such as coastlines, mountain ridges, and major waterways such as the Mississippi River. One of the nonvisual cues that is believed to aid bird navigation is the earth’s magnetic field. Now don’t try this at home, but when magnets were placed on the heads of captive birds, they did not fly in the correct direction even on sunny days.

One investigator noted a change in direction and altitude of migrating birds when a powerful underground antenna was turned on, interfering with the earth’s magnetic field. Even more interesting than a bird’s ability to navigate is its ability to “home.” Homing is the ability to find home when a bird is released in an unfamiliar place or from an unfamiliar direction. How waterfowl actually do this is not at all clear.

¹ *How Ducks Navigate*, Tina Yerkes, Ducks Unlimited, <http://www.ducks.org/conservation/waterfowl-biology/how-ducks-navigate>

They likely imprint information about their home breeding and wintering areas and use navigational cues to return to them. Ducks and geese differ in their rates of homing. Adult female ducks often return to former breeding sites. As many as 75% of adult female Canvasbacks return to their breeding area each year, often nesting in the same pothole where they nested the previous year.

This is also true of cavity-nesting species such as Wood Ducks, Buffleheads, and Goldeneyes. Blue-winged Teal, on the other hand, have one of the lowest homing rates of all ducks: From 5 to 15% return to their former home.

Geese are different because they pair for life. In geese, because pair bonds are long lasting, both males and females home to the same breeding area.

Family units including the mother, father, and goslings will stay together for up to a year. They go to the same wintering area and return the next year to the same breeding area as a family. The young goslings likely learn their migration routes and breeding and wintering areas from their parents.

In young, new pairs, the male will follow the female to her birthplace. If re-pairing does occur, the male goose will follow the female to her breeding area.

The ability to navigate over many miles from breeding to wintering grounds is an amazing adaptation. It is likely that most birds use a combination of visual and nonvisual cues, as well as homing. Navigation and migration behavior is very difficult to study and therefore has not been fully resolved, but we quest for answers with great enthusiasm every fall when the birds return to the same wintering ground, or every spring when I see the same female Wood Duck nesting in her old box from the year before.

Who leads and who follows? The female duck always makes the choice for the breeding area because she is homing to the site of her birth or a site where she successfully hatched a nest. There is very little evidence indicating which sex determines the wintering site. In most duck species, males and females will go their separate ways after the breeding season, each returning to their respective wintering site from the previous year. Female ducks tend to winter farther south, and those that were successful at raising young arrive much later than males.

How do young ducks find their way?

In nearly all waterfowl species, young birds return to breeding areas at much lower rates than adult females: Only about 27% of Canvasback young return to the area where they were hatched. This is mostly because young do not survive as well as adults. For those that make it through the winter, how do they find their hatch area? This is an unsolved mystery, but they likely use some of the navigation mechanisms mentioned in the text.

What about the wintering grounds?

We know from banding programs and neck collars that birds will return year after year to the same wintering area. Geese and swans are very loyal to specific wintering sites. Ducks are a little more flexible, yet they still home to wintering areas, as well as molting and migration stopover areas. There are important lessons to learn here for managers and private landowners. For birds to return year after year, disturbance and food availability should be managed.

Supplying Nutritional Needs for Waterfowl and the Importance of Diverse Habitat¹

The large body sizes of waterfowl enable them to store nutrients as body reserves. In some cases nutrients for an upcoming stage in the life cycle are acquired at a distant wetland and transported as body reserves. The best known examples are the transport of fats, calcium, and protein by arctic-nesting geese from wintering and migrational stopovers to breeding habitats. Because waterfowl store body reserves, managers should make an effort to supply required nutrients throughout the annual cycle rather than supplying nutrients solely for events at the time they occur.

Identifying shortfalls in nutritional needs is becoming more of a reality as the requirements for free-living animals are identified. Waterfowl are well adapted to the dynamics of natural wetland systems.

Mobility and foraging adaptability are behavioral characteristics that enable waterfowl to acquire needed resources. Dynamic wetlands supply a variety of food resources that allow waterfowl to feed selectively and to formulate nutritionally adequate diets from a variety of sites. Although a single wetland site may not provide adequate food for all requirements, management areas with a variety of wetlands or flooding regimes usually have a mix of habitats that provide all nutritional requirements.

Because a variety of strategies exists within and among waterfowl species (wintering, migration, or breeding), not all individuals or species require similar resources simultaneously. Thus, a diverse habitat base is a logical approach to meet the various needs of waterfowl. Furthermore, when suitable food and cover are within daily foraging range, acquisition of required resources is enhanced. A good rule of thumb is to provide many wetland types or food choices within a 10-mile radius of waterfowl concentrations. Some species such as Snow Geese have far greater foraging ranges, but they are the exception rather than the rule.

Appropriate management requires preservation, development, and manipulation of manmade and natural wetland complexes. Such an approach provides nutritionally balanced diets for diverse waterfowl populations. Where natural wetlands remain intact, they should be protected as unique components of the ecosystems. The protection of natural systems and the development and management of degraded systems increases choices of habitats and foods for waterfowl. Likewise, the provision of adequate refuge areas where birds are protected from disturbance is an essential ingredient to ensure that food resources are available to waterfowl and can be used efficiently.

Bird Migration and Urban Students

As shown in the following article, even students living in large cities have opportunities to marvel at the spectacle of large bird migrations.

¹ Adapted from *Waterfowl Management Handbook*, 13.1.1. *Nutritional Values of Waterfowl Foods*, USFWS leaflet 13.1.1. http://www.nwrc.usgs.gov/wdb/pub/wmh/13_1_1.pdf

Bird Migration Up Close: Manhattan

Cornell Lab of Ornithology, BirdScope, Summer 2008/Vol. 22, Num. 3.



© Ian Stedman

For most people, the word “Manhattan” doesn’t conjure thoughts of bird migration or stopover habitat. But every spring and fall for the past 10 years, since I moved back there, I am reminded constantly that it’s a prime (and cool!) location to experience birds migrating. The passage that occurs here, by day and by night, can be spectacular!

One brief example: the third week of October in 2005. From our apartment on 63rd Street, I spent each morning scanning down the East River and across Queens as a stream of birds poured into Manhattan. The spectacle cannot be described simply by numbers. Tens of thousands of birds passed by in tens, fifties, hundreds, across from Long Island into Manhattan. Flocks of White-throated Sparrows and Dark-eyed Juncos intermingling with American Robins, Eastern Bluebirds, Red-winged Blackbirds, Purple Finches, American Goldfinches, interspersed with kinglets and nuthatches here and there; Rusty Blackbirds and a real surprise—a Red-headed Woodpecker! Yellow-rumped Warblers streamed past the United Nations and Trump Towers, with the occasional American Redstart, Palm Warbler, Common Yellowthroat. Northern Flickers everywhere! Even Brown Creepers.

By late morning, every patch of trees found thousands of these birds stopping over, refueling, resting, taking shelter. On the lawn at Rockefeller University, I counted almost 500 Ruby-crowned and Golden-crowned kinglets in a single, one-square-block area.

And this says nothing of the raptor and waterfowl passages that followed.

A nighttime visit to the Empire State Building is the right way to top off these migration days, not for sightseeing or a panorama of the city, but for the avian spectacle. All those migrants that filled the city parks lift off in a spectacular exodus and continue southward. Birds stream past the observation deck, occasionally circling the tower, occasionally fighting cross winds. Birders aren’t the only ones watching for them. Peregrine Falcons frequent the Empire State Building, taking advantage of lighting to grab nighttime snacks.

—Andrew Farnsworth, postdoctoral research associate, Conservation Science

For permission to reprint all or part of this article, please contact Laura Erickson, editor, Cornell Lab of Ornithology, 159 Sapsucker Woods Rd., Ithaca, NY, 14850. Phone: (607) 254-1114. email: lle24@cornell.edu

**PENCIL-TO-PAPER WARM-UP**

Description: Students add a new layer to their *geo*-bird drawing, which describes their *geo*-bird in a location along its migratory route. They compare their new sketch with their *geo*-bird drawings from Unit 3 and share their ideas with classmates.

Setting: Indoors

Skills: Communicating, describing, developing visual ideas, explaining

Preparation: Students, particularly younger students, may need to see photos, diagrams or videos depicting waterfowl migratory behaviors and habitat characteristics (such as large congregations of birds in flight or on the ground or winter-like habitat changes) before initiating this activity. Search the Internet for “waterfowl migration photos” and find resources in the Unit 4 *Related Resources* list, page 114.

Materials: Nature Notebook, art pencil or charcoal stick.

EXPLORE**Learning Objectives:**

On completing the *Explore* activities described below, learners will be able to:

- Describe basic characteristics (how, why, where, when) of waterfowl migration
- Locate the waterfowl flyway that is closest to their community
- Explain the conservation roles of national wildlife refuge staff

Activities:**Why Do Waterfowl Migrate?**

Description: Students predict what factors trigger waterfowl migration.

Setting: Indoors

Skills: Describing, explaining, inferring, recording, thinking critically

Materials: Nature Notebook and a pen or pencil

**How Do Waterfowl Know Where to Go?**

Description: Students consider how waterfowl determine where to go when they migrate. They devise a plan for investigating their ideas, using Dr. Eichholz’s migration study (page 125 of the *Youth Guide*) as an example.

Setting: Indoors

Skills: Describing, developing research skills, inferring, observing, predicting, questioning

Materials: Nature Notebook and a pen or pencil

**Where Do Different Species of Waterfowl Go and What Pathways Do They Take?**

Description: Students explore major flyways in North America to determine which are closest to their community and which waterfowl frequent the flyway closest to home.

Setting: Indoors

Preparation tip: Ducks Unlimited's *Waterfowl Migration Headquarters*, <http://www.ducks.org/hunting/migration>, and *Waterfowl Migration Map*, <http://www.ducks.org/migrationmap/?poe=migrationHQ>, offer real-time data on waterfowl movement through the flyways.

Skills: Describing, developing research skills, gathering data, using maps

Materials: Nature Notebook and a pen or pencil; access to a library or the Internet to find resources on waterfowl migration



Migration Math

Description: Students measure migratory routes and calculate distance traveled by different species. They also estimate the time it would take for the birds to reach their destinations.

Setting: Indoors

Skills: Describing, computing, connecting math with other subjects, gathering data, measuring, inferring, using maps

Materials: Nature Notebook and a pen or pencil; maps on page 130 of the *Youth Guide*, full size maps in Appendix G



How Do Waterfowl Survive the Journey?

Description: In this four-part activity, students imagine themselves on a 3,000-mile migratory journey; determine if there is a suitable place in their community to overnight along the way; identify which species might join them during the migration and stopover; explore opportunities for waterfowl stewardship activities in their community.

Setting: Indoors

Skills: Computing, connecting math with other subjects, evaluating, measuring, measuring, questioning, using maps

Materials: Nature Notebook and a pen or pencil; library or Internet access to research job and stewardship activities.

INVESTIGATE

Learning Objectives:

On completing the *Investigate* activities described below, learners will be able to:

- Observe and record seasonal changes of plants and animals
- Apply science inquiry and math skills to answer questions about waterfowl migration

Activities:**Featured Investigator, You**

Description: Students become waterfowl investigators; their first task is to think of questions about waterfowl migration that they are interested in investigating.

Setting: Indoors

Skills: Creating evaluation strategies, questioning, using maps

Materials: Nature Notebook and pencil or pen

**Meet a Waterfowl Ecologist**

Description: Students consider the work of Waterfowl Ecologist Dr. Michael Schummer on determining the possible impacts of climate change on waterfowl migration. They use Dr. Schummer's study results to practice interpreting scientific data.

Setting: Indoors

Skills: Explaining, interpreting, predicting, questioning

Materials: Nature Notebook and pencil or pen, Mallard migration data from Missouri, Table 1, page 138 of the *Youth Guide*

**What Do You Think Would Cause Mallards to Migrate?**

Description: In this activity students use a formula created by Dr. Schummer to determine if changes in weather cause Mallards to migrate.

Setting: Indoors

Skills: Analyzing data, computing, connecting math with other subjects, interpreting, predicting

Materials: Nature Notebook and pen or pencil, Table 2, Steps to calculate the Weather Severity Index (WSI), page 140 of the *Youth Guide*, and Table 3, Sample WSI calculations for three locations, page 141 of the *Youth Guide*

**Looking at the Past to Understand the Future**

Description: Students are introduced to the study of seasonal events—phenology—through the work of the famous scientists and writer, Dr. Aldo Leopold. They interpret data collected over a 70-year period by Aldo and his daughter, Nina, on Canada Goose migration in central Wisconsin.

Setting: Indoors

Skills: Analyzing data, computing, connecting math to other subjects, interpreting, predicting

Materials: Nature Notebook and pen or pencil, Table 4, Leopold goose migration data, page 143 of the *Youth Guide*, Table 5, My Julian data calculations for the Leopold data, page 144 of the *Youth Guide*, and Table 6, Sample graph for your Nature Notebook, page 145 of the *Youth Guide*.



You Too Can Be a Phenologist!

Description: Students are encouraged to record their own observations of seasonal changes and to investigate Internet resources to join their data with observations from others interested in the same topics.

Setting: Indoors

Skills: Describing, inferring, investigating, observing, predicting, recording

Materials: Nature Notebook and pen or pencil.

EXPRESS

Learning Objective:

On completing the *Express* activities described below, learners will be able to:

- Explain what they find interesting or unique about waterfowl migration and why, through their choice of language arts, visual arts, or stewardship activities

Activities:



Visit Your Favorite Bird

Description: In this two-part activity, students choose one of the species they studied in the Migration Math activity on page 130 of the *Youth Guide*. They then research the migratory route of that species, note the countries it might stop at along the route, and create artwork that reflects the different cultures and habitats of those countries.

Skills: Applying knowledge to art, connecting art to other subjects, describing, developing research skills, developing visual ideas, modeling, observing, sketching, using maps

Materials: Nature Notebook and pen, art pencils, charcoal sticks, colored pencils, paints or other art materials as requested by students, access to the Internet and/or library

Draw It Yourself



Description: Students choose one of five activities that express what they've learned in Unit 4. They choose a particular art medium to depict their favorite bird using an artistic technique or language from a different culture; write a travel journal from the perspective of a waterfowl species; collect photos or artwork that describe what might attract waterfowl to particular migratory areas; initiate regular visits to a local natural area to record phenological data.

Setting: Indoors and outdoors

Skills: Applying knowledge to art, applying knowledge to language, connecting art to other subjects, designing, developing research skills, developing visual ideas, experimenting, gathering evidence, modeling, sketching, writing

Materials: Nature Notebook, pen or pencil, art pencils, charcoal sticks, colored pencils, paints or other art materials as requested by students, access to the Internet and/or library

SHARE

Learning Objective:

On completing the *Share* activities described below, learners will be able to:

- Demonstrate new knowledge or skills gained in Unit 4 by creating a new work of art in the medium of their choice

Activities:



What Could You Share?

Description: Students choose what they would like to share about what they've learned and created during Unit 4 activities on waterfowl migration, and with whom they'd like to share this information.

Setting: Indoors

Skills: Communicating, connecting art to other subjects, describing, developing visual ideas, modeling, planning

Materials: Nature Notebook, pen or pencil



Reflection on Waterfowl Migration

Description: Students create a new work of art, using the medium of their choice, to show others what interested them most about what they learned about waterfowl migration.

Setting: Indoors

Skills: Applying knowledge to art, applying knowledge to language, connecting art to other subjects, designing, developing research skills, developing visual ideas, experimenting, gathering evidence, modeling, sketching, writing

Materials: Nature Notebook, pen or pencil



Mystery of the Labrador Duck – Evidence of Migration

Description: Students consider migration problems as a cause of extinction of the Labrador Duck. They map possible migratory routes and write their ideas about what might have gone wrong in their Nature Notebooks.

Setting: Indoors

Skills: Analyzing, communicating, describing, developing, gathering evidence, inferring, modeling, planning, predicting, visual ideas

Materials: Nature Notebook, pen or pencil, migration map from page 151 of the *Youth Guide*, access to Internet or library



PENCIL-TO-PAPER WRAP-UP

Students revisit the *geo*-bird created in the *Warm-Up* section of this unit (page 108). Encourage them to think about what they learned in Unit 4. Students should update their drawing to reflect their new knowledge about migration and its relationship to waterfowl habitat and survival.

Adaptations for Early Elementary Students

As suggested by the *NAAEE Excellence in Environmental Education: Guidelines for Learning (K–12)*, strategies for examining environmental issues with early elementary student should be simple, local, and make close links between what they’re observing and learning about the local environment.¹

Fun Zone Mallard: *Puddler Magazine* Activity, Ducks Unlimited

<http://www.greenwing.org/dueducator/ele2.htm>

Students can color or paint this Mallard and its range map to see where these ducks spend each season.

Check the *Related Resources* list on page 114 for curricula, activities, and materials that are appropriate for grades K–4.

Adaptations for High School Students

In Unit 2 activity, observe and study waterfowl—A blind to help you see (page 65), we suggested older students could investigate how the knowledge of waterfowl behavior has led to the use of different types of decoys and strategies for deploying decoys in the field to attract waterfowl for hunting, photography, or just observation. Engage students in investigating how waterfowl appearance and habitat might change during migration. How you would capture those changes in your decoy or duck blind design if you lived in different places along the migratory route?

NOTES:

¹ *Excellence in Environmental Education: Guidelines for Learning (K–12)*. 2010. North American Association for Environmental Education, www.naaee.org

UNIT 4 – RELATED RESOURCES

Activities

- *Bird Behavior Scavenger Hunt* (6–8th), Flying WILD: An Educator’s Guide to Celebrating Birds, Council for Environmental Education.
<http://www.flyingwild.org/guide.htm>
Students identify different behavior patterns of bird and explain their functions.
- *Diversity and adaptations, Lesson 5* (9–12th) Wetland Ecosystems III, Ducks Unlimited Canada.
<http://www.epa.gov/gmpo/education/pdfs/DUEducators9-12.pdf>
Students explore the diversity of structural and behavioral adaptations.
- *Ecosystem Phenology* (7–12th), Wisconsin Department of Natural Resources, *CLIMATE CHANGE: A Wisconsin Activity Guide*, Grades 7–12
<http://dnr.wi.gov/org/caer/ce/ee/educator/Climateguide/PDF/03-4245-phenology.pdf>
- *Migration Science and Mystery: A Distance Learning Adventure*
<http://migration.pwnet.org/>
 - Migration Lesson Plans <http://migration.pwnet.org/resource/archives.php#B>
 - Shorebird Profiles (6–12th), http://migration.pwnet.org/pdf/Shorebird_Profiles.pdf
By critically reading four shorebird profiles provided in this educator’s guide, students make direct comparisons among the appearance, food habits, migration routes, and mating behaviors of four shorebirds found in their area.
- *Young Naturalists*, Minnesota Conservation Volunteer, MN DNR
<http://www.dnr.state.mn.us/young-naturalists/index.html>
This website has youth activities with Educator’s Guides for the following related topics:
 - *What are portable, durable, dependable, convertible, and altogether incredible? Eggs!*
<http://www.dnr.state.mn.us/young-naturalists/eggs/index.html>
 - *What’s in a Bird Song?*
<http://www.dnr.state.mn.us/young-naturalists/birdsong/index.html>

DVD or video

America’s Duck Chaser (Web video), *Status of Waterfowl*, Flyways.us
<http://www.flyways.us/status-of-waterfowl?phpMyAdmin=31cf681b01b6663384007aa1cfa655cd>
Watch pilot biologists survey waterfowl populations.
Winged Migration (DVD), Jacques Perrin, Sony Pictures, 89 mins.

Print resources

Atlas of Bird Migration: Tracing the Great Journeys of the World’s Birds. (2007). Elphick, J. & Lovejoy, T.E. Smithsonian Institution. Firefly Books.

Web resources

Climate Change

Conservation in a Changing Climate, USFWS
<http://www.fws.gov/home/climatechange/>
This site offers basic climate change information as well as information on wildlife impacts, the USFWS response, and suggestions for related stewardship activities.

The State of the Birds 2010 Report on Climate Change, USFWS et al.

<http://www.stateofthebirds.org/>

This report calls attention to the collective efforts needed to protect nature's resources for the benefit of people and wildlife.

Global Warming and Waterfowl, National Wildlife Federation

<http://www.nwf.org/Global-Warming/Effects-on-Wildlife-and-Habitat/Birds-and-Waterfowl.aspx>

The National Wildlife Federation's predictions of the impacts of climate change on waterfowl within specific flyways are summarized here. The page includes a link to the *Waterfowler's Guide to Global Warming: Potential and Current Threats to America's Waterfowl*

Flyways

Click on Your Flyway, Migration Science and Mystery: A Distance Learning Adventure

http://migration.pwnet.org/resource/your_flyway.php

This site offers brief flyway facts.

Weekly Weather Severity Index for Mississippi Flyway Duck Migrations, Schummer, M. et al., Mississippi State University

<http://www.cfr.msstate.edu/kennedychair/weather.asp>

Find details about Mallard migration and its relationship to weather patterns at this MSU website.

Investigation and science inquiry

BirdSleuth: Investigating Evidence (6–8th), Cornell Lab of Ornithology

<http://www.birds.cornell.edu/birdsleuth/inquiry-resources/we-want-to-support-you-as-your-students-become-scientists>

This curriculum includes lesson plans, journal pages, and online resources that will help your students ask scientific questions, craft and test hypotheses, collect and organize data, draw meaningful conclusions, and publish their work.

Migration

Migration Basics for Students, National Park Service

<http://www.nps.gov/akso/ParkWise/Students/ReferenceLibrary/general/MigrationBasics.htm>

Basic facts about migration for students.

Travels of the Tundra Swan

<http://tundraswanmigration.org/main.htm>

This program allows students to follow the migration of Tundra Swans as they travel between Canada and the U.S wetlands.

U.S. Fish and Wildlife Service Migratory Bird Program

<http://www.fws.gov/migratorybirds/>

The U.S. Fish and Wildlife Service Migratory Bird Program offers a variety of program resources and information on its efforts to conserve migratory bird populations and their habitats for future generations.

Waterfowl Migration Headquarters: Follow the Ducks This Season, Duck Unlimited

<http://www.ducks.org/hunting/migration>

This site offers general migration information as well as an interactive migration map and video that allows users to track birds across the country.

Why Do Geese Fly in a V?, Everyday Mysteries, Library of Congress
<http://www.loc.gov/rr/scitech/mysteries/geese.html>

This site offers fun science facts for students about the flight pattern of geese.

Migration and Cultural Arts

Civilizaciones Mesoamericanas

http://library.thinkquest.org/C006206F/culturas_mesoamericanas.htm

See an ancient drawing of hunters, in what is now Central America, capturing shorebirds with nets. This site is in Spanish and is appropriate for high school students, particularly those studying Spanish.

Galleries and Museums

There are many sites online for art museums commercial art galleries that feature Native American artists and that post photos of their collections.

Maps of Native American Tribes in the United States

<http://www.native-languages.org/states.htm>

There are many different artistic styles used by ancient and modern-day Native American artists. Once students find some of the states that a species of interest travels through, encourage them to check this site to determine which Native American tribes inhabited that area. They can then follow the links to learn more about those specific tribes, their culture and their artwork.

Phenology

eBird

<http://ebird.org/content/ebird>

eBird is a site that allows users from all over North America to keep an electronic record of birds they've seen. Students can submit their own observations and/or view and explore data submitted by others in their community or in any part of the country. Some areas of the country do not have much data and your students might fill those gaps!

How to Observe: Nature's Notebook Plant and Animal Phenology Handbook

http://www.usanpn.org/files/shared/files/How_to_Observe_Field_Handbook_7-28-10.pdf

This guide provides step-by-step instructions for observing and recording phenology information.

National Phenology Network Educator's Clearinghouse

<http://www.usanpn.org/education/clearinghouse>

The USA National Phenology Network houses educational materials (lesson plans, activity guides, syllabuses, project design plans), to provide a convenient and growing collection of resources on phenology learning both inside and outside of K-12 classroom settings.

North American Bird Phenology Program,

<http://www.pwrc.usgs.gov/bpp/ProgramCoordinators2.cfm#>

This site describes the North American Bird Phenology Program, a part of the USA-National Phenology Network, which was a network of volunteer observers who recorded information on first arrival dates, maximum abundance, and departure dates of migratory birds across the North America between 1880 and 1970.

Signs of the Seasons: Collect and Exchange Phenology Data

<http://www.learner.org/jnorth/tm/PhenDataExchange.html>

This Journey North site offers the Phenology Data Exchange, a means of sharing phenological information about a variety of plant and animal species.



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

We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.

Aldo Leopold

Purpose

In Unit 4, students investigated waterfowl migration and explored how ecosystem change might affect migration. Unit 5 carries the theme of change further to look at historical changes in waterfowl populations brought about by human activity, the programs and people who have helped manage changes in the past and present, and the opportunities for students to help wildlife ecologists and land managers conserve waterfowl habitat tomorrow.

Students should understand that they get to choose which activities to pursue; the guide is designed to help them but not give them all the answers; and they're going to have fun!

Learning Objectives

If learners choose to complete all the activities in this section, they will be able to:

- Describe some past and present examples of human impacts on waterfowl populations or wetland habitat

Unit 5 at a Glance

Purpose: To examine the past and present human influences on waterfowl populations and habitat from a variety of perspectives.

Subjects: Geography, language arts, math, science, and visual arts.

Process skills:

- **Geography skills**
 - Using geographic tools

- **Language arts skills**
 - Applying knowledge to language
 - Communicating
 - Creating evaluation strategies
 - Developing research skills
 - Evaluating data
 - Gathering data
 - Interpreting
 - Participating in society
 - Questioning
 - Reading for perspective
 - Reflecting
 - Writing
- **Math skills**
 - Analyzing data
 - Collecting data
 - Computing
 - Connecting math with other subjects
 - Designing studies
 - Formulating questions
 - Measuring
 - Predicting
- **Science skills**
 - Analyzing
 - Describing
 - Gathering evidence
 - Interpreting
 - Investigating
 - Questioning
 - Thinking critically
- **Visual arts skills**
 - Applying knowledge to art
 - Connecting art to other subjects
 - Creating meaning through art
 - Designing
 - Developing visual ideas
 - Experimenting
 - Modeling
 - Sketching

Conservation concepts:

- All living things depend on habitat that includes adequate supplies and suitably arranged food, water, shelter, and space
- Ecosystems change over time
- Changes in environmental conditions can affect the survival of individual organisms and entire species. Species can become extinct because of habitat change or loss
- The impact of the human species has major consequences for other species
- Science-based management considers the needs of humans as well as wetlands and waterfowl
- Everyone should understand and participate in the stewardship and support of our natural resources

Vocabulary: climate, crossbreed, evidence, excise tax, extinction, fallow, feces, invasive species, Mississippi Flyway, opinion, peer review, phenology, plumage, stewardship, trends, weather

- Explain the possible impacts of climate change and oil spills on waterfowl populations
- Plan a stewardship activity that would benefit waterfowl through habitat restoration

Featured Artists

Meet Raina Huang and Lily Spang, Junior Duck Stamp Contest Winners

On pages 156 and 157 of the *Youth Guide*, students get to meet Junior Duck Stamp Contest winners Raina Huang (2010) and Lily Spang (2009). This section provides an opportunity for students to learn about their experiences and their inspirations for creating their winning designs.

Featured Scientist

Meet Kira Newcomb, Wildlife Biologist

As described on page 158 of the *Youth Guide*, Kira is trying to discover why the population of American Black Ducks is declining in western Tennessee. The following article describes her work and illustrates some of the steps scientists take to study waterfowl populations.

Winter Habitat Use and Survival of Female American Black Ducks in Western Tennessee

The American Black Duck has declined in much of its range since the 1950s, and loss of wintering habitat may be one important factor contributing to population decreases. Although Black Ducks wintering along the Atlantic coast have been studied, less is known about Black Ducks wintering in interior regions of the Mississippi Flyway, such as in western Tennessee. Information about interior Black Ducks is important primarily because of differences between coastal and interior palustrine wetland habitats where the ducks winter (Palustrine wetlands include all nontidal wetlands dominated by trees, shrubs, persistent emergent plants, or emergent mosses or lichens, as well as small, shallow, open-water ponds or potholes. Palustrine wetlands are often called swamps, marshes, potholes, bogs, or fens. Source: http://www.conservapedia.com/Palustrine_Wetland).

Tennessee and Cross Creeks National Wildlife Refuges (NWRs) and surrounding public and private lands provide wintering habitat for most Black Ducks present in Tennessee and about half of the Black Ducks wintering in the Mississippi Flyway. Despite significant presence of Black Ducks in western Tennessee, habitat use and survival of the ducks is not well known. Furthermore, there is a need to understand how the co-occurrence of Mallards, which occupy the same areas and can hybridize with Black Ducks, may affect Black Duck habitat use and survival in the Mississippi Flyway. Key questions include whether or not Black Ducks avoid agricultural habitats often used by Mallards, whether Black Ducks seek critical habitat not provided by the NWRs on surrounding lands, and what composition and distribution of habitats enhances survival of Black Ducks. This information is vital for guiding management strategies at the NWRs and conservation planning by the Black Duck Joint Venture and other agencies.

Mississippi State University, the University of Tennessee-Knoxville, and the U.S. Fish and Wildlife Service (USFWS) teamed together to study Black Duck winter ecology during winters 2010-2011 and 2011-2012. The study on the Duck River Unit of the Tennessee National Wildlife Refuge was initiated in November 2010. As the Black Ducks arrived, researchers trapped, banded, and attached radio transmitters to approximately 100 females. Radio-marked ducks were followed daily by vehicle and semiweekly by airplane to record movements, habitat use, and estimate survival of these birds in

important habitats in western Tennessee. This information will be critical for better understanding habitat management needs at these interior NWRs. The results will provide USFWS with the opportunity to make science-based habitat management decisions that will help sustain Black Ducks wintering at Tennessee National Wildlife Refuge.

Unit 5. Activities Preparation Tips

Background information

WATERFOWL MIGRATION ... AND COLLABORATIVE MANAGEMENT

U.S. Fish and Wildlife Service Joint Venture

In the mid 1980s, waterfowl populations were in crisis. A 10-year-long drought and the draining of wetlands for agricultural and other uses were taking their toll on the birds' habitats and subsequently on them. Because waterfowl were then (and are now) North America's most prominent and economically important group of migratory birds, the U.S. and Canadian governments took action. Scientists, from inside and outside the government, were asked to identify "waterfowl habitat areas of major concern" across the continent and to develop a conservation plan. The *North American Waterfowl Management Plan* was signed by the U.S. Secretary of the Interior and the Canadian Minister of the Environment in 1986.

The scope of the conservation effort needed left no room for doubt: acting alone, the two federal governments did not have the resources needed to save these vital habitats. It was from this dilemma that the concept of conservation joint ventures was born: private- and public-sector partners working together to conserve the continent's waterfowl populations and their essential habitats.

Conservationists concerned about other migratory bird groups—landbirds, shorebirds, colonial waterbirds—saw the success of the Plan model and adopted it as they developed conservation strategies for their species of concern. Rather than reinvent the wheel, they looked to the Plan's joint ventures to help implement their plans. Within their established geographic areas, the Plan's habitat joint ventures, when possible, have integrated the conservation of shorebirds, landbirds, and other waterbirds into their planning processes.

But "white spaces" remained on the map of North America—areas of habitat needing conservation attention where Plan joint ventures did not exist. New joint ventures, not associated with the Plan, have formed. To ensure a logical and coordinated approach to the development and support of these new joint ventures, the U.S. Fish and Wildlife Service issued Director's Order No. 146 to define Joint Venture.

What is a Joint Venture?

A Joint Venture (JV) is a self-directed partnership of agencies, organizations, corporations, tribes, or individuals that has formally accepted the responsibility of implementing national or international bird conservation plans within a specific geographic area or for a specific taxonomic group, and has received general acceptance in the bird conservation community for such responsibility.

What do Joint Ventures do?

Working both collectively and independently, JV partners conduct activities in support of bird conservation goals cooperatively developed by the partnership. These activities include:

- biological planning, conservation design, and prioritization,
- project development and implementation,
- monitoring, evaluation, and applied research activities,
- communications and outreach, and
- fundraising for projects and activities.

Wetland and Waterfowl Management Collaboration¹

One of the first things waterfowl managers learned from their early waterfowl banding efforts was that waterfowl follow distinct, traditional migration corridors or flyways in their annual travels between breeding and wintering areas. Since 1948, waterfowl have been managed by four administrative flyways that are based on those migration paths: the Atlantic, Mississippi, Central, and Pacific Flyways. Each flyway has a flyway council which is a formal organization composed of one member from each State and Province in that flyway. Recently, Mexico has also provided representation at Pacific and Central Flyway meetings and discussions.

Each of the flyways also has a technical committee composed of waterfowl biologists from the states and provinces in the flyway. The technical committees meet several times annually to review the biological data from monitoring programs and provide recommendations to their respective flyway councils. Recommendations that are adopted by the flyway councils are presented to the U.S. Fish and Wildlife Service's Regulations Committee for consideration in the setting of waterfowl hunting regulations and management programs.

The flyway councils and technical committees are involved in many aspects of migratory game bird management, including development of recommendations for hunting regulations and assisting in research and habitat management activities. Some of the important waterfowl hunting regulations that are set each year, including season length and daily bag limits, are specific to these individual flyways. Carefully regulated hunting is an important tool in the management of waterfowl populations.

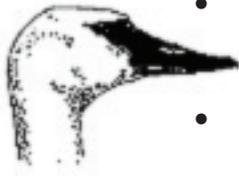
See General Flyways Info, <http://www.flyways.us/flyways/info>, for information on each of the four administrative flyways.

¹ Adapted from General Flyways Info, <http://www.flyways.us/info>

Swans

Swans belong to the same family of birds as geese and ducks, Anatidae, and there are three different species found in the U.S.: Trumpeter, Mute, and Tundra. A swan gliding across the water may be a beautiful sight. Not all swans, however, are native to the U.S.

Trumpeter Swans (*Cygnus buccinator*) are the largest waterfowl in North America and the largest swan in the world. They are native to the U.S., but their populations declined during the 19th century when they were hunted for their meat and feathers. By 1930, fewer than 100 Trumpeter Swans remained in the U.S.



Identification Tips:

- Length: 45 inches
Wingspan: 95 inches
- Large, long-necked waterbird with short legs and a short, duck-like bill
- Long neck held straight up with a kink at base

Adult:

- Black bill
- Black of bill extends up to eye but does not encircle it
- V-shaped demarcation on forehead between black bill and white feathering
- Black legs and feet
- Entirely white plumage
- Sexes similar

Diet:

- Almost Exclusively:
 - Green Plant Matter
 - Seeds
- Lesser Quantities of:
 - Aquatic Invertebrates

Mute Swans (*Cygnus olor*) is an indigenous species to Europe and parts of Asia and was introduced into North America as a decorative waterfowl for parks, zoos, and private estates during the later 1870s. However, by the early 1900s, a small number of birds escaped into the wild in New Jersey and New York.



Identification Tips:

- Length: 40 inches
- Large, long-necked waterbird with short legs and a short duck-like bill
- Long neck held in distinctive “S” curve at rest

Adult:

- Orange bill with black base, lores and knob above bill
- Black legs and feet
- Entirely white plumage
- Fluffy back feathers
- Female has smaller bill knob
- Sexes similar

Diet:

- Almost Exclusively:
 - Plant Matter
- Lesser Quantities of:
 - Aquatic Invertebrates

Tundra Swans (*Cygnus columbianus*) were formerly known as whistling swans. They are smaller than the Trumpeter and Mute Swans and breed in the far northern regions of North America.



Identification Tips:

- Length: 36 inches
Wingspan: 85 inches
- Large, long-necked waterbird with short legs and a short, duck-like bill
- Long neck held straight up with a kink at base

Adult:

- Black bill with variably-sized yellow spot at base
- Black of bill extends up to eye but does not encircle it
- Straight demarcation on forehead between black bill and white feathering
- Black legs and feet
- Entirely white plumage
- Sexes similar

Diet:

- Almost Exclusively:
 - Green Plant Matter
 - Seeds
- Lesser Quantities of:
 - Aquatic Invertebrates

(Swan illustrations courtesy of Wisconsin Department of Natural Resources)

NOTES:

Purple Loosestrife¹

Purple loosestrife, the beautiful purple plant found in many wetlands and moist soil areas, is an exotic species of Eurasian origin and a threat to the viability of North American wetland habitats. In Europe and Asia, purple loosestrife is a minor component of wetland habitats and not the dominant species it tends to be in North American wetlands. The major difference involves the lack of the plant's natural enemies. Natural enemies did not accompany purple loosestrife when it arrived in North America during the early 1800s. This, along with the plant's ability to grow in a variety of soil types and in various depths of water, has given purple loosestrife a competitive edge over North America's native wetland plants.

Purple loosestrife typically infests areas where native wetland plant communities have been disturbed. This includes man-made disturbances such as digging or moving wetland soils with tractors and bulldozers, as well as natural disturbances like droughts and floods. Purple loosestrife spreads primarily by seed germination in moist soil areas. A typical 3-year-old plant can produce in excess of one million seeds.

The impact of this weed on North American wetlands has been disastrous. Native wetland plants have been crowded out by purple loosestrife. This in turn causes a reduction in suitable habitat for wildlife, particularly waterfowl and waterbirds, and reduced productivity for those species which depend on aquatic ecosystems.

Impact of Purple Loosestrife on Waterfowl²

The Canvasback (*Aythya valisineria*) has never recovered from the low levels of the great "duck depression" brought on by the disastrous drought of the early 1930s. The species has been nearly simultaneously beset with loss of nesting habitat in the Prairie Pothole Region and a gradual decline in the quality of its restricted wintering grounds (Trauger, 1974). Its preference for platform nests built over water in cattail, *Typha latifolia*, or hard-stem bulrush, *Scirpus acutus* (Stoudt, 1982) makes it vulnerable to encroachment by purple loosestrife. Fortunately, *L. salicaria* seems to be slow in colonizing the Prairie Pothole Region. A plant was collected at Neepawa in 1896 (Stuckey, 1980), but the species did not begin to spread into Manitoba wetlands until after 1950. It may prove to be less vigorous than native plants in competing for space under the harsh and widely fluctuating climatic patterns of the northern prairies. The relative isolation of prairie pothole sloughs also makes spread by waterborne propagules a slow process. Nevertheless, it invaded Delta Marsh in 1955 and has required vigorous local control in disturbed areas along the marsh edge (H. Hochbaum, personal communication; Friesen, 1966). With drawdown or drought, *L. salicaria* could threaten the deep-water nesting areas of the canvasback at Delta.

¹ From *Purple Loosestrife*, Montezuma National Wildlife Refuge, U.S. FWS, <http://www.fws.gov/r5mnwr/mnwrls.html>

² Adapted from *Impact of Lythrum salicaria on Wetland Habitats and Wildlife, Spread, Impact, and Control of Purple Loosestrife (Lythrum salicaria) in North American Wetlands*, Northern Prairie Wildlife Research Center, USGS: <http://www.npwrc.usgs.gov/resource/plants/loosstrf/impact.htm>

Saving Great Lakes Wetlands: Today, vital habitat in this waterfowl-rich region faces a host of threats, Tina Yerkes, Ducks Unlimited¹

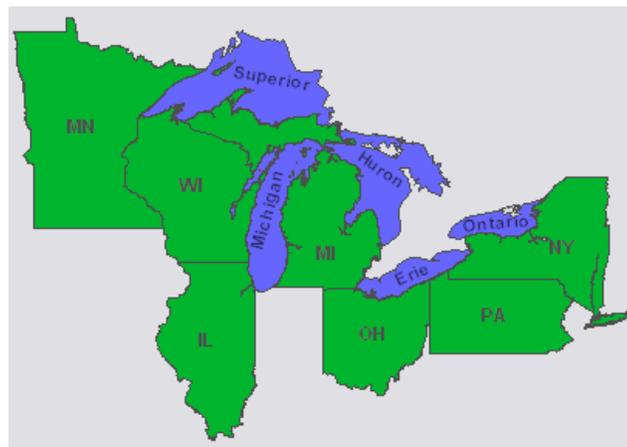
The Great Lakes contain 20% of the world’s fresh water, sustain an economy for 30 million people, and support millions of waterfowl throughout their annual cycle. This massive watershed drains 201,000 square miles and has over 10,000 miles of shoreline, which is more than the Atlantic and Pacific coasts combined.

The Great Lakes in North America are important for drinking water, sport and commercial fishing, waterfowl hunting, and other recreational activities. Some of the oldest hunting clubs in the U.S. and Canada are found along the shores of the Great Lakes, where waterfowlers still pursue Mallards, Black Ducks, Canvasbacks, and Lesser Scaup.

Conserving the region’s waterfowl habitat is wrought with challenges, including invasive species, expanding human populations, continued loss and degradation of habitat, and the effects of climate change. Nonnative species, such as the Zebra Mussel and purple loosestrife, are disrupting food webs and causing billions of dollars in damage to infrastructure and fisheries.

Birds that eat Zebra Mussels, which are filter feeders, ingest heavy metals and other toxins. Phragmites (common reed) and purple loosestrife displace native plants that provide nesting cover and food for waterfowl and other wetland species. Biologists have documented at least 185 invasive species in the Great Lakes system, and a new one is introduced every month.

The Great Lakes watershed has lost 62% of its original wetlands, and some parts of this region have lost more than 90% of these habitats. Such extensive losses have created a highly fragmented landscape. Unfortunately, the most critical challenge for Great Lakes waterfowl is the continued destruction and degradation of habitat, including the coastal and inland wetlands and river corridors the birds depend on. Habitat loss in the region results from a combination of urban expansion and changing agricultural practices. Despite laws and regulations intended to protect wetlands, the Great Lakes watershed continues to experience losses of small, seasonally flooded wetlands, which are critically important for waterfowl.



The Great Lakes and adjoining states.

Image courtesy of the National Oceanic and Atmospheric Administration

¹ Adapted from: <http://www.ducks.org/conservation/where-we-work/us-great-lakes-system/saving-great-lakes-wetlands>

Urban Waterfowl

The fact that people, concerned about the health and well-being of waterfowl, shouldn't feed birds might surprise students. The following article illustrates why we should...

Stop Feeding Waterfowl¹

Some people enjoy feeding waterfowl. They visit lakes, ponds, and town parks to toss bread, corn, popcorn, or table scraps to the ducks and geese that congregate in these places. Some people say that it makes them feel good to help the ducks ... that it brings the ducks closer for their kids to see ... that it's an escape from the daily grind.

Is it good to feed waterfowl? No, artificial feeding is actually harmful to waterfowl.

Artificial feeding of waterfowl can cause:

- Poor nutrition
- Increased hybridization
- Water pollution
- Delayed migration
- Concentrations at unnatural sites
- Overcrowding
- Spread of disease
- Costly management efforts
- Unnatural behavior
- Cumulative effects
- Devaluation of the species

Read on to explore this issue and decide for yourself whether you want to continue feeding waterfowl.

Nutrition

It would seem that providing food for ducks and geese would make them healthier. However, this is not the case. Waterfowl at artificial feeding sites are often found to suffer from poor nutrition. In natural settings, waterfowl seek and feed on a variety of nutritious foods such as aquatic plants, natural grains, and invertebrates. Many of the items commonly used to feed waterfowl (bread, corn, popcorn, etc.) are low in protein and are very poor substitutes for natural foods.

Natural foods are also widely scattered. Ducks and geese are able to find these foods and eat them in relative seclusion. At artificial feeding sites, competition for each scrap or kernel is high. Some ducks and geese (usually the youngest) are unable to compete for handouts.

.....
¹ Adapted from *Stop Feeding Wildlife*, New York State Department of Environmental Conservation. <http://www.dec.ny.gov/animals/7001.htm>.

Visible symptoms of poor nutrition and advanced stages of starvation are often seen at artificial feeding sites. For example, waterfowl may have drooping wings or may lose their ability to fly.

Disease

When ducks and geese feed on scattered corn or bread, they eat in the same place where they defecate. This is not healthy. In addition, large concentrations of waterfowl can facilitate the spread of disease. Also not healthy. Diseases generally not transmissible in a wild setting find overcrowded and unsanitary conditions very favorable.

Most waterfowl die-offs in the past ten years have involved artificial feeding:

- 2,000 Mallards and Black Ducks were killed in an outbreak of Duck Virus Enteritis in Central New York.
- Another fatal disease, *Aspergillus*, occurs when food is scattered too liberally, it piles up, and becomes moldy
- In Cheektowaga, New York, hundreds of ducks were killed in an outbreak of Avian Botulism at a feeding site. A local ordinance was later passed to prohibit the feeding of waterfowl. An added bonus ... rat populations that fed well on waterfowl handouts have since declined

In some cases, humans have been affected by disease transmitted by waterfowl. In Skaneateles, New York, swimmers contracted Swimmer's Itch, caused by a parasite that was emitted from ducks attracted to artificial feeding at the town park.

Overcrowding

Feeding attracts birds in unnatural numbers, beyond natural food and water supplies, and frequently in numbers beyond what people will tolerate. Over-grazed and badly-eroded lawns, golf courses, and school playing fields are often the result of overcrowding. Grassy areas such as ball fields and golf courses can become unsanitary and unusable. In Dutchess County, New York, recreational areas were forced to close down until goose droppings could be cleaned up.

Delayed Migration

Feeding alters normal migration patterns of waterfowl by shortening or even eliminating them. Ducks, reluctant to leave in the winter, may not survive sudden cold. If the artificial feeding is stopped in time, ducks and geese can quickly adapt to finding natural foods and will follow their companions south. In West Haven, Connecticut, 30 swans died from starvation at an artificial feeding site during the harsh winter of '93-'94. Meanwhile, over 800 swans survived nearby on natural food.

Unnatural Sites

Artificial feeding often attracts birds to human habitats—parking lots, fast-food restaurants, and retention ponds—where they are more subject to accidental death. Natural cover, which can provide protection from bad weather and predators (even dogs and cats), is often lacking at these feeding sites.

Unnatural Behavior

Waterfowl can rapidly become conditioned to, and dependent on, handouts. Fed ducks and geese behave differently. They become more aggressive and eventually lose their wariness of humans. Some will not survive because they can't compete. Many will lose the quality which endears them to most people, their wildness.

Increased Hybridization

At many feeding sites, domestic ducks have interbred with Mallards, further compromising the wild population.

Water Pollution

Excess nutrients in ponds caused by unnatural numbers of waterfowl droppings can result in water-quality problems such as summer algal blooms. And where waterfowl congregate to feed, bacterial counts from feces can swell to levels that make the water unsuitable for swimming.

Costly Management Efforts

Many damage-avoidance techniques such as chemical repellents, fencing, or noise makers are costly and may even be useless once animals lose their fear of humans. At times, it is necessary to destroy nuisance waterfowl because of the damage they cause.

Devaluation

From treasure to nuisance... wildlife managers recognize that the public's perception of the value of wildlife is often reduced when numbers swell. When any wildlife population exceeds the number that can be naturally supported by available habitat, this can polarize the public and exaggerate conflicts between landowners who suffer damage and those who visit the site to feed the geese and ducks.

Cumulative Effects

It may be hard to imagine that a handful of bread or a stray french fry could contribute to such a growing problem. Compound that, though. In most cases where artificial feeding occurs, one well-intentioned feeder leaves and another soon arrives.

People Love Waterfowl

- A birdwatcher searches wetlands for hidden sightings and travels cross-country to see different species
- A farmer pauses from his chores to gaze skyward and take in the sights and sounds of a "V" of geese
- A hunter pats the head of his trusted hunting dog for quickly returning a bird to the blind
- Parents take their children to see ducks at the town park or wildlife refuge

Yes, people love waterfowl and care about their well-being! Please consider the effects of feeding waterfowl, and do what's right.

Each person that cares enough to become educated about the effects of artificial feeding can make a difference. This problem requires cooperation from everyone, but the solution starts with each individual. One person may choose to discontinue feeding. Another person may decide to put up a sign to discourage others from feeding.

Alternatives

If everyone stops feeding waterfowl, the waterfowl won't disappear. Families can still visit sites to enjoy viewing ducks and geese. A child can still be encouraged to learn more about waterfowl and their natural habits. And some zoos offer feeding of captive waterfowl.

Clearly, you do not need to feed waterfowl in order to enjoy them. In fact, it should be apparent now that the best thing you can do for the overall benefit of waterfowl is to stop artificial feeding.

Waterfowl Population Surveys—How do scientists count waterfowl populations? As illustrated in the article below, with the help of hunters and other citizens who voluntarily monitor birds. See the *Related Resources* section on page 127 for more information on monitoring techniques.

Harvest Diary Surveys¹

National harvest surveys of sport hunters have been conducted annually since 1952 in the U.S. and since 1967 in Canada. Although these surveys have undergone some changes since their inception, they are conducted by mail and consist of asking selected waterfowl hunters to report the number of ducks and geese they harvested during the hunting season. These surveys provide annual information that allows biologists to evaluate long-term trends in harvest, hunter numbers, and hunting pressure.

Typically in the late summer of each year, the U.S. Fish and Wildlife Service (USFWS) releases a summary of hunter activity and harvest from the previous year.

The most recent summary report at the time of publishing was from 2009. More than 13.1 million ducks were harvested in the U.S. during the 2009–2010 waterfowl hunting season, according to these preliminary estimates. This is down from 13.6 million ducks harvested the previous season.

United States

Currently in the U.S., the *Cooperative State-Federal Migratory Bird Harvest Information Program* (HIP) is the program the U.S. Fish and Wildlife Service and the states use to produce reliable estimates of all migratory bird harvest across the country. In a nutshell, here's how the program works: The state agencies collect the name and address of every migratory bird hunter who purchases a hunting license, and they send that information to the U.S. Fish and Wildlife Service. The U.S. Fish and Wildlife Service selects a random sample of hunters in each state, and mails them a diary survey form. Finally, the U.S. Fish and Wildlife Service uses the hunters' responses on the survey forms to estimate harvest and hunter activity at the state, flyway, and national levels.

¹ From Flyways.US, <http://flyways.us/surveys-and-monitoring/hunter-surveys/harvest-diary-surveys>

States have the most difficult job—identifying all of the migratory bird hunters in their state. Most states use their licensing systems to identify migratory bird hunters and to collect hunter name and address. Once identified, hunters are asked a series of standard “screening” questions about the species they hunted and their hunting success the previous year. Contrary to popular belief, hunters’ answers to these questions are not used to compile harvest estimates, but simply to identify what types of migratory birds they usually hunt. This allows the U.S. Fish and Wildlife Service to mail surveys to the appropriate types of hunters. HIP certification is mandatory for all migratory bird hunters in every state in which they hunt.

The U.S. Fish and Wildlife Service receives name, address, and screening question information from about 3,500,000 migratory bird hunters each year. The U.S. Fish and Wildlife Service selects a random sample of hunters from this list and mails them a hunting diary form and asks each hunter to record the date, location and number of ducks and geese taken for each day of waterfowl hunting. Survey forms are usually mailed out at the beginning of the hunting season or shortly after the U.S. Fish and Wildlife Service receives the selected hunters’ names and address information from the states.

After the end of the hunting season, the U.S. Fish and Wildlife Service sends reminder letters and replacement survey forms to the sampled hunters (if necessary), and asks them to complete and mail back their hunting diaries. About 70,000 waterfowl hunters are selected annually for this survey. Responses from hunters who choose to participate are kept strictly confidential. Participation is voluntary, and on average, the response rate is about 60%. In addition to the HIP waterfowl survey, the U.S. Fish and Wildlife Service also conducts four other harvest surveys, including: 1) Doves and Band-tailed Pigeons, 2) Woodcock, 3) Snipe, Coots, Rails and Gallinules, and 4) Sandhill Cranes.

Hunters’ survey responses are analyzed using standard statistical techniques and are used to estimate the total harvest of ducks and geese, the number of active hunters, the total days hunters spend afield, and the average seasonal bag per active hunter.



PENCIL-TO-PAPER WARM-UP

Description: Students add a new layer to their *geo*-bird drawing, which describes how the influences of humans might alter the habitat of their *geo*-bird. They compare their new sketch with their *geo*-bird drawings from Unit 4 and share their ideas with classmates.

Setting: Indoors

Skills: Connecting art to other subjects, describing, developing visual ideas, explaining, sketching

Preparation: Students, particular younger students, may need to see photos, diagrams or videos depicting waterfowl/human interactions before initiating this activity. Search the Internet for urban waterfowl, hunters, or waterfowl in agricultural fields, and find resources in the Unit 5 *Related Resources* list, page 137.

Unit 5 *Explore* and *Investigate* activities have been grouped according to the following four themes: Urban Waterfowl; Species in Decline; Climate Change; and Habitat Gain and Habitat Loss.

Theme: Urban Waterfowl**Learning Objective:**

On completing the *Explore* and *Investigate* activities described below, learners will be able to:

- Describe the challenges of managing urban waterfowl

EXPLORE**Urban Waterfowl – Make Way for Ducklings and Goslings!**

Description: Students watch a video of Sebastian the goose talking about how great it is living on lake-side lawns. They are asked to speculate about the pros and cons of having geese in urban areas and about solutions to discouraging unwanted geese.

Setting: Indoors

Skills: Describing, inferring, comparing, analyzing

Materials: Nature Notebook and a pen or pencil, access to YouTube

INVESTIGATE**Urban Waterfowl**

Description: Students apply skills learned in Units 1– 4 to formulate questions and hypotheses about urban waterfowl issues, particularly those caused by geese and Mallards.

Setting: Indoors

Skills: Describing, reading for perspective, questioning, thinking critically

Materials: Nature Notebook and pencil or pen, and worksheet on page 167 of *Youth Guide*

Theme: Species in Decline**Learning Objective:**

On completing the *Explore* activities described below, learners will be able to:

- Interpret simple data to predict waterfowl population changes

EXPLORE**Species in Decline: Scaup, Pintail, and Common Eider**

Description: Students read about the characteristics of three waterfowl species. They're given three problems and three possible solutions relating to waterfowl decline. In a small group, they match one problem and one solution to each of the three species.

Setting: Indoors

Skills: Describing, developing research capabilities, gathering evidence, identifying, recording

Materials: Nature Notebook and pen or pencil

INVESTIGATE

**Species in Decline: The Ups and Downs of Duck Populations**

Description: Students consider data on declining duck species, use Internet or library resources to gather data about the species, and then speculate why the species are in trouble. Pintail, Mottled Duck, Black Duck, and Tree Duck populations have decreased, as well as Steller's and Spectacled Eider Ducks (these last two are closely related to the Labrador Duck and thus may provide some clues to its extinction).

Setting: Indoors

Skills: Analyzing, describing, evaluating, interpreting data

Materials: Nature Notebook and a pen or pencil; access to a library or the Internet to find resources on declining species, and graphs of duck population data and data worksheet from pages 178–180 of the *Youth Guide*

Theme: Climate Change**Learning Objective:**

On completing the *Explore* activities described below, learners will be able to:

- Distinguish between fact and opinion as they consider climate change data and waterfowl conservation issues

EXPLORE

**How Do You Know What to Think about Climate Change?**

Description: In this four-part activity on climate change, the focus is on gathering evidence to distinguish between fact and opinion. Students may choose to: consider climate change in general and the importance of gathering evidence; analyze media reports, collect their own data, explore the variables related to climate change studies; and/or investigate climate information for their own state.

Setting: Indoors

Skills: Applying knowledge to language, communicating, describing, evaluating data, gathering evidence, measuring, questioning, thinking critically

Materials: Nature Notebook and a pen or pencil; library or Internet access for climate change research, the worksheet and sample graphs for your Nature Notebook on page 184, of the *Youth Guide*

INVESTIGATE

**Using Data to Learn about Climate Change**

Description: Students examine data from the Wisconsin State Climatology Office and their own state's office of climatology to look for trends, hottest and coldest years, and other records of interest.

Setting: Indoors

Skills: Describing, evaluating data, gathering evidence, measuring, questioning, thinking critically

Preparation: Investigate sources of climatology information from state agencies in your state.

Materials: Nature Notebook and a pen or pencil; the diagram of Wisconsin Statewide Average Annual Temperature on page 185 of the *Youth Guide*

Theme: Habitat Gain and Habitat Loss**Learning Objectives:**

On completing the *Explore* and *Investigate* activities described below, learners will be able to:

- Develop a question and hypothesis related to the human influences on waterfowl populations
- Identify at least one local, invasive species
- Explain the basic impacts of oil spills on waterfowl populations

EXPLORE

**Habitat Gain and Habitat Loss**

Description: Students consider issues that often arise concerning community development and wetland conservation.

Setting: Indoors

Skills: Evaluating, interpreting, questioning, reflecting, thinking critically

Materials: Nature Notebook and pencil or pen

**Invasive Species**

Description: Students can choose from two activities on invasive species. One activity focuses on the invasive purple loosestrife and its effects on waterfowl. The other, encourages students to get involved in a stewardship project that uses GPS technology to manage invasive species.

Skills: Analyzing data, communicating, developing research skills, gathering data, questioning, using geographic tools

Materials: Nature Notebook and pen or pencil, access to the Internet and/or library

**Oil Spills**

Description: Ecosystem change is a natural process and, as with flooding, can be beneficial to wetland habitats and wildlife. Large-scale human-caused ecosystem change, like an oil spill, is often catastrophic for wildlife. In this activity students consider information about two, U.S. oil spills and their effects on waterfowl populations over time.

Setting: Indoors

Skills: Describing, gathering evidence, questioning

Materials: Nature Notebook and a pen or pencil

**Access to History**

Description: Students research local media archives to learn about waterfowl and human interactions, and about waterfowl conservation needs in their own community.

Setting: Indoors

Skills: Describing, developing research skills, gathering evidence, questioning, reading for perspective

Materials: Nature Notebook and a pen or pencil; library or Internet access media research (local and national newspaper archives, magazine archives, local TV archives)

INVESTIGATE**Oil Spill in the Gulf: People Making a Difference**

Description: Students read four stories about real people who responded to the Gulf Deep Horizon oil spill. They then try to identify the conservation goal that person was trying to meet and the skills that they brought to the task. This activity highlights positive actions that people were able to take to help make a difference during the Gulf oil spill. Look up Olivia Bouler/Audubon as an example of kids taking action and making a difference. Challenge students to brainstorm ways they could take action and make a difference to prevent oil-related disasters.

Setting: Indoors

Skills: Communicating, describing, participating in society

Materials: Nature Notebook and pen or pencil

EXPRESS**Learning Objectives:**

On completing the *Express* activities described below, learners will be able to:

- Describe in writing the decline of a local waterfowl species
- Plan a stewardship activity related to wetland restoration

**Write**

Description: Students write a mystery story about a waterfowl species that is in decline, using real facts about that species and its habitat needs.

Setting: Indoors

Skills: Communicating, connecting language to other subjects, developing research skills, describing, interpreting, observing

Materials: Nature Notebook and pen

**Draw**

Description: Students learn about writer, cartoonist, and conservationist “Ding” Darling and then draw their own cartoons mimicking his style and techniques.

Setting: Indoors

Skills: Applying knowledge to art, connecting art to other subjects, developing visual ideas, experimenting, sketching.

Materials: Nature Notebook, pen or pencil

**Restore**

Description: Students find resources to help them plan a wetland or waterfowl conservation activity.

Setting: Indoors

Skills: Participating in society

Materials: Nature Notebook, pen or pencil, art pencils, charcoal sticks, colored pencils, paints or other art materials as requested by students

SHARE**Learning Objectives**

On completing the *Share* activities described below, learners will be able to:

- Communicate, within their school community, their newly acquired knowledge and skills related to wetlands and waterfowl

**An Art Contest of Your Own:**

Description: In this two-part activity, students work with the school librarian and/or the community librarian to collect waterfowl-related materials that could help them illustrate what they found most interesting about the interactions of people and waterfowl. Next, students plan a waterfowl art contest for their school containing works that depict the relationships and interactions of people and waterfowl in their community. If your school does not already host a Junior Duck Stamp art competition, work with your students to set one up.

Setting: Indoors

Skills: Communicating, connecting art to other subjects, describing, developing visual ideas, participating in society, working independently and collaboratively

Materials: Nature Notebook, pen or pencil



Mystery of the Labrador Duck – Evidence about Interaction with People

Description: Students add another piece of evidence (human influences) to their Labrador Duck mystery notes to try to solve the mystery of this species' extinction. They then review their Labrador Duck clues from each unit and choose one that seems the most likely to them.

Setting: Indoors

Skills: Communicating, describing

Materials: Nature Notebook, pen or pencil



PENCIL-TO-PAPER WRAP-UP

Students revisit the *geo*-bird created in the *Warm-Up* section of this unit (page 159 in the *Youth Guide*). Encourage them to think about what they learned in Unit 5. Students should update their drawing to reflect their new knowledge about the relationships between human influences and waterfowl habitat and survival.

Adaptations for Early Elementary Students

As suggested by the *NAAEE Excellence in Environmental Education: Guidelines for Learning (K–12)*, strategies for examining environmental issues with early elementary student should be simple, local, and make close links between what they're observing and learning about the local environment.¹

ACTION – *Helping Wetland Habitats* is a K–12, *Wonders of Wetlands*² activity that provides directions for improving a wetland site.

URBAN WATERFOWL – **Are Waterfowl in Your Community a Nuisance or Welcomed Species?**

What problems do waterfowl cause in cities? They have to eat, drink, defecate, sleep, nest, raise young, and fly as part of their normal routines. What problems might these activities cause for people? What benefits are there from having waterfowl living within our cities?

Make copies of the article, “Stop Feeding Waterfowl” (page 125) for each student. Students should read the article.

¹ *Excellence in Environmental Education: Guidelines for Learning (K–12)*. 2010. North American Association for Environmental Education, www.naaee.org

² *Wonders of Wetlands*, Environmental Concerns, http://www.Wetland.Org/publications_home.htm

Have students make a chart, like the one below, in their Nature Notebook:

Are Waterfowl in Your Community a Nuisance or Welcomed Species?		
Waterfowl activities	Problems for people	Benefits for People
Example: Raising young	Cross roadways Become aggressive to protect young	Fun and interesting to watch

Then ask them to fill in at least one activity, problem, and benefit in each box. When they have completed their work, have a group discussion about whether they think the benefits of having urban waterfowl outweigh the problems they create.

Check the *Related Resources* list on page 127 for curricula, activities, and materials that are appropriate for grades K–4.

Adaptations for High School Students

Thinking about U.S. Fish and Wildlife Service Careers

Throughout the curriculum we highlighted the interesting roles that scientists and non-scientists take on to help conserve wetlands and waterfowl. This additional activity emphasizes the variety of roles available through the U.S. Fish and Wildlife Service to help in their wetland management efforts.

1. Download copies of the fact sheet, *Careers: Conserving the Nature of America* from the U.S. Fish and Wildlife Service website: <http://www.fws.gov/humancapital/factsheetpdfs/2FWS%20Careers%20hc%20A%208.pdf>
Each student will need a copy.
2. Ask students to brainstorm what skills they might bring to a wetland or waterfowl conservation effort. Have them write their ideas in their Nature Notebook.
3. Pass the fact sheet out to each student.
4. First ask the students to circle the career possibilities they would like to pursue, if any. Then ask them to put a star next to the career titles that match the skills they wrote in their Nature Notebook.
5. Hold a classroom discussion about how many students had circled and starred any of the same career titles. Brainstorm ideas about what students would need to do to develop the skills needed for the careers they circled. Ask a natural resource professional to participate in this discussion if possible so s/he can elaborate on job descriptions as needed.

Science and Civics: Sustaining Wildlife, Project WILD Curriculum for Grades 9–12 **(www.projectwild.org/scienceandcivics.htm)**

This curriculum contains activities related to wildlife and human interactions that could be adapted for waterfowl conservation, such as:

- ***Limits to Living Here:*** *Students will interpret a graph of changes in an animal population over time, hypothesize relationships in the ecosystem, and predict population distributions.*
- ***How to Evaluate Habitats:*** *Students will map and survey a school or community area to compile a full description of site conditions and populations, to assess the biotic and abiotic features, to research the needs of animals native to the site, and to rate the ability of the habitat to meet those needs.*

It also includes a section that provides guidelines for stewardship activities called *Taking Action*.

Check the *Related Resources* list below for curricula, activities, and materials that are appropriate for grades 9–12.

UNIT 5 – RELATED RESOURCES

Activities

Ecosystem Phenology (7–12th), Wisconsin Department of Natural Resources, *CLIMATE CHANGE: A Wisconsin Activity Guide, Grades 7–12th*

<http://dnr.wi.gov/org/caer/ce/eeek/educator/Climateguide/PDF/03-4245-phenology.pdf>

DVD or Video

America's Duck Chaser (Web video), *Status of Waterfowl*, Flyways.us

<http://www.flyways.us/status-of-waterfowl?phpMyAdmin=31cf681b01b6663384007aa1cfa655cd>

Watch pilot biologists survey waterfowl populations.

Sebastian the Goose Encourages Natural Shoreline (Web-video), University of WI-Madison, Life Sciences Communications

<http://www.youtube.com/watch?v=ZkJF6x48fwU>

Ever wonder why geese seem to gather on your favorite picnic spot, lake front shoreline, or backyard? It's explained in this one-on-one interview with Sebastian, the freeloading fowl.

Winged Migration (DVD), Jacques Perrin, Sony Pictures, 89 mins.

This movie offers a birds-eye view of the world's bird migratory routes.

Print resources

Atlas of Bird Migration: Tracing the Great Journeys of the World's Birds. (2007). Elphick, J. & Lovejoy, T.E. Smithsonian Institution. Firefly Books.

Make Way for Ducklings, Robert McCloskey

Web resources

Art, Science, and Nature

These sites highlight the work of people or projects that combine the arts, science, and nature.

- Keepers of the Waters: <http://www.keepersofthewaters.org/>
- Lynne Hull: <http://www.eco-art.org/>
- Lorna Jordan: <http://lornajordan.com>
- Patricia Johansen: <http://www.patriciajohanson.com>
- Mel Chin: <http://www.satorimedia.com/fmraWeb/chin.htm>

Climate Change

Conservation in a Changing Climate, USFWS

<http://www.fws.gov/home/climatechange/>

This site offers basic climate change information as well as information on wildlife impacts, the U.S. Fish and Wildlife Service response, and suggestions for related stewardship activities.

The State of the Birds 2010 Report on Climate Change, USFWS et al.

<http://www.stateofthebirds.org/>

This report calls attention to the collective efforts needed to protect nature's resources for the benefit of people and wildlife.

Global Warming and Waterfowl, National Wildlife Federation

<http://www.nwf.org/Global-Warming/Effects-on-Wildlife-and-Habitat/Birds-and-Waterfowl.aspx>

The National Wildlife Federation's predictions of the impacts of climate change on waterfowl within specific flyways are summarized on this site. The page includes a link to the *Waterfowler's Guide to Global Warming: Potential and Current Threats to America's Waterfowl*.

Conservation Careers and Volunteer Opportunities

Conservation Careers and Volunteer Opportunities, U.S. Fish and Wildlife Service

<http://www.fws.gov/volunteers>

This page lists career and volunteer opportunities within the U.S. Fish and Wildlife Service.

Careers in Wildlife Conservation, The Wildlife Society

http://joomla.wildlife.org/index.php?option=com_content&task=view&id=73

This page lists a variety of possible wildlife conservation careers with a brief description of each position.

Weather Volunteers: Meteorology gets a boost from thousands of weather watchers across the country.

http://www.acfnewsources.org/science/weather_volunteers.html

Students may enjoy reading this article about a volunteer weather observer in the National Weather Service's program, Cooperative Weather Observer.

Youth Conservation Corps: Understanding the Public Lands Corps Act and the Youth Conservation Corps

<http://www.fws.gov/humancapital/factsheetpdfs/YouthFactSheetFinal.pdf>

This fact sheet describes the Department of the Interior effort to engage young people across the country in conservation and energy efficiency projects on America's public lands, to inspire and provide career pathways in natural resource occupations and related sciences, and to become better educated about the nation's ecosystems.

Invasive Species

When Weeds Move In Waterfowl Move Out, Bureau of Land Management
http://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/fish__wildlife_and_weeds.Par.42925.File.dat/RamosFinalID_Ad.pdf

This flyer offers information on the effects of invasive weeds on waterfowl and conservation tips for avoiding the spread of invasives. It could be printed as a poster for the classroom.

Frequently Asked Questions about Invasive Species, Wisconsin Department of Natural Resources
<http://dnr.wi.gov/invasives/faq/>

This site answers the basic questions about invasive species and offers links to information about specific invasives such as purple loosestrife, <http://dnr.wi.gov/invasives/fact/loosestrife.htm>

Investigation and Science Inquiry

BirdSleuth: Investigating Evidence (6–8th), Cornell Lab of Ornithology
<http://www.birds.cornell.edu/birdsleuth/inquiry-resources/we-want-to-support-you-as-your-students-become-scientists>

This curriculum includes lesson plans, journal pages, and online resources that will help your students ask scientific questions, craft and test hypotheses, collect and organize data, draw meaningful conclusions, and publish their work.

Oil Spills

Classroom for Educators and Students, Restorethegulf.gov
<http://www.restorethegulf.gov/response/education-resources/classroom>

This site offers a variety of activities and lesson plans related to oil spill issues, as well as links to a number of fact sheets about the Gulf spill and restoration.

FWS Deepwater Horizon Oil Spill Response, U.S. Fish and Wildlife Service
<http://www.fws.gov/home/dhoilspill/factsheets.html>

This fact sheet provides general information about the U.S. Fish and Wildlife Service response to the Deepwater Horizon oil spill (2010).

Effects of Oil on Wildlife and Habitat, USFWS
<http://www.fws.gov/home/dhoilspill/pdfs/DHJICFWSOilImpactsWildlifeFactSheet.pdf>

The U.S. Fish and Wildlife Service provides information on the impacts of oil spills on wildlife and the environment.

Legacy of an Oil Spill 20 Years After Exxon Valdez, Exxon Valdez Oil Spill Trustee Council
<http://www.evostc.state.ak.us/facts/details.cfm>

This site provides information on the oil spill, habitat protection, restoration projects, and the status of restoration efforts.

Waterfowl Population Surveys

Part Collection Survey, Flyways.US
<http://flyways.us/surveys-and-monitoring/hunter-surveys/parts-collection-surveys>

On page 126 of the *Educator Guide* there is a description of the Flyways.US Waterfowl Harvest Surveys. This site describes the use of wing and/or tail feathers collected from hunters for estimating waterfowl population sizes.

Waterfowl Banding Program, Flyways.US
<http://flyways.us/surveys-and-monitoring/banding-and-marking-programs/waterfowl-banding-program>
Scientists band the legs of thousands of ducks and geese each year. Learn more about that process at this site.

NOTES:



VII. Conclusion

Migratory waterfowl and other migratory birds are key indicators of biological diversity. Shifts in bird populations reflect overall changes in the health of the ecosystems on which they depend. All migratory birds require healthy ecosystems throughout their migratory ranges.

Fortunately, much can be done to help protect migratory waterfowl and other migratory birds. Many things can be done by educators, students, natural resources professionals, and other community members working together in school or other local settings. First and foremost, we hope you will encourage your students to participate in the Junior Duck Stamp Art Contest. Their new knowledge of waterfowl and wetlands and their journal sketches of waterfowl characteristics and behaviors will give them a solid base on which to build their contest entry. How do you get started?

- Go to the Junior Duck Stamp website to contest information: <http://www.fws.gov/juniorduck/ArtContest.htm#GeneralInformation>
- Each state has a Junior Duck Stamp Contest Coordinator to help answer questions. Find your state coordinator at this FWS site: <http://www.fws.gov/juniorduck/ArtContest.htm#StateCoordinator>
- Find nearby wetlands where students can view waterfowl. Check this site for a national wildlife refuge near you: <http://www.fws.gov/refuges/>.
- Use the tips about finding community experts on page 23 to help you find other assistance you might need.

Second, make use of the Junior Duck Stamp curriculum as a means to link with other conservation outreach programs such as International Migratory Bird Day, National Wildlife Refuge Week, National Wetlands Week, and others. Third, use the materials as a springboard to a number of other conservation or stewardship activities, such as habitat restoration and nest-box building projects. Finally, encourage students to extend their understanding of migratory birds and to become even more active conservation stewards by introducing their families and friends to local refuges and public lands, and the waterfowl that inhabit them.

As all students will discover during their Junior Duck Stamp program participation, human activity and natural forces can easily tip the delicate ecological balance in wetlands, compromising the health of waterfowl and other wildlife. After completing the curriculum, youth should be encouraged to learn more about the social, economic, and management aspects of waterfowl and wetlands. The avenues they choose to develop that knowledge might be based in the visual arts, language arts, or sciences, or a combination of the three. Will they go on to become accomplished wildlife artists, volunteer stewards of these valuable resources, or pursue work as natural resource managers themselves? Only time will tell, but congratulations on planting that seed. These young people now have the base of knowledge needed to consider those goals for themselves and their communities.

NOTES:



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APPENDIX A | Correlation of Curriculum to Standards

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APPENDIX A1 | Correlations to National Geography Standards (National Geographic Society)

Correlations to National Geography Standards	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
THE WORLD IN SPATIAL TERMS						
Understand how to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.				X	X	X
Understand how to analyze the spatial organization of people, places, and environments on Earth's surface.			X		X	
PLACES AND REGIONS						
Understand the physical and human characteristics of places.					X	
Understand how culture and experience influence people's perceptions of places and regions.					X	
PHYSICAL SYSTEMS						
Understand the characteristics and spatial distribution of ecosystems on Earth's surface.					X	
HUMAN SYSTEMS						
Understand the characteristics, distribution, and complexity of Earth's cultural mosaics, a term used to describe the mix of ethnic groups, languages, and cultures that coexist within society.					X	
Understand the patterns and networks of economic interdependence on Earth's surface.						X
ENVIRONMENT AND SOCIETY						
Understand how human actions modify the physical environment.				X		X

APPENDIX A2 | Correlations to National Standards for the English Language Arts (National Council of Teachers of English)

Correlations to National Standards for the English Language Arts	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
READING FOR PERSPECTIVE: Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves, and of the cultures of the U.S. and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.			X			X
UNDERSTANDING THE HUMAN EXPERIENCE: Students read a wide range of literature from many periods in many genres to build an understanding of the many dimensions (e.g., philosophical, ethical, aesthetic) of human experience.			X			
EVALUATION STRATEGIES: Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).						X
COMMUNICATION SKILLS: Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.	X					X
COMMUNICATION STRATEGIES: Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.		X	X	X	X	X
APPLYING KNOWLEDGE: Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and nonprint texts.					X	X

Correlations to National Standards for the English Language Arts	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
EVALUATING DATA: Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.		X	X	X	X	X
DEVELOPING RESEARCH SKILLS: Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.			X	X	X	X
MULTICULTURAL UNDERSTANDING: Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles					X	
PARTICIPATING IN SOCIETY: Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.				X		X
APPLYING LANGUAGE SKILLS: Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).	X	X	X	X	X	X

APPENDIX A3 | Correlations to National Mathematics Standards (National Council of Teachers of Mathematics)

Correlations to National Mathematics Standards	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
NUMBER AND OPERATIONS						
Understand numbers, ways of representing numbers, relationships among numbers, and number systems.						
Work flexibly with fractions, decimals, and percents to solve problems.			X			
Compute fluently and make reasonable estimates.						
Select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on the situation, and apply the selected methods.					X	
Develop and use strategies to estimate the results of rational-number computations and judge the reasonableness of the results.					X	
ALGEBRA						
Use mathematical models to represent and understand quantitative relationships.						
Model and solve contextualized problems using various representations, such as graphs, tables, and equations.						X
GEOMETRY						
Use visualization, spatial reasoning, and geometric modeling to solve problems.						
Recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science and everyday life.		X	X	X	X	X
MEASUREMENT						
Understand measurable attributes of objects and the units, systems, and processes of measurement.						
Understand both metric and customary systems of measurement.					X	
Apply appropriate techniques, tools, and formulas to determine measurements.						
Use common benchmarks to select appropriate methods for estimating measurements.						X

Correlations to National Mathematics Standards	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision.					X	
Solve simple problems involving rates and derived measurements for such attributes as velocity and density.					X	
DATA ANALYSIS AND PROBABILITY						
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.						
Formulate questions, design studies, and collect data about a characteristic shared by two populations or different characteristics within one population.		X	X		X	X
Develop and evaluate inferences and predictions that are based on data.						
Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken.					X	
Use conjectures to formulate new questions and plan new studies to answer them.					X	X
PROCESS						
Communication						
Analyze and evaluate the mathematical thinking and strategies of others.						X
Connections						
Recognize and apply mathematics in contexts outside of mathematics.			X			X
Representation						
Use representations to model and interpret physical, social, and mathematical phenomena.						X



APPENDIX A4 | Correlations to National Science Education Standards (National Academy of Sciences)

SCIENCE AS INQUIRY						
Abilities necessary to do scientific inquiry	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Identify questions that can be answered through scientific investigations.		X	X	X	X	X
Design and conduct a scientific investigation.	X	X	X	X	X	X
Use appropriate tools and techniques to gather, analyze, and interpret data.		X	X	X	X	X
Develop descriptions, explanations, predictions, and models using evidence.		X	X		X	
Think critically and logically to make the relationships between evidence and explanations.		X		X	X	X
Recognize and analyze alternative explanations and predictions.				X		
Communicate scientific procedures and explanations.				X		X
Use mathematics in all aspects of scientific inquiry.		X	X		X	
LIFE SCIENCE						
Structure and function of living systems	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.		X				
Reproduction and heredity						
Reproduction is a characteristic of all living systems because no individual organism lives forever, reproduction is essential to the continuation of every species, and some organisms reproduce asexually. Other organisms reproduce sexually.				X		
The characteristics of an organism can be described in terms of a combination of traits. Some are inherited and others result from interactions with the environment.			X			

	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Regulation and Behavior						
All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing environment.			X			
Regulation of an organism’s internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive.					X	
Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.			X			
Populations and ecosystems						
A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.			X			
The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.				X		X
Diversity and adaptations of organisms						
Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.			X	X		X
Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on earth no longer exist.		X				X

	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Abilities of technological design.						
Design a solution or product.			X			
Implement a proposed design.			X			
SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES						
Populations, resources, and environments						
When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.				X		X
Causes of environmental degradation and resource depletion vary from region to region and from country to country.						X
HUMAN ACTIVITIES AND ENVIRONMENTAL IMPACTS						
Human activities can also induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.				X		
HISTORY AND NATURE OF SCIENCE						
SCIENTIFIC INQUIRY AND COMMUNICATION						
Women and men of various social and ethnic backgrounds—and with diverse interests, talents, qualities, and motivations—engage in the activities of science, engineering, and related fields such as the health professions. Some scientists work in teams, and some work alone, but all communicate extensively with others.				X		
SCIENTIFIC INQUIRY AND COMMUNICATION						
Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.			X			

APPENDIX A5 | Correlations to National Standards for Visual Arts: Grades 5-8

The current national standards for visual arts were developed at the behest of The National Association for Music Education in 1994. The State Education Agency Directors of Arts Education (<http://www.seadae.org/>) convened in November of 2010 to begin to develop National Arts Standards 2.0, but the process was in the early planning stages at the time of this publication. The National Standards for Arts Education—Visual Arts do not reflect the significant changes in art education and technology in the seventeen years since they were adopted. The six major content standards have 15 achievement standards at the middle school level. Despite their broad application, only 13 of the achievement standards apply to the art activities that the *Youth Guide* utilizes to inform students about waterfowl and encourage their participation in art and design.

Wisconsin's Model Academic Standards for Art and Design Education (Appendix A6) are included in this guide as an example of newer standards that also address the activities that are offered in the *Youth Guide* and the skills that are developed through those activities.

The Wisconsin Model Academic Standards for Art and Design Education were published in 2000 and “they include not only the traditional fine arts but also design arts, media arts, visual learning skills, and understanding of art and society. In addition to traditional drawing, painting, and sculpting, students learn about things like folk arts and crafts, architecture, city planning, product design, television, film, and computer graphics. Students also learn visual skills for non- arts purposes such as making and reading maps, charts, diagrams, plans, and models.”

Wisconsin's middle school standards are organized around 12 major visual arts standards, with 85 performance standards. Thirty of these standards are addressed in the *Youth Guide*. This more detailed breakdown of art and design skills provides teachers and curriculum specialists with specific benchmarks that are more readily utilized in lesson planning.

Correlations to National Standards for Visual Arts: Grades 5-8	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
CONTENT STANDARD #1: UNDERSTANDING AND APPLYING MEDIA, TECHNIQUES, AND PROCESSES						
Students select media, techniques, and processes; analyze what makes them effective or not effective in communicating ideas; and reflect upon the effectiveness of their choices		X	X	X	X	
Students intentionally take advantage of the qualities and characteristics of art media, techniques, and processes to enhance communication of their experiences and ideas.	X	X	X	X	X	
CONTENT STANDARD #2: USING KNOWLEDGE OF STRUCTURES AND FUNCTIONS						
Students generalize about the effects of visual structures and functions and reflect upon these effects in their own work.		X	X	X	X	
Students employ organizational structures and analyze what makes them effective or not effective in the communication of ideas.			X	X	X	
Students select and use the qualities of structures and functions of art to improve communication of their ideas.		X	X	X	X	
CONTENT STANDARD #3: CHOOSING AND EVALUATING A RANGE OF SUBJECT MATTER, SYMBOLS, AND IDEAS						
Students integrate visual, spatial, and temporal concepts with content to communicate intended meaning in their artworks.		X	X	X	X	
Students use subjects, themes, and symbols that demonstrate knowledge of contexts, values, and aesthetics that communicate intended meaning in artworks.			X			
CONTENT STANDARD #4: UNDERSTANDING THE VISUAL ARTS IN RELATION TO HISTORY AND CULTURES						
Students know and compare the characteristics of artworks in various eras and cultures.					X	
Students describe and place a variety of art objects in historical and cultural contexts.						
Students analyze, describe, and demonstrate how factors of time and place (such as climate, resources, ideas, and technology) influence visual characteristics that give meaning and value to a work of art.		X		X		

Correlations to National Standards for Visual Arts: Grades 5-8	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
CONTENT STANDARD #5: REFLECTING UPON AND ASSESSING THE CHARACTERISTICS AND MERITS OF THEIR WORK AND THE WORK OF OTHERS						
Students compare multiple purposes for creating works of art.						X
Students analyze contemporary and historic meanings in specific artworks through cultural and aesthetic inquiry.		X				X
Students describe and compare a variety of individual responses to their own artworks and to artworks from various eras and cultures.		X			X	
CONTENT STANDARD #6: MAKING CONNECTIONS BETWEEN VISUAL ARTS AND OTHER DISCIPLINES						
Students compare the characteristics of works in two or more art forms that share similar subject matter, historical periods, or cultural context.						
Students describe ways in which the principles and subject matter of other disciplines taught in the school are interrelated with the visual arts.						X

APPENDIX A6 | Correlations to Wisconsin's Model Academic Standards for Art and Design Education

Correlations to Wisconsin's Model Academic Standards for Art and Design Education	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
VISUAL MEMORY AND KNOWLEDGE						
Develop a mental storehouse of images.					X	
Know about styles of art from their own and other parts of the world.					X	
Identify ways in which art is basic to thinking and communicating about the world.		X				
ART AND DESIGN HISTORY, CITIZENSHIP, AND ENVIRONMENT						
Explore how artists and cultures throughout history have used art to communicate ideas and to develop functions, structures, and designs.		X				
Recognize ways in which form, function, meaning, and expressive qualities of art and design change from culture to culture and artist to artist.					X	X
Learn about the contributions of art historians, cultural anthropologists, and philosophers of art to our understanding of art and design.						X
VISUAL DESIGN AND PRODUCTION						
Use thumbnail sketches to experiment and start developing visual ideas.	X	X	X	X	X	X
Understand the natural characteristics of materials and their possibilities and limitations.				X		
Develop the craft and skills to produce quality art.						X
Reflect on their work during the creative process to assess and better understand their own artwork.	X	X				X
VISUAL COMMUNICATION AND EXPRESSION						
Communicate complex ideas by producing visual communication forms useful in everyday life, such as sketches, diagrams, graphs, plans, and models.		X	X	X		
Use the visual arts to express ideas that can't be expressed by words alone.				X		

Correlations to Wisconsin's Model Academic Standards for Art and Design Education	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
ART AND DESIGN CRITICISM						
Know that visual images are important tools for thinking and communicating.						X
Create works of art that have meanings.						X
VISUAL THINKING						
Look at things using different methods and tools, such as through a microscope.		X				
Know how light, shadow, color, distance, and angle of viewing affect sight.			X			
Be able to draw, paint, and sculpt from life.				X		
Create three-dimensional models.		X	X			
Make and interpret photographs and videos.			X	X		
PERSONAL AND SOCIAL DEVELOPMENT						
Recognize that their own feelings affect how they look at art.		X				
Understand that art reflects the time and place in which it was created.					X	
Work independently and collaboratively to produce ideas and works of art.						X
MAKING CONNECTIONS						
Connect their knowledge and skills in art to other areas, such as the humanities, sciences, social studies, and technology.		X	X		X	X
Invent new artistic forms to communicate ideas and solutions to problems.		X				
Apply what they know about the nature of life, nature, the physical world, and the human condition to their understanding and creation of art.		X			X	X
Know about a range of art activities, such as museum curation, historic preservation, collecting, and writing about art and design.						X

Correlations to Wisconsin’s Model Academic Standards for Art and Design Education	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
VISUAL IMAGINATION AND CREATIVITY						
Use their knowledge, intuition, and experiences to develop ideas for artwork.						X
Develop a base of knowledge and skills from which to create new ideas.						X
Understand that nature and other designs can be sources for new ideas.						X
Study ways that artists develop personal style that reflects who they are.		X				

APPENDIX A7 | North American Association for Environmental Education Guidelines for Learning

NAAEE Guidelines for Learning	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Strand 1—Questioning, Analysis, and Interpretation Skills						
Questioning		X	X	X	X	X
Designing Investigations		X	X	X	X	
Collecting information	X	X	X	X		X
Evaluating accuracy and reliability						X
Organizing information	X		X	X	X	X
Working with models and simulations				X		
Drawing conclusions and developing explanations				X		X
Strand 2—Knowledge of Environmental Processes and Systems						
Strand 2.1—The Earth as a Physical System						
Processes that shape the Earth						
Changes in matter						
Energy						
Strand 2.2—The Living Environment						
Organisms, populations, and communities			X	X	X	X
Heredity and evolution		X		X		
Systems and connections				X		
Flow of matter and energy						
Strand 2.3—Humans and Their Societies						
Individuals and groups			X			
Culture			X			
Political and economic systems						
Global connections					X	



NAAEE Guidelines for Learning	Intro	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Strand 2.4—Environment and Society						
Human/environment interactions			X	X	X	X
Places					X	X
Resources						X
Environmental issues				X		X
Strand 3—Skills for Understanding and Addressing Environmental Issues						
Strand 3.1—Skills for Analyzing and Investigating Environmental Issues						
Identifying and investigating issues				X	X	X
Sorting out the consequences of issues			X			X
Identifying and evaluating alternative solutions and courses of action						X
Working with flexibility, creativity, and openness						X
Strand 3.2—Decision-Making and Citizenship Skills						
Forming and evaluating personal views				X		X
Evaluating the need for citizen action				X		X
Planning and taking action				X		X

APPENDIX B | More Resources

Activities

Adaptations

- *Adaptation Artistry* (4–9th), Project WILD, Council for Environmental Education
<http://www.projectwild.org/index.htm>
The purpose of this activity is for students to realize how physical adaptations give birds advantages for survival.
- *Diversity and adaptations, Lesson 5* (9–12th) Wetland Ecosystems III, Ducks Unlimited Canada.
<http://www.epa.gov/gmpo/education/pdfs/DUEducators9-12.pdf>
Students explore the diversity of structural and behavioral adaptations in this wetlands activity.

Behavior

- *Bird Behavior Scavenger Hunt* (6–8th), Flying WILD: An Educator's Guide to Celebrating Birds, Council for Environmental Education.
<http://www.flyingwild.org/guide.htm>
In this activity students identify different behavior patterns of birds and explain their functions.
- *Get to Know the Shorebirds Puppet Show* (K–6th), Migration Science and Mystery
http://migration.pwnet.org/pdf/Get_to_Know_the_Shorebirds_Puppet_Shows.pdf
By creating shorebird puppets and putting on a shorebird puppet show, students learn the physical and behavioral characteristics that make a bird a shorebird.
- *Young Naturalists*, Minnesota Conservation Volunteer, MN DNR
<http://www.dnr.state.mn.us/volunteer/index.html>
This website has youth activities with educator's guides for the related topic: *What's in a Bird Song?*

Bird Conservation

- Ducks Unlimited Program for Young Conservationists: Greenwings
<http://www.greenwing.org/>
This Ducks Unlimited site is just for youth and features online games and activities.
- *Flying WILD: An Educator's Guide to Celebrating Birds*
<http://www.flyingwild.org/>
Flying WILD, a program of the Council for Environmental Education, introduces students to bird conservation through standards-based classroom activities and environmental stewardship projects. See the Expanded Topic List on page 360 of the *Flying WILD Guide* to find activities that meet your curriculum needs, such as adaptations, behavior, conservation, habitat, habitat types, or migration.

Migration

- *One Bird Two Habitats: A Middle School Environmental Education Curriculum on Migratory Birds*
<http://dnr.state.il.us/education/classrm/birds/1b2hfull.pdf>
 Neotropical migratory bird conservation is a global environmental issue that illustrates the connections between people, birds, and forests in different parts of the world. The major theme addressed in the curriculum is interconnectedness. People and wildlife share similar needs. It is in trying to meet these needs that we are interconnected. Environmental issues are global and only through global connections among people can we address environmental concerns.
- *Migration Headache (4–12th)*, Project WILD Aquatic, K-12 Curriculum and Activity Guide
<http://www.projectwild.org/ProjectWILDK-12AquaticCurriculumandActivityGuide.htm>
 In this role-playing activity, students pretend to be migrating water birds to predict the effects of land use and explore the importance of wetland conservation.
- *Migration Science and Mystery: A Distance Learning Adventure*
<http://migration.pwnet.org/>
 - *Migration Lesson Plans* <http://migration.pwnet.org/resource/archives.php#B>
 - *Shorebird Profiles (6–12th)*, http://migration.pwnet.org/pdf/Shorebird_Profiles.pdf
 By critically reading four shorebird profiles provided in this educator’s guide, students make direct comparisons among the appearance, food habits, migration routes, and mating behaviors of four shorebirds found in their area.

Phenology

- *Ecosystem Phenology (7–12th)*, Wisconsin Department of Natural Resources, *CLIMATE CHANGE: A Wisconsin Activity Guide*, Grades 7–12th
<http://dnr.wi.gov/org/caer/ce/ee/educator/Climateguide/PDF/03-4245-phenology.pdf>

Reproduction

- *Migration Science and Mystery: A Distance Learning Adventure*
 - *Colorful Changes (3–12th)*, http://migration.pwnet.org/pdf/Colorful_Changes.pdf
 Students discover that some shorebirds have dramatically different breeding and nonbreeding plumage. They then create an artistic representation of a shorebird species in both seasons.
 - *Guard Your Nest (3–12th)*, http://migration.pwnet.org/pdf/Guard_Your_Nest.pdf
 Students, pretending to be shorebirds, must guard their nests from a multitude of predators and threats. They discover that camouflage and distraction displays are two strategies that increase a shorebird’s chance of nesting success.
- *Young Naturalists*, Minnesota Conservation Volunteer, MN DNR
<http://www.dnr.state.mn.us/volunteer/index.html>
 This website has youth activities with educator’s guides for the related topic: *What are portable, durable, dependable, convertible, and altogether incredible? Eggs!*



Stamp Collecting

- *Wildlife on Coins and Stamps* (7–12th), Project WILD, Council for Environmental Education, <http://www.projectwild.org/index.htm>
The purpose of this activity is for students to reflect on the symbolic meaning of the use of wildlife images on coins and stamps.

Wetlands

- *Dragonfly Pond* (4–12th), Project WILD Aquatic, K-12 Curriculum and Activity Guide <http://www.projectwild.org/ProjectWILDK-12AquaticCurriculumandActivityGuide.htm>
Students create a collage to demonstrate land-use activities around the image of a pond.
- *Project Webfoot*, Wetland and Environmental Education Lesson Plans, Ducks Unlimited Canada
http://www.ducks.ca/resource/educators/lesson_plans/index.html
Ducks Unlimited has developed three units in a wetland ecosystems series. Each unit consists of an educator's guide and accompanying student journal.
 - Wetland Ecosystems I - Habitats, Communities and the Diversity of Life (4–6th)
 - Wetland Ecosystems II - Interactions and Ecosystems (7–8th)
 - Wetland Ecosystems III - Evolution, Diversity and the Sustainability of Ecosystems (9–12th)
- *Educators: A Resource Site for Wetland Education from Ducks Unlimited* http://www.greenwing.org/dueducator/alph_educator.html
Enhance your classroom curriculum using activities from current and past issues of Ducks Unlimited's *Puddler* magazine.
- *Fragile Fringe – A Guide for Teaching about Coastal Wetlands*, National Wetlands Research Center, USGS.
http://www.nwrc.usgs.gov/fringe/about_ff.html
The *Fragile Fringe* activities provide a basis from which a comprehensive study of coastal wetlands can be developed by the educator on the basis of individual needs.
- *WET in the City Curriculum and Activity Guide* (K–12th), Council for Environmental Education
http://www.wetcity.org/resources.htm#WIC_Guide
This multi-disciplinary, hands-on urban water education curriculum engages K–12 students in explorations of the science of water and complex issues surrounding its management and stewardship.
- *Wetlands: A World in Our Backyard*, New England Interstate Water Pollution Control Commission and Environmental Protection Agency
<http://www.epa.gov/ne/students/educator/wetlands.html>
This resource provides information and activities about wetlands in New England for educators and their middle school students. It suggests ways to study wetland characteristics, why wetlands are important, and how students and educators

can help protect a local wetland. This guide aims to help students get to know the complexities of wetlands, discover wildlife, enjoy the experience of being outdoors, and learn how necessary wetlands are to the health of our environment.

- *Wetlands Education Materials*, Gulf of Mexico Program, Environmental Protection Agency <http://www.epa.gov/gmpo/education/>
This site outlines wetland-related activities for preschool to high school.
- *Wetland Metaphors* (1–12th), Project WILD Aquatic, K-12 Curriculum and Activity Guide
<http://www.projectwild.org/ProjectWILDK-12AquaticCurriculumandActivityGuide.htm>
Students explore the characteristics of wetlands and their importance to wildlife and people in this activity.
- *WOW!: The Wonders of Wetlands* (K–12th)
http://www.wetland.org/education_wow.htm
This instructional guide provides a collection of over 50 hands-on, multidisciplinary wetland activities in lesson plan format and with extensive background information on wetland characteristics, wetland functions, wetlands as habitat, wetland management, and wetland stewardship suggestions. Here is a sample of related activities:
 - *Introducing Wetlands* (K–12th) – Fourteen fun activities to begin your wetlands study.
 - *Wetland Habitats* (6–12th) – A flowchart key to types of wetlands.
 - *Recipe for Trouble* (4–12th) – Experiment: what happens when water has excess nutrients and pollutants?
 - *Hydropoly* (4–2nd) – A board game of decision-making (land use decisions and impacts on wetlands).

DVD or Video

America's Duck Chaser (Web video), *Status of Waterfowl*, Flyways.us

<http://www.flyways.us/status-of-waterfowl?phpMyAdmin=31cf681b01b6663384007aa1cfa655cd>

Watch pilot biologists survey waterfowl populations.

Ducks Unlimited News and Media

<http://www.ducks.org/news-media>

Find links at this site to the DU Video Library, Photo Gallery, and TV Shows and Schedules.

Sebastian the Goose Encourages Natural Shoreline (Web-video), University of WI-Madison, Life Sciences Communications

<http://www.youtube.com/watch?v=ZkJF6x48fwU>

Ever wonder why geese seem to gather on your favorite picnic spot, lake front shoreline, or backyard? It's explained in this one-on-one interview with Sebastian, the freeloading fowl.

Winged Migration (DVD), Jacques Perrin, Sony Pictures, 89 mins.

This movie offers a birds-eye view of the world's bird migratory routes.



Finding natural areas and natural resource professional partners

- See the contact for ideas list on page 16 of the *Youth Guide*. Check *Potential Partners* (page 24) of this guide for suggestions for creating partnerships with natural resource experts.
- Many states have a state-wide environmental education (EE) association. Environmental Education association memberships are made up of EE or nature centers, museums, zoos, and a variety of other non-profit organizations. They often have natural areas and public EE programs, and are a good source of resources to find people, places, and programs on wetlands and/or waterfowl in your area. Find contact information for your state's EE association at the North American Association of Environmental Education's, Affiliates Contacts by Regions page, <http://www.naaee.org/about-naaee/affiliates/affiliates-contacts-by-region>.
- Find public lands:
 - National Wildlife Refuge System, U.S. Fish and Wildlife Service
<http://www.fws.gov/refuges/>
 - USFWS Refuge Locator Map
<http://www.fws.gov/refuges/refugeLocatorMaps/index.html>
 - Find a Forest by State, USDA Forest Service
http://www.fs.fed.us/recreation/map/state_list.shtml
 - Find a National Park, U.S. National Park Service
<http://www.nps.gov/findapark/index.htm>
 - Public Lands Information Center: Your One-Stop Source for Recreation Information, Public Lands Interpretive Association
<http://www.publiclands.org/home.php>

Habitat

WOW!: *The Wonders of Wetlands*

http://www.wetland.org/education_wow.htm

WOW!: *The Wonders of Wetlands* is an instructional guide for educators that provides a resourceful and creative collection of wetland activities, information, and ideas. WOW! includes: over 50 hands-on, multidisciplinary activities in lesson plan format, extensive background information on wetlands, ideas for student action projects, and a wetlands resource guide.

Journaling

There are a number of how-to guides available on the Internet for learning how to keep a nature journal. Here are a few examples:

- (K–12) Smithsonian Education in your Classroom, *Introduction to the Nature Journal*: http://www.smithsonianeducation.org/educators/lesson_plans/journals/smithsonian_siyc_fall06.pdf
- (5–12) *Take Note!*, All About Birds, Cornell Lab of Ornithology.
<http://www.allaboutbirds.org/NetCommunity/Page.aspx?pid=1852>

Print resources

Check with your school librarian or on the Internet for books that are appropriate for your students' age and interest. Here are a few suggestions:

- *Atlas of Bird Migration: Tracing the Great Journeys of the World's Birds.* (2007). Elphick, J. & Lovejoy, T.E. Smithsonian Institution. Firefly Books.
- Children's books that illustrate the use of waterfowl in literature and fairy tales:
 - *City Geese*, by Ron Hirschi and Galen Burrell
 - *The Goose that Laid the Golden Egg*, from *Aesop's Fables*
 - *Swan Lake*, by Mark Helprin and Chris Van Allsburg
 - *The Snow Goose*, (Wildlife Habitats and Habitat Series), by Mark Ahlstrom
- *The Mishomis Book: The Voice of the Ojibwe* by Edward Benton-Benai (1988) Red School House, Indian Country Communications
<http://nativeauthors.com/index.php?productID=1367>
This book explores the history, philosophy, and teachings of the Ojibwe people, as passed down to the present generation by parents, grandparents, and elders of the Lac Court Oreilles Reservation (Wisconsin).

Other Web Resources

Climate Change

Conservation in a Changing Climate, USFWS

<http://www.fws.gov/home/climatechange/>

This site offers basic climate change information as well as information on wildlife impacts, the U.S. Fish and Wildlife Service response, and suggestions for related stewardship activities.

The State of the Birds 2010 Report on Climate Change, USFWS et al.

<http://www.stateofthebirds.org/>

This report calls attention to the collective efforts needed to protect nature's resources for the benefit of people and wildlife.

Global Warming and Waterfowl, National Wildlife Federation

<http://www.nwf.org/Global-Warming/Effects-on-Wildlife-and-Habitat/Birds-and-Waterfowl.aspx>

The National Wildlife Federation's predictions of the impacts of climate change on waterfowl within specific flyways are summarized on this site. The page includes a link to the *Waterfowler's Guide to Global Warming: Potential and Current Threats to America's Waterfowl*.

Conservation Careers and Volunteer Opportunities

Careers in Wildlife Conservation, The Wildlife Society

http://joomla.wildlife.org/index.php?option=com_content&task=view&id=73

This page lists a variety of possible wildlife conservation careers with a brief description of each position.

Weather Volunteers: Meteorology gets a boost from thousands of weather watchers across the country.

http://www.acfnewsresource.org/science/weather_volunteers.html

Students may enjoy reading this article about a volunteer weather observer in the National Weather Service's program, Cooperative Weather Observer.

Youth Conservation Corps: Understanding the Public Lands Corps Act and the Youth Conservation Corps

<http://www.fws.gov/humancapital/factsheetpdfs/YouthFactSheetFinal.pdf>

This fact sheet describes the Department of the Interior effort to engage young people across the country in conservation and energy efficiency projects on America's public lands, to inspire and provide career pathways in natural resource occupations and related sciences, and to become better educated about the nation's ecosystems.

Cross-Disciplinary Works in Art, Science, and Nature

Check the Internet for sites like these that highlight the work of people or projects that combine the arts, science, and nature.

- Keepers of the Waters: <http://www.keepersofthewaters.org/>
- Lynne Hull: <http://www.eco-art.org/>
- Lorna Jordan: <http://lornajordan.com>
- Patricia Johansen: <http://www.patriciajohanson.com>
- Mel Chin: <http://www.satorimedia.com/fmraWeb/chin.htm>

Invasive Species

When Weeds Move In Waterfowl Move Out. Bureau of Land Management

http://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/fish__wildlife_and/weeds.Par.42925.File.dat/RamosFinalID_Ad.pdf

This flyer offers information on the effects of invasive weeds on waterfowl and conservation tips for avoiding the spread of invasives. It could be printed as a poster for the classroom.

Frequently Asked Questions about Invasive Species, Wisconsin Department of Natural Resources

<http://dnr.wi.gov/invasives/faq/>

This site answers the basic questions about invasive species and offers links to information about specific invasives such as purple loosestrife. <http://dnr.wi.gov/invasives/fact/loosestrife.htm>

Investigation and science inquiry

BirdSleuth: Investigating Evidence (6–8th), Cornell Lab of Ornithology

<http://www.birds.cornell.edu/birdsleuth/inquiry-resources/we-want-to-support-you-as-your-students-become-scientists>

This curriculum includes lesson plans, journal pages, and online resources that will help your students ask scientific questions, craft and test hypotheses, collect and organize data, draw meaningful conclusions, and publish their work.

Migration

Migration Basics for Students, National Park Service

<http://www.nps.gov/akso/ParkWise/Students/ReferenceLibrary/general/MigrationBasics.htm>

Basic facts about migration for students.

Travels of the Tundra Swan

<http://tundraswanmigration.org/main.htm>

This program allows students to follow the migration of Tundra Swans as they travel between Canada and the U.S.

US FWS Migratory Bird Program

<http://www.fws.gov/migratorybirds/>

The U.S. Fish and Wildlife Service Migratory Bird Program offers a variety of program resources and information on its efforts to conserve migratory bird populations and their habitats for future generations.

Waterfowl Migration Headquarters: Follow the Ducks This Season, Ducks Unlimited

<http://www.ducks.org/hunting/migration>

This site offers general migration information as well as an interactive migration map and video that allows users to track birds across the country.

Why Do Geese Fly in a V?, Everyday Mysteries, Library of Congress

<http://www.loc.gov/rr/scitech/mysteries/geese.html>

This site offers fun science facts for students about the flight pattern of geese.

Migration and Cultural Arts

Civilizaciones Mesoamericanas

http://library.thinkquest.org/C006206F/culturas_mesoamericanas.htm

See an ancient drawing of hunters, in what is now Central America, capturing shorebirds with nets. This site is in Spanish and is appropriate for high school students, particularly those studying Spanish.

Galleries and Museums

There are many art museums and commercial art gallery sites online that feature Native American artists and that post photos of their collections. They can often be searched by topic.

Maps of Native American Tribes in the United States

<http://www.native-languages.org/states.htm>

There are many different artistic styles used by ancient and modern-day Native American artists. Once students find some of the states that a species of interest travels through, encourage them to check this site to determine which Native American tribes inhabited that area. They can then follow the links to learn more about those specific tribes, their culture, and their artwork.

Nest Boxes

*Nest Structures for Ducks and Geese: A Guide to the Construction, Placement, and Maintenance of Nest Structures for Canada Geese, Mallards, and Wood Duck*¹, Northern Prairie Wildlife Research Center, USGS

<http://www.npwrc.usgs.gov/resource/birds/neststru/index.htm>

If you're planning to build a goose, Mallard, or Wood Duck nest, check this site for species-specific instructions including detailed location and site specifications.

How to Build a Wood Duck Nest Box, MDC Discover Nature, Missouri Department of Conservation

<http://mdc.mo.gov/discover-nature/how/woodworking/how-build-wood-duck-nest-box>

Check this site for Wood Duck nest box construction, installation instructions, and related nesting biology information.

Oil Spills

Classroom for Educators and Students, Restorethegulf.gov

<http://www.restorethegulf.gov/response/education-resources/classroom>

This site offers a variety of activities and lesson plans related to oil spill issues, as well as links to a number of fact sheets about the Gulf spill and restoration.

FWS Deepwater Horizon Oil Spill Response, U.S. Fish and Wildlife Service

<http://www.fws.gov/home/dhoilspill/factsheets.html>

This fact sheet provides general information about the U.S. Fish and Wildlife Service response to the Deepwater Horizon oil spill (2010).

Effects of Oil on Wildlife and Habitat, USFWS

<http://www.fws.gov/home/dhoilspill/pdfs/DHJICFWSOilImpactsWildlifeFactSheet.pdf>

The U.S. Fish and Wildlife Service provides information on the impacts of oil spills on wildlife and the environment.

Legacy of an Oil Spill 20 Years After Exxon Valdez, Exxon Valdez Oil Spill

Trustee Council

<http://www.evostc.state.ak.us/facts/details.cfm>

This site provides information on the oil spill, habitat protection, restoration projects and the status of restoration efforts.

¹ Zenner, Guy G., Theodore G. LaGrange, and Alan W. Hancock. 1992. *Nest structures for ducks and geese*. Iowa Department of Natural Resources, Des Moines, IA. Jamestown, ND: Northern Prairie Wildlife Research Center. Online. [Http://www.npwrc.usgs.gov/resource/birds/neststru/index.htm](http://www.npwrc.usgs.gov/resource/birds/neststru/index.htm) (Version 16JUL97)

Phenology

eBird

<http://ebird.org/content/ebird>

eBird is a site that allows users from all over North America keep an electronic record of birds they've seen. Students can submit their own observations and/or view and explore data submitted by others in their community or in any part of the country. Some areas of the country do not have much data and your students might fill those gaps!

How to Observe: Nature's Notebook Plant and Animal Phenology Handbook

http://www.usanpn.org/files/shared/files/How_to_Observe_Field_Handbook_7-28-10.pdf

This guide provides step-by-step instructions for observing and recording phenology information.

National Phenology Network Educator's Clearinghouse

<http://www.usanpn.org/education/clearinghouse>

The USA National Phenology Network houses educational materials (lesson plans, activity guides, syllabuses, project design plans) to provide a convenient and growing collection of resources on phenology learning both inside and outside of K–12 classroom settings.

North American Bird Phenology Program,

<http://www.pwrc.usgs.gov/bpp/ProgramCoordinators2.cfm#>

This site describes the North American Bird Phenology Program, a part of the USA-National Phenology Network, which was a network of volunteer observers who recorded information on first arrival dates, maximum abundance, and departure dates of migratory birds across North America between 1880 and 1970.

Signs of the Seasons: Collect and Exchange Phenology Data

<http://www.learner.org/jnorth/tm/PhenDataExchange.html>

This Journey North site offers the Phenology Data Exchange, a means of sharing phenological information about a variety of plant and animal species.

Stamp Collecting

American Philatelic Society – Just for Kids

http://www.stamps.org/kids/kid_stampfun.htm

Students will find the answers to all their stamp collecting questions at this site.

Water Monitoring

Citizens Monitoring Biotic Index (6–12th), Wisconsin Action Volunteers

<http://watermonitoring.uwex.edu/pdf/level1/FactSeries-Bugs.pdf>

This fact sheet provides basic information about and an activity outline of stream monitoring, including macroinvertebrate (bug) monitoring.



Waterfowl

Behavior

Young Naturalists: Minnesota Ducks Dabble or Dive For Dinner (4–12th). Welsh, Janice. Minnesota Department of Natural Resources.

http://www.dnr.state.mn.us/young_naturalists/ducks/index.html

This piece offers background information and photos on duck foods, behaviors, bills, feet, feathers, and raising a family.

Calls and decoys

There a variety of Internet sites that offer instructions for making duck calls out of simple materials like straws and milk jugs. We are not listing their URLs because they are commercial sites. You can discover them easily by searching “how to make a duck call” or “how to make a decoy.”

Webber and Maude McMallard, Billy B. The Natural Science Song and Dance Man, <http://billybproductions.com/main/albums/romp-in-the-swamp/webber-and-maude-mcmallard>

This song tells the tale of Webber and Maude’s migration to and raising young in a prairie pothole in the Great Plains.

Flyways

Click on Your Flyway, Migration Science and Mystery: A Distance Learning Adventure

http://migration.pwnet.org/resource/your_flyway.php

This site offers brief flyway facts.

Weekly Weather Severity Index for Mississippi Flyway Duck Migrations, Schummer, M. et al., Mississippi State University

<http://www.cfr.msstate.edu/kennedychair/weather.asp>

Find details about Mallard migration and its relationship to weather patterns at this MSU website.

Reproduction

Adopt-a-Swan Curriculum (9–12th), Blackfoot Challenge.

http://www.blackfootchallenge.org/SwanProject/Docs/Curriculum/Background_Information_for_Educators.pdf

Background information provided for educators on swan behavior, sizes, shapes, calls, food habits, migration, and raising a family.

Courtship Activities of the Anatidae in Eastern Washington, Johnsgard, P. A. (1955). Papers in Ornithology, University of Nebraska, Lincoln.

<http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1065&context=biosciornithology>

Although this article is dated, it offers very good descriptions and drawings of waterfowl courtship behaviors.

The Parenting Game (K–12th). Welsh, Jan. Minnesota Department of Natural Resources.
http://files.dnr.state.mn.us/publications/volunteer/young_naturalists/parenting/baby_animals.pdf

This article discusses wildlife parenting techniques for a variety of species including Wood Ducks and Mallards.

Waterfowl Mating Systems: “Until death do us part”- A statement that is generally true for geese, but not ducks. Ducks Unlimited.

<http://www.ducks.org/conservation/waterfowl-biology/waterfowl-mating-systems>

This article describes monogamous bonds in waterfowl.

Young Naturalists: Baby Birds of Minnesota (K–12th). Welsh, Janice.

http://www.dnr.state.mn.us/young_naturalists/babybirds/index.html

This article highlights nesting behaviors and features a photo comparing different egg sizes, from a Hummingbird egg to a Trumpeter Swan egg.

Swans

Mute Swan (Cygnus olor): Invasive Species in the Chesapeake Watershed, Maryland Sea Grant and the Chesapeake Bay Program.

http://www.mdsg.umd.edu/issues/restoration/non-natives/workshop/mute_swan.html

The Mute Swan, an invasive species, is a concern to waterfowl biologists because of its capacity to overgraze on submerged aquatic vegetation. This site outlines the characteristics of Mute Swans and their impacts in the Chesapeake Bay.

Trumpeter Swans Questions and Answers, USFWS

<http://www.fws.gov/mountain-prairie/species/birds/trumpeterswan/TSwan%20QandA.htm>

Waterfowl Population Surveys

Part Collection Survey, Flyways.US

<http://flyways.us/surveys-and-monitoring/hunter-surveys/parts-collection-surveys>

On page 126 of this Guide there is a description of the Flyways.US Waterfowl Harvest Surveys. This site describes the use of wing and/or tail feathers collected from hunters for estimating waterfowl harvest.

Waterfowl Banding Program, Flyways.US

<http://flyways.us/surveys-and-monitoring/banding-and-marking-programs/waterfowl-banding-program>

Scientists band the legs of thousands of ducks and geese each year. Learn more about that process at this site.

APPENDIX C | Curriculum Concept Map

JDS Unit	Conservation Concepts	Areas of Study	Outcomes: Youth will be able to...
Intro	<p>There are living and non-living components of wetland ecosystems.</p> <p>Complex interactions exist among organisms in an ecosystem.</p> <p>There are people who make their livings studying and managing natural resources.</p>	<p>Language arts</p> <p>Science</p> <p>Visual arts</p>	<p>Use their <i>Youth Guides</i> effectively.</p> <p>Create a plan to complete guide activities.</p> <p>Find and communicate with natural resource professionals in the community.</p> <p>Locate wetland areas in their communities that attract waterfowl.</p> <p>Observe wildlife.</p> <p>Describe wildlife features.</p> <p>Describe living and non-living components of a natural area.</p> <p>Practice writing in a nature journal as a means of exploring questions, recording responses and data, and reflecting thoughts about nature.</p>
Unit 1	<p>Organisms have basic needs and can survive only in environments in which their needs can be met.</p> <p>Different kinds of organisms are adapted for living in different environments.</p> <p>There are people who make their livings studying and managing natural resources.</p>	<p>Language arts</p> <p>Science</p> <p>Visual arts</p>	<p>Investigate how waterfowl keep their feathers dry.</p> <p>Investigate how waterfowl feet and the shape of their bills help them survive in the wild.</p> <p>Demonstrate an understanding of the differences between the shapes of waterfowl and other birds, as well as the differences among the shapes of ducks, geese, and swans.</p> <p>Communicate with others about the unique characteristics of waterfowl.</p>
Unit 2	<p>Species differ in their ability to adapt.</p> <p>All living things depend on habitat that includes adequate supplies and suitably arranged food, water, shelter, and space.</p> <p>There are people who make their livings studying and managing natural resources.</p>	<p>Language arts</p> <p>Math</p> <p>Science</p> <p>Visual arts</p>	<p>Describe and explain common waterfowl behaviors.</p> <p>Explain how waterfowl behavior is related to habitat characteristics.</p> <p>Describe common tools used by humans to attract waterfowl (decoys, calls, and blinds) to specific waterfowl behaviors.</p> <p>Share how waterfowl behaviors are described in the oral traditions and writing of other cultures.</p> <p>Apply aspects of waterfowl behavior into their language and visual arts projects to make their work more realistic.</p>

JDS Unit	Conservation Concepts	Areas of Study	Outcomes: Youth will be able to...
Unit 3	<p>All living things depend on habitat that includes adequate supplies and suitably arranged food, water, shelter, and space.</p> <p>Living things tend to reproduce in numbers greater than their habitat can support. Populations are limited by the quantity and quality of food, water, shelter, and space, and also by disease, predation, and climatic conditions.</p>	<p>Geography Language arts Science Visual arts</p>	<p>Describe common waterfowl behaviors related to reproduction.</p> <p>Explain how changes in food and habitat can affect the survival of waterfowl young.</p> <p>Describe nesting materials and behaviors of a specific waterfowl species.</p> <p>Explain the importance of the Prairie Pothole Region to waterfowl reproduction.</p>
Unit 4	<p>All living things depend on habitat that includes adequate supplies and suitably arranged food, water, shelter, and space.</p> <p>Ecosystems change over time.</p> <p>Changes in environmental conditions can affect the survival of individual organisms and entire species.</p> <p>Species can become extinct because of habitat change or loss.</p> <p>The impact of the human species has major consequences for other species.</p>	<p>Geography Language arts Math Science Visual arts</p>	<p>Describe basic characteristics of waterfowl migration:</p> <ul style="list-style-type: none"> • Why waterfowl migrate • Where different species of waterfowl go and what paths they take • How they know when and where to go • What some threats are to waterfowl survival and how students can help minimize those threats • Explain the possible impacts of climate change on Mallard migration

JDS Unit	Conservation Concepts	Areas of Study	Outcomes: Youth will be able to...
Unit 5	<p>All living things depend on habitat that includes adequate supplies and suitably arranged food, water, shelter, and space.</p> <p>Ecosystems change over time.</p> <p>Changes in environmental conditions can affect the survival of individual organisms and entire species.</p> <p>Species can become extinct because of habitat change or loss.</p> <p>The impact of the human species has major consequences for other species.</p> <p>Science-based management considers the needs of humans as well as wetlands and waterfowl.</p> <p>Everyone should understand and participate in the stewardship and support of our natural resources.</p>	<p>Geography</p> <p>Language arts</p> <p>Math</p> <p>Science</p> <p>Visual arts</p>	<p>Describe some past and present examples of human impacts on waterfowl populations or wetland habitat.</p> <p>Explain the possible impacts of climate change and oil spills on waterfowl populations.</p> <p>Plan a stewardship activity that would benefit waterfowl through habitat restoration.</p>

APPENDIX D | K–12 Partnership with Natural Resources Professionals Example

Learn more about Jena Moon’s K–12 wetland and waterfowl conservation project with two wildlife refuges in Texas.

The mission of the McFaddin and Texas Point Alliance is: “To promote, enhance, restore, and conserve the resources of McFaddin and Texas Point National Wildlife Refuges. Working cooperatively with the U.S. Fish and Wildlife Service, the McFaddin and Texas Point Refuges Alliance will facilitate communication between the public and refuge personnel, encourage public awareness of and involvement in refuge operations and programs, and enhance scientific, educational, and recreational opportunities.”

The McFaddin and Texas Point Alliance is a nonprofit organization established to facilitate public education and communication at the McFaddin and Texas Point National Wildlife Refuge. Jena Moon is working with a variety of agencies and organizations to educate local students about the importance of Mottled Ducks and marsh conservation. The project objective is to enhance the effectiveness of outreach efforts by providing additional resources and volunteers in both indoor and outdoor classrooms. The project works with U.S. Fish and Wildlife Service partners at the refuges and is developing new partnerships (including Texas Parks and Wildlife Department [TPWD]) to build a curriculum based on standards set forth by the State of Texas through its Texas Assessment of Knowledge and Skills. The program integrates the community into the project by encouraging schools and students to build on existing outreach activities, and by encouraging sound recreation on Federal and State Wildlife Areas in southeastern Texas.

As an example, elementary and intermediate classes in Sabine Pass and Hamshire-Fannett Schools have the opportunity to work on a project that will focus on the Mottled Duck and its relationship with local wildlife refuges, state managed properties, and private lands. The McFaddin/Texas Point Refuge and surrounding properties are composed of intricate patchworks of coastal marsh, wetlands, bayous, coastal prairies, and other uplands. The Mottled Duck has been established as an indicator species for coastal marsh and wetland health and function by the U.S. Fish and Wildlife Service’s Strategic Habitat Conservation Plan. The Mottled Duck is a species of waterfowl that is increasingly less common along the Texas Gulf Coast, and population levels of this species are currently below goal numbers established by the Gulf Coast Joint Venture for Texas. Biologists have a relatively poor understanding of the Mottled Duck’s habitat use, regional movements, response to management (e.g., prescribed burning, mowing, changes in water depths, etc.), and movements between Refuge and other properties. Habitat quality/quantity and disturbance (e.g., hunting) may be important factors dictating Mottled Duck movements across time and available space.

Researchers attached 18-gram solar satellite radios to 10–15 Mottled Duck hens. These radios have a life expectancy of 2–5 years, far beyond that of conventional radio transmitters (typically only 6–8 months). Previously, researchers had attached conventional radios to hen Mottled Ducks on the refuge for 4 years. The satellite radios are needed to

document movements, in particular when hens depart refuge property. Additionally, satellite radios will increase time efficiency of biologists and decrease disturbance on this sensitive species.

Other objectives of the monitoring effort will include documenting coarse- and fine-scale habitat use, documenting seasonal movements of Mottled Ducks, and examining variability of responses in relation to climatic events (e.g., hurricanes, cold fronts, etc.), landscape habitat conditions (e.g., wetland availability), and disturbance. This information is important to resource managers along the upper Texas Coast and across the Mottled Duck range. It is needed to refine and improve habitat management practices (e.g., burning, grazing, hydrology manipulation, herbicide applications, mechanical treatments, etc.) to allow for changes in habitat management across the Mottled Duck's range.

The deployment of satellite transmitters offers conservation officers the unique opportunity to bring the refuge and a wealth of information to local schools. All factors affecting Mottled Ducks discussed above will be followed by chosen local schools via an interactive website, for the duration of the school year. U.S. Fish and Wildlife Service and TPWD employees will visit schools on three separate (USFWS-2 visits, TPWD-1 visit) occasions during the school year to discuss Mottled Duck locations, how they have changed, and possible reasons for the change. Additionally, staff will be tying the Mottled Duck study into other interesting facets of the marsh and management of the refuge and Wildlife Management Area. Students also will take a field trip to McFaddin National Wildlife Refuge where they will enjoy a field day of ecology-based activities including five different stations:

1. Learn how radio telemetry works and actually track wildlife like biologists.
2. Play interactive games teaching basic wildlife ecology (Project WILD and Project WILD Aquatic based).
3. Get up close to wildlife in an exhibit and touch tanks.
4. Seine for fish with TPWD coastal fisheries biologists and technicians.
5. Demonstrations of marsh equipment (airboats, marsh masters, amphibious excavators, etc.).

Teaching students the value of habitat and the importance of conservation is particularly important in southeastern Texas. Recognized by many scientists as one of the most biologically diverse regions in the continental U.S., this area comprises the majority of Mottled Duck habitat in Texas, with Mottled Duck densities remaining ten times higher on NWR land than the surrounding lands. Coastal Marshes in the local county have been impacted heavily by Hurricanes Rita and Ike, and there has been a significant rise in saltwater intrusion, causing a loss of Mottled Duck habitat. During Hurricane Ike, the refuge offices and visitor center were destroyed, further elevating the need for this educational project. Due to habitat loss and fewer facilities, students have fewer opportunities to visit natural areas and make connections with the natural environment. Therefore, it is important to make every such encounter meaningful and memorable.

There will also be a link on the website to “Ask a Biologist” where USFWS and TPWD staff will have the ability to field questions asked by either individual students or classrooms participating in the project. Furthermore, the U.S. Fish and Wildlife Service will be working closely with educators on all matters related to this project to ensure students will be receiving all the benefits this project has to offer.

APPENDIX E | *Vegavis iaai* – A 65 Million Year-Old Relative of Today’s Waterfowl¹

January 19, 2005

Relatives of Living Ducks and Chickens Existed Alongside Dinosaurs More Than 65 Million Years Ago

FOR IMMEDIATE RELEASE

Newly published North Carolina State University research into the evolution of birds shows the first definitive fossil proof linking close relatives of living birds to a time when dinosaurs roamed the earth.

Research by paleontologist Dr. Julia A. Clarke, an assistant professor in the marine, earth and atmospheric sciences department at NC State, and colleagues provides unprecedented fossil proof that some close cousins to living bird species coexisted with dinosaurs more than 65 million years ago. Information from a new avian species called *Vegavis iaai* indicates that these birds lived in the Cretaceous period and must have survived the Cretaceous/Tertiary (K/T) mass extinction event that included the disappearance of all other dinosaurs.

Analysis of fresh evidence from computed tomography (CT) scans of the fossil—which uncovered new bones deep within the rock matrix—and recovery of latex peels made of the specimen just after its discovery in Antarctica in 1992 revealed its importance to avian evolution and that it represented a new species. This partial skeleton is the most complete specimen from the Cretaceous to be found to have its evolutionary relationship to a living bird group. These new data show *Vegavis* is within the group Anseriformes, which includes ducks and geese.

The research is published in the January 20 edition of the scientific journal *Nature*.

The question of whether relatives of living birds existed alongside non-bird dinosaurs has evoked intense recent controversy in scientific circles. Some scholars, arguing from some “molecular clock” models and new DNA sequence data as well as the distribution of living bird groups, have concluded that relatives of living birds must have existed alongside non-avian dinosaurs and survived the mass extinction of dinosaurs at the K/T boundary, about 65 million years ago. Until the discovery of *Vegavis*, fossil data to support this hypothesis was weak at best.

Other scientists have claimed this limited previous data was unreliable and that the fossil record showed no evidence of living bird lineages in the Cretaceous. In a “big bang” theory of bird evolution, these scientists have proposed that relatives of today’s birds came on the scene only after non-avian dinosaurs became extinct at the K/T boundary.

“We have more data than ever to propose at least the beginnings of the radiation of all living birds in the Cretaceous,” Clarke says. “We now know that duck and chicken relatives coexisted with non-avian dinosaurs. This does not mean that today’s chicken and duck

¹ Used with permission from the North Carolina State University News Services. 11/10/10 http://www.ncsu.edu/news/press_releases/05_01/015.htm Mick Kulikowski, News Services, 919/515-3470; also appears adapted in the *Youth Guide*.

species lived with non-avian dinosaurs, but that the evolutionary lineages leading to today’s duck and chicken species did.”

The fossil’s fragility—the specimen was damaged as it was being prepared for study – led to difficulties in conducting a full examination in 1992. Earlier this year, Clarke received a grant from the National Science Foundation to give the fossil—named for the location it was discovered (Vega Island in western Antarctica) and for the name of the party that made the discovery (the Instituto Antártico Argentino, or IAA)—a second look with a team of colleagues from Argentina and the United States.

Clarke and her fellow scientists conducted new analyses on the fragile partial skeleton. CT scans were performed on the fossil for the first time; these X-rays uncovered new bones in the rock matrix, including a number of vertebrae, pelvic bones, and arm and leg bones. The researchers also found the original latex peels – applied to the fossil before any other preparation had been done—that provided a mirror image of the bones originally exposed on the rock surface.

The newly discovered bones and latex peels allowed the scientists to compare features of *Vegavis* to other birds and determine its evolutionary relationships. Clarke and her colleagues used some of the largest data sets available and all placed *Vegavis* within the radiation of living birds—as most closely related to ducks and geese. Histological analysis of the bone tissues present in a cross section of a *Vegavis* arm bone not only indicates that *Vegavis* was an adult at the time of death but also supports inference of its evolutionary relationships from the independent phylogenetic results.

The data place *Vegavis* within *Aves*, which includes common ancestors of all living birds we have today and all its descendents—that is, the radiation of all living birds—and specifically within one group of *Aves* called *Anseriformes*, the waterfowl, which includes ducks, geese and allies. Within this group *Vegavis* is positioned close to the lineage leading to true ducks and geese, called *Anatidae*.

Clarke will now continue her search for more clues to the evolution of birds. “Looking to the Cretaceous for more parts of extant avian radiation is essential,” she says.

Funding for the research came from an NSF Office of Polar Programs Small Grant for Experimental Research.

APPENDIX F | Macroinvertebrate Biotic Index

Critter Cube Count

(See pages 183–184 for full size versions.)

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

No. of group 1 animals circled:

Relative Size Key:
 = larger than picture
 = smaller than picture

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

No. of group 2 animals circled:

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

No. of group 3 animals circled:

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

No. of group 4 animals circled:

For more information, call (920) 255-3887 or (920) 244-0943. Download and print data sheets from watermonitoring.uwex.edu/watermonitoring/sheets.html

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Water Action Volunteers

Macroinvertebrate Tally Sheet Recording Form *

Name: _____ Date: _____
 Stream Name: _____ Time: _____
(Under 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

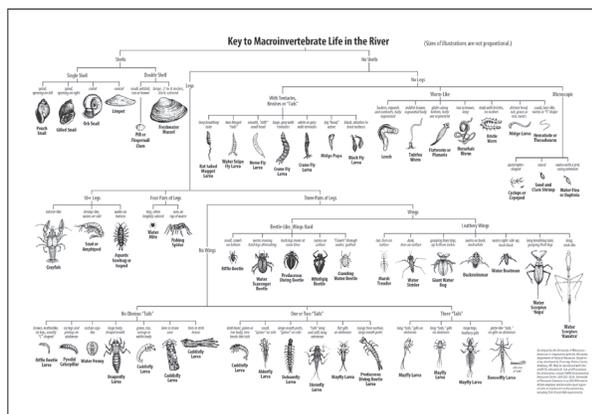
Poor = index score of 1.0 – 2.0

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

Key to Macroinvertebrate Life in the River

Wisconsin Action Volunteers (WAV): <http://watermonitoring.uwex.edu/pdf/level1/riverkey.pdf>

(See page 185 for full size version. Provided as 8.5" x 11" size in the guide. For best results, enlarge Key on a photocopier by approximately 130% onto 11" x 17" paper.



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



Stonefly Larva



Dobsonfly Larva



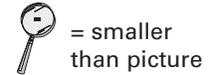
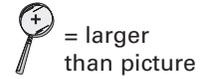
Alderfly Larva



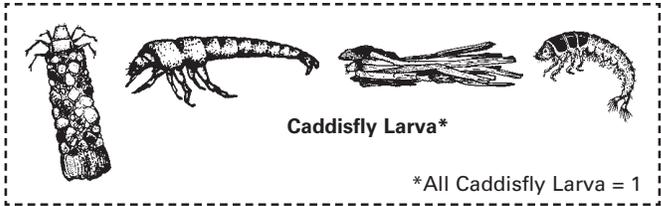
Water Snipe Fly Larva

No. of group 1 animals circled:

Relative Size Key:



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



Caddisfly Larva*

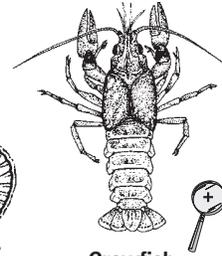
*All Caddisfly Larva = 1



Dragonfly Larva



Water Penny

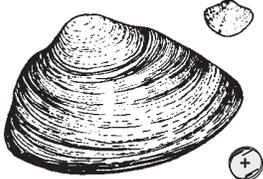


Crawfish

No. of group 2 animals circled:



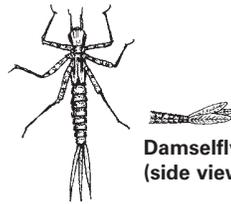
Crane Fly Larvae



Freshwater Mussel or Fingernail clam



Mayfly Larva



Damselfly tail (side view)

Damselfly Larva



Riffle Beetle Larva*

Riffle Beetle Adult*

*All Riffle Beetles = 1

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



Black Fly Larva

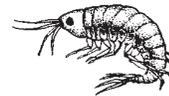


Non-Red Midge Larva



Snails: Orb or Gilled (right side opening)

*All Snails = 1



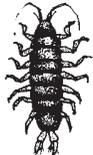
Amphipod or Scud

No. of group 3 animals circled:

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



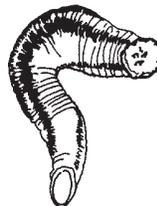
Pouch Snail (left side opening)



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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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

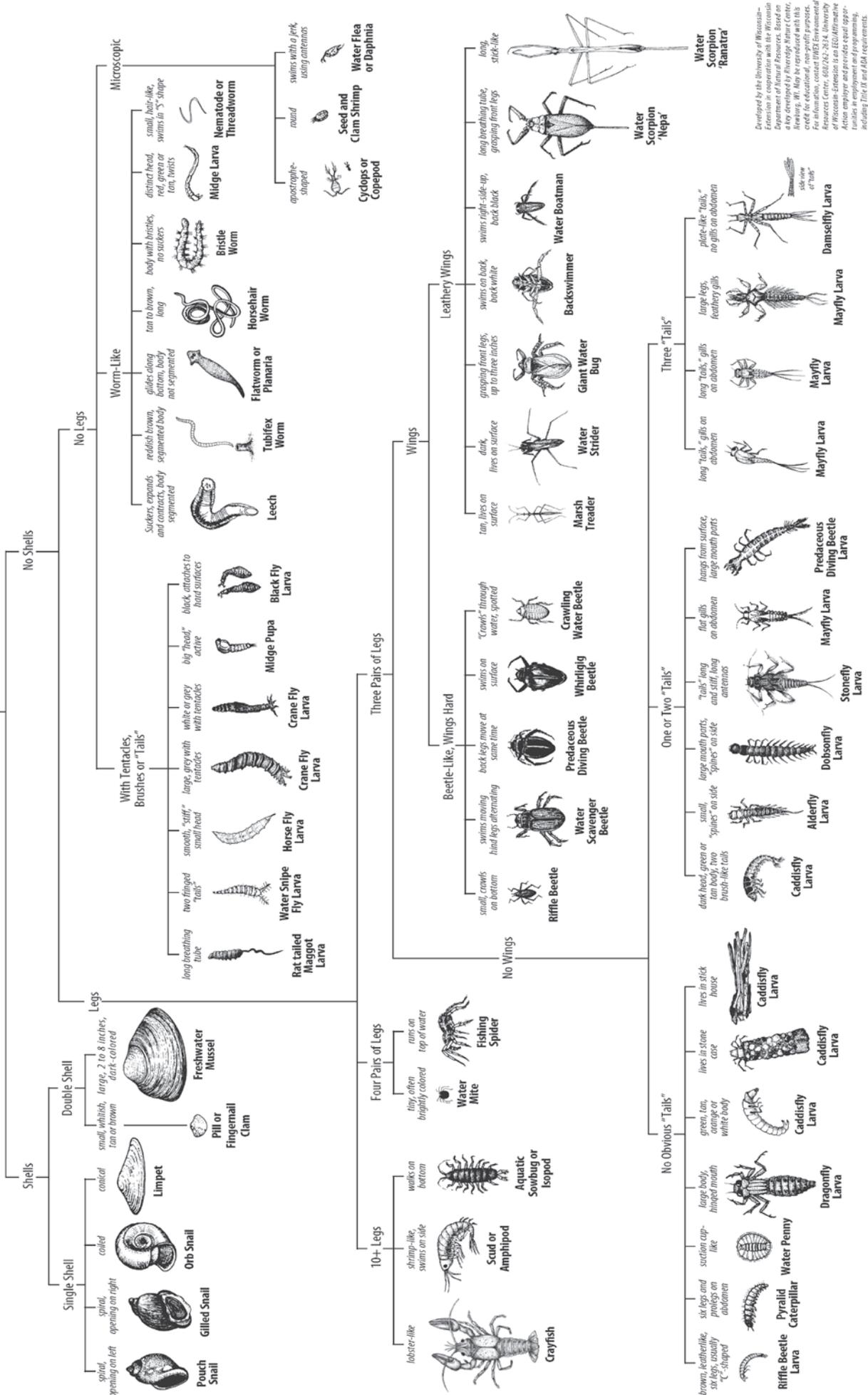
Poor = index score of 1.0 – 2.0

*Adapted from *Holding onto the Green Zone*, University of Wisconsin and Action Volunteers, University of Wisconsin-Extension and Wisconsin Dept. of Natural Resources, 2008.



Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)

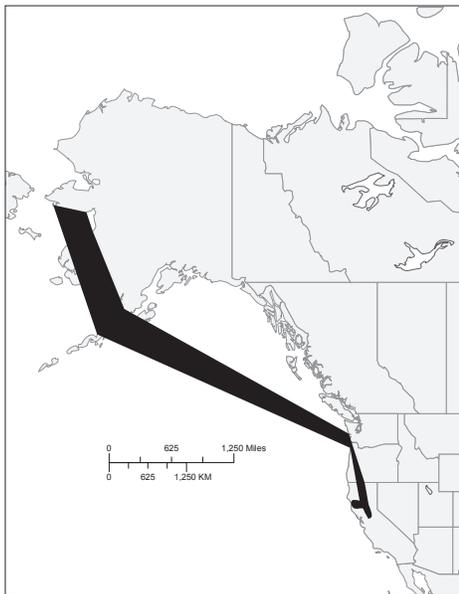
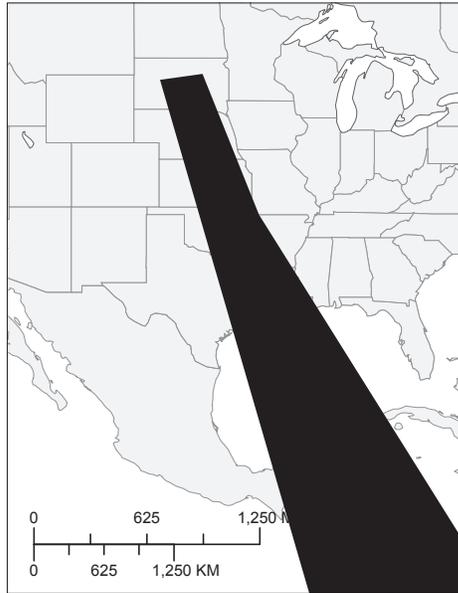
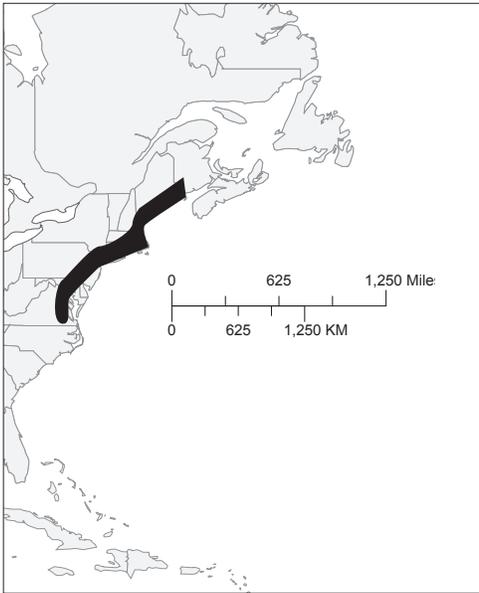


Developed by the University of Wisconsin-Extension in cooperation with the Wisconsin Department of Natural Resources. Based on a key developed by Riverside-Nature Center, Haverly, WI. May be reproduced with the permission of the University of Wisconsin-Extension. For information, contact DNR's Environmental Resources Center, 608/262-2634. University of Wisconsin-Extension is an EEO/Affirmative Action employer and provides equal opportunities in employment and programming. Including Title IX and ADA requirements.

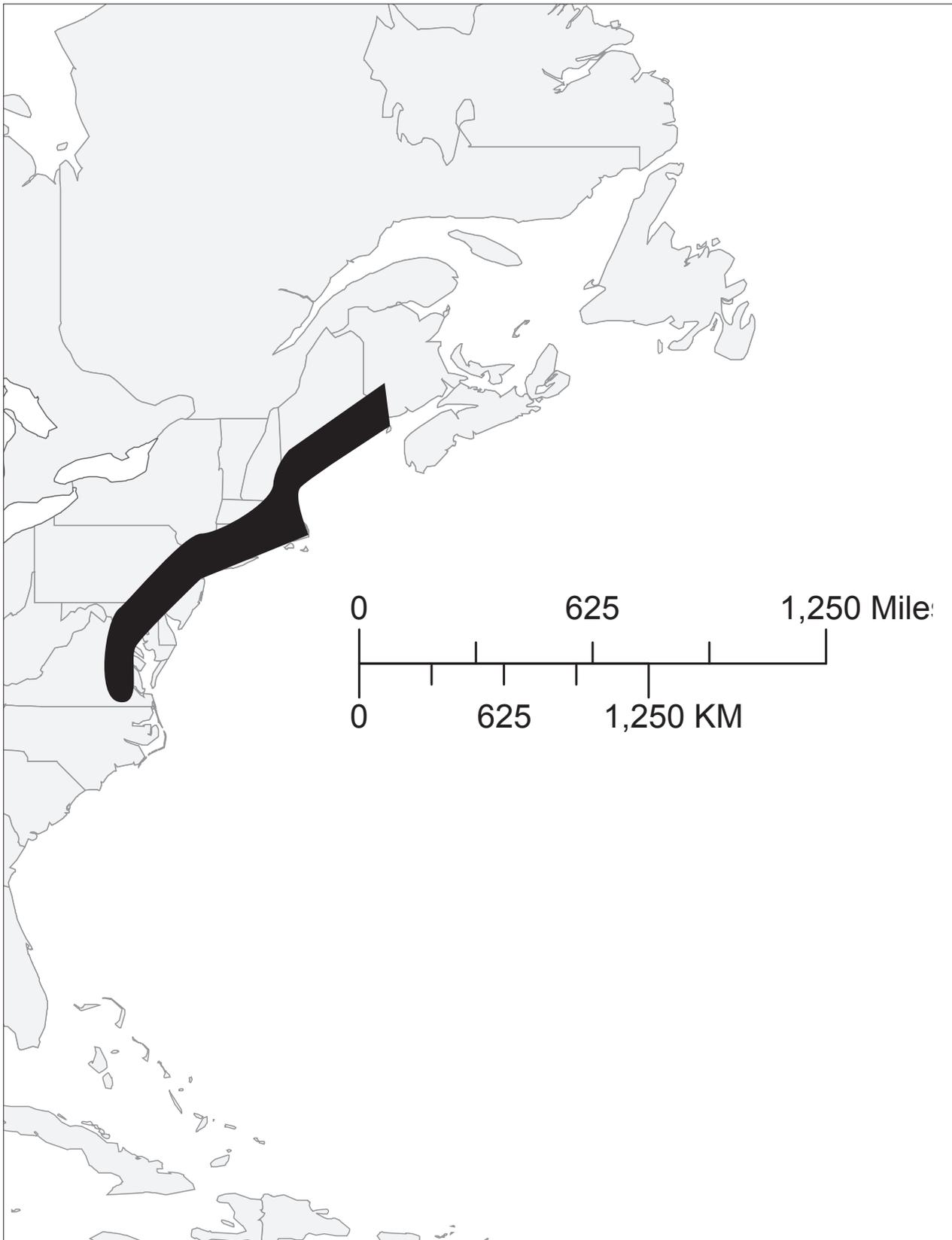
Adapted from *Water Action Volunteers*, University of Wisconsin-Extension and Wisconsin Department of Natural Resources, 2008.

APPENDIX G | Migration Math Maps

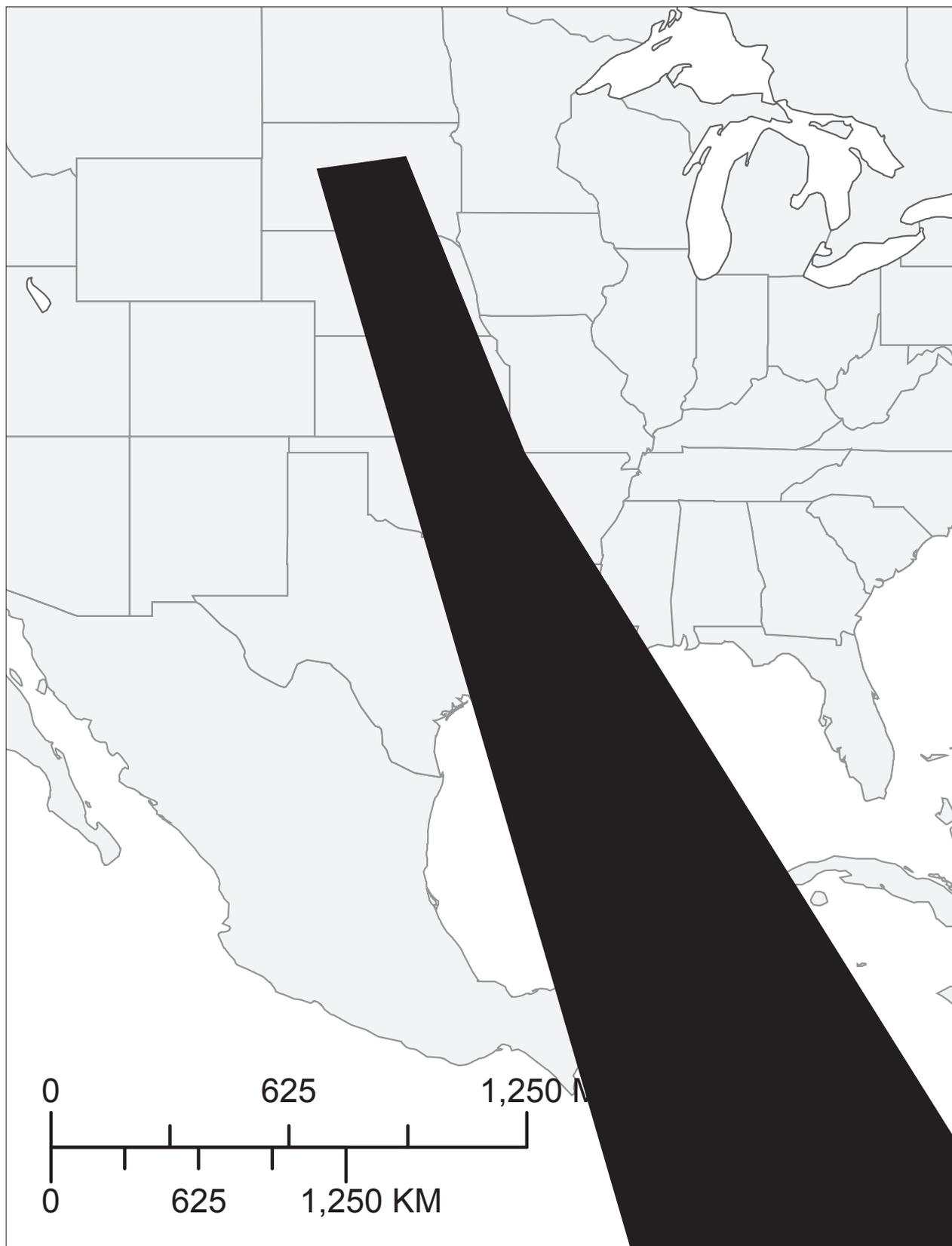
Full size maps from page 130 in the *Youth Guide* are found on the following pages.



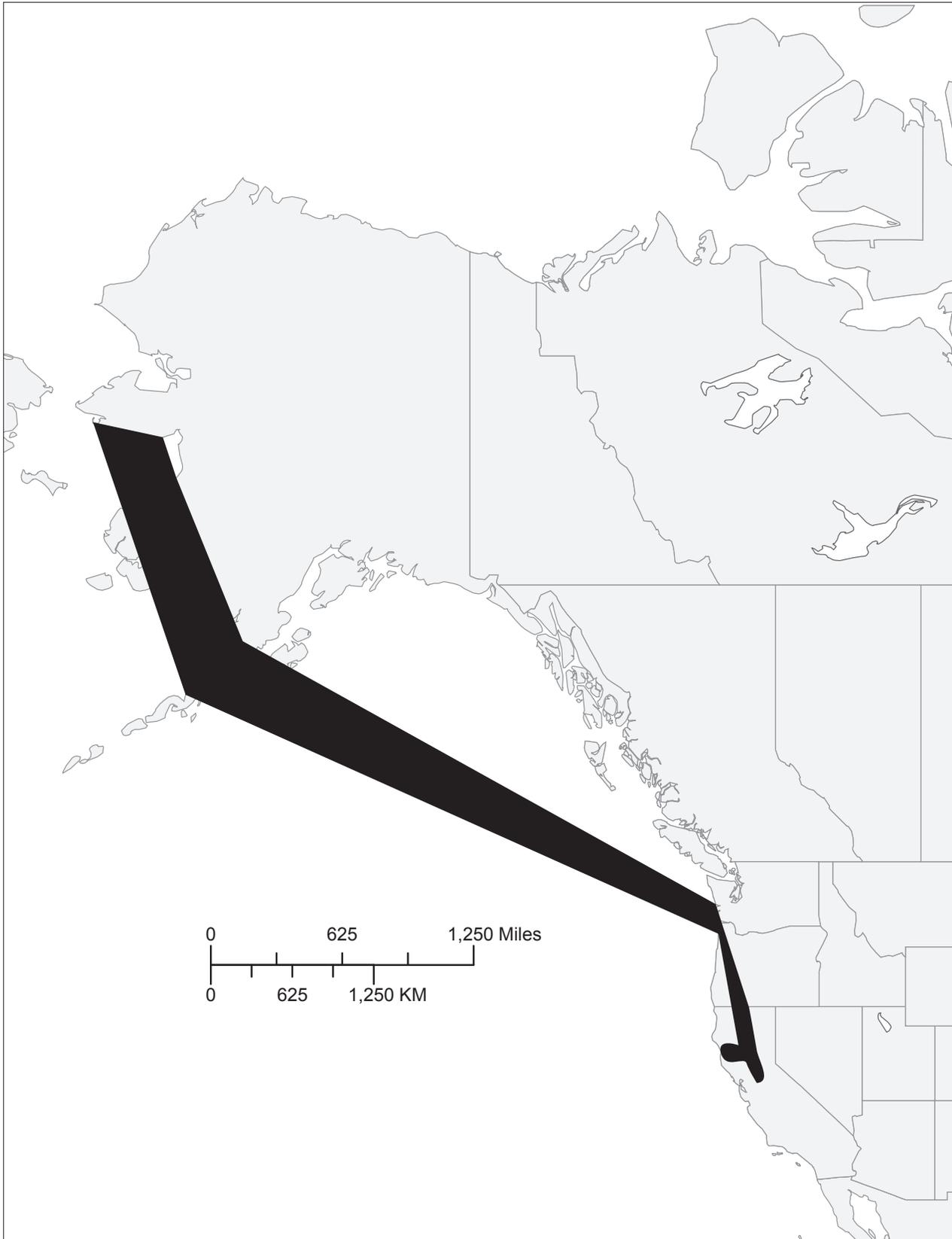
Unit 4. Migration Math | Atlantic Flyway | Black Duck



Unit 4. Migration Math | Central Flyway | Green-winged Teal



Unit 4. Migration Math | Pacific Flyway | White-fronted Goose



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