



## 2.0 Wildlife Ecology

### 2.1 Introduction

**Wildlife** are the animals that live wild in a country. Animals include amphibians, reptiles, fish, mammals, birds, and invertebrates. Invertebrates are generally not included as wildlife, with the exception of crustaceans that are used by humans for food or bait. Only animals native to the country are usually considered wildlife and **domesticated** animals that have become **wild**, or feral, are usually not included.

The term wildlife is arbitrary depending upon who is using it. Today most government wildlife management agencies in U.S. have an interest in reptiles, amphibians and small animals that are not used by humans nor are seen as pests, as well as being interested in traditional game species. In the past, wildlife management agencies were only concerned with **game** and **vermin**. However, game and vermin species are still the major focus of wildlife management agencies. Partially this is a result of the history of interest and greater quantities of research into these species. Since we know much more about these animals, it is much easier to make management decisions regarding them. Non-government agencies that are interested in the conservation of wildlife may use a very broad definition of wildlife, focus specifically on the non-game species or take a non-utilitarian stance on game species. As our societies have begun to express the wider interest utilitarian and non-utilitarian values of animals, the term wildlife has become more inclusive.

Regardless of your definition of wildlife, all living organisms have needs for the continual survival of their species. These needs are grouped together and called **habitat**, which includes food, water, shelter and space. Animals are **adapted** to their environment and therefore may have specific habitat requirements that may be different or overlap with others. Animals with overlapping requirements can sometimes find themselves in **competition** for limited resources. The **carrying**

**capacity** of the habitat as well as predator and disease influence the population of wildlife. Populations normally fluctuate and some **populations** follow cyclical patterns of high population followed by decreases to a low population at which time the populations start to grow again until they hit a high number and start to decrease again. A constant population size is not in a natural equilibrium.

The term "habitat" describes the environmental conditions where wildlife species live. Food, water, cover, and space all contribute to the basic habitat needs for all organisms. These factors are responsible for determining species numbers and distribution and, when in short supply, can be the limiting factor (Environment Canada, 2013).

- **Food** – a requirement to meet an animal's energy demands: growth, reproduction, predatory avoidance, surviving long winters and migrations. Certain species are more specific to what food item they invest time into locating and consuming (i.e. specialist vs. generalist).
- **Cover** – shelter is required to either protect the animal from the elements, avoid predation, or raise young. Dense vegetation is the most common, but downed woody debris, cavities, pits, mounds, and rock piles can also serve similar purposes.
- **Water** – an essential requirement for all living organisms. Certain species obtain water from their diet/food and some are required to ingest it directly. Like humans, without water many species are unable to survive as it forms the basis of their biological functions.
- **Space** – animals need space to survive. Overcrowding increases competition for food, cover, and water but can also lead to the rapid spread of disease or parasites. For example, whitetail deer (*Odocoileus virginianus*) require a mix of open and forest cover to protect their fawns and bald eagles (*Haliaeetus leucocephalus*) require large trees in proximity to shorelines to raise their young. All species are, to a certain extent, territorial to ensure proper spacing and prevent overcrowding.
- **Abiotic** – non-living chemical and physical parts of the environment that affect living organisms and the functioning of ecosystems
- **Biotic** – the living things that shape an ecosystem

### 2.1.1 Wetland Habitat

Wetlands are important habitats for many terrestrial and aquatic organisms. In Illinois, approximately 42 percent of all the native plant species are wetland species (Illinois Department of Natural Resources 1994). There are also a number of plant species usually associated with upland areas that can survive in wetlands. The US Fish and Wildlife Service has identified a total of 6,728 species of plants that occur in wetlands throughout the United

States (Reed 1988). Because wetlands are highly productive and support a diversity of plant life, they are an important source of food and habitat for wildlife. This productivity helps support commercial and recreational fish and waterfowl harvests throughout the Illinois and the rest of the world (Illinois Department of Natural Resources 1997).

There are several species of animals dependent upon wetlands for their day to day survival. Most people readily identify some of these animals, such as frogs and ducks, as wetland species. There are, however, many other species of wildlife usually associated with upland or deep water areas that depend on or use wetlands for feeding, spawning, and/or resting grounds at some point in their life cycles. Most people do not readily identify these various species of shiners, sunfish, bats, and terns with wetlands. They also do not realize many well-known species, such as bald eagles and bobcats, are also commonly found in and around wetlands.

In rivers, streams, and most lakes the constant flow of water washes away many of these nutrients. But in marshes, and other wetlands, nutrients tend to remain and accumulate. In northern regions, where water levels are relatively stable, nutrients often become trapped in the bottom sediments; but in southern regions they are released each year during spring flooding. This is one of the reasons why wetlands in southern regions are so productive and why they attract so many forms of wildlife. Wetlands also provide necessary and valuable services to humans.



**Photo by: Illinois Natural History Survey, Forbes Biological Station staff**

### **2.1.2 Forest Habitat**

An ecosystem's ability to support wildlife depends on the amount of forest cover, size of individual forest patches, forest type, and linkages to other patches in a landscape. Mammals and forest interior birds require extensive forests. More is known about the habitat requirements and distribution of forest birds than any other group of wildlife, and for this reason they are most often used as an indicator of the quality of the forest.



**Wood Thrush on nest, Source: All About Birds website**

### 2.1.3 Riparian Habitat

Riparian areas are the zones along water bodies that serve as interfaces between terrestrial and aquatic ecosystems. Riparian ecosystems generally compose a minor proportion of the landscape. Typically, however, they are more structurally diverse and more productive in plant and animal biomass than adjacent upland areas. Riparian areas supply food, cover, and water for a large diversity of animals, and serve as migration routes and connectors between habitats for a variety of wildlife (Manci 1989).



**Aerial photograph of an environmental corridor. (Reprinted from Conservation Corridor Planning at the Landscape Level Handbook, USDA NRCS.)**

Riparian areas are important in mitigating or controlling nonpoint source pollution. Riparian vegetation can be effective in removing excess nutrients and sediment from surface runoff and shallow ground water and in shading streams to optimize light and temperature conditions for aquatic plants and animals. Riparian vegetation, especially trees, is also effective in stabilizing streambanks and slowing flood flows, resulting in reduced downstream flood peaks.

Riparian areas are often important for their recreation and scenic values, such as hunting, fishing, boating, swimming, hiking, camping, picnicking and bird watching. However, because riparian areas often are relatively small areas and occur in conjunction with watercourses, they are vulnerable to severe alteration.

Riparian ecosystems throughout the United States have been heavily impacted by human activities, such as highway, bridge, and pipeline construction; water development; channel modifications for flood control; recreation; industrial and residential development; agriculture; irrigation; livestock grazing; logging; and mining. Offsite disturbances in the watershed that change watershed hydrology can also have adverse effects on the composition and productivity of riparian plants and corresponding animal associations (Manci 1989).

## 2.2 Food Chains & Species Interactions

Within an ecosystem there are **food chains** and **food webs**. Both of these systems organize organisms based on a trophic level system (Figure 3). The basis of a food chain is a primary producer which is an organism that produces organic compounds from inorganic compounds. Plants undergoing photosynthesis by utilizing carbon dioxide and energy from the sun to produce oxygen and complex sugars are a good example of this. **Primary consumers**, also known as **herbivores**, are organisms which feed solely on these primary producers. An excellent example of an herbivore is the white-tailed deer (*Odocoileus virginianus*). Moving up the food-chain we have our secondary and tertiary consumers. Some of these consumers are **carnivores**, organisms which feed solely on other animals (e.g. wolves). Some carnivores are **predators**, as they hunt other animals as **prey**, while other carnivores are **scavengers**, feeding on the carcasses of dead animals. Lastly, **omnivores** are animals which feed on both plant and animal matter, for example, black bears (*Ursus americanus*) (Schraer & Stoltze, 1993). Omnivores can be secondary or tertiary consumers.

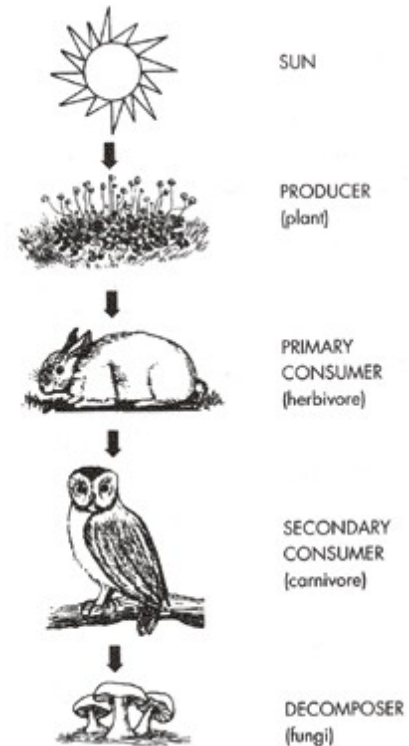


Figure 3. Simple Food Chain (Study Everywhere, 2015)

The soil food web (Figure 4) is the community of organisms living all or part of their lives in the soil. A food web diagram shows a series of conversions (represented by arrows) of energy and nutrients as one organism eats another.

All food webs are fueled by the primary producers: the plants, lichens, moss, photosynthetic bacteria, and algae that use the sun's energy to fix carbon dioxide from the atmosphere. Most other soil organisms get energy and carbon by

consuming the organic compounds found in plants, other organisms, and waste by-products.

As organisms decompose complex materials, or consume other organisms, nutrients are converted from one form to another, and are made available to plants and to other soil organisms. All plants - grass, trees, shrubs, agricultural crops - depend on the food web for their nutrition.

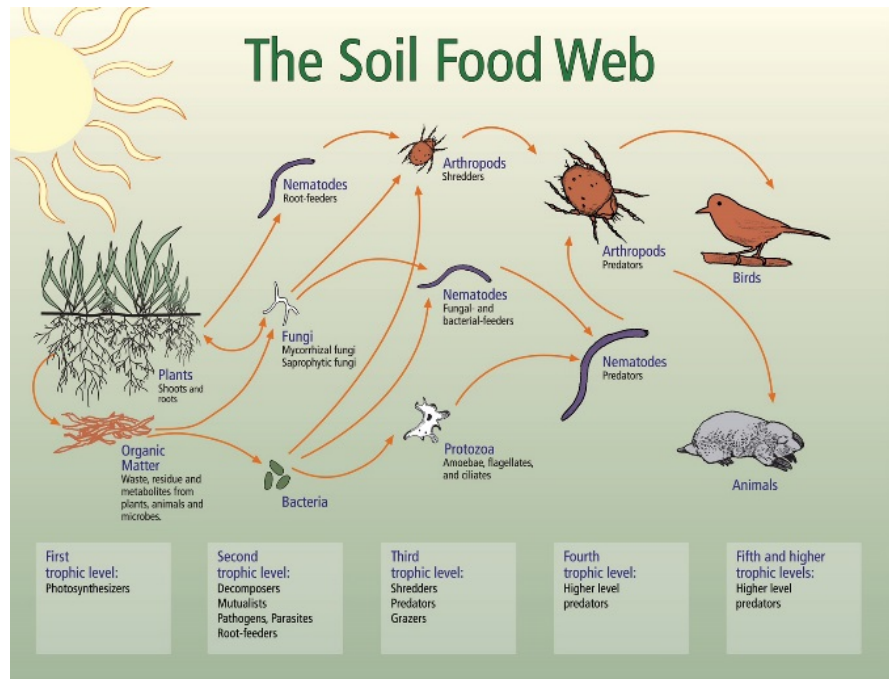


Figure 4. NRCS Soil Biology Primer

### 2.2.1 Species Interactions

Symbiosis is the close and long-term interaction between two different biological species. Mutualism, parasitism and commensalism are different examples of symbiotic relationships.

**Mutualism** is the way two organisms of different species exist in a relationship in which each individual benefits from the activity of the other. These species work together which each benefiting from the overall relationship. A great example of a mutualistic relationship is the bee and flower. Bees fly from flower to flower gathering the nectar which they make into food. During this process they also pick up pollen from one flower and transfer it to the next one, helping to pollinate the plant.



**Parasitism** is a non-mutual relationship where one organisms gains while the other suffers. The parasite (gain) attacks the host (sufferer), and may cause sickness but unlikely death. One such example is the deer tick, which feeds on deer blood and may cause sickness to the deer.



**Commensalism** is where one species benefits while the other is neither helped nor harmed. The benefits for the one organism can be food, shelter, transportation or seed dispersal. One example would be beavers making dams to create a new water body that fish, waterfowl and many other animals can use for food, water, shelter and raise their next generations.



### 2.3 What Makes Habitat Suitable?

Scientists have been studying particular species for many years to understand their habitat requirements and how to manage them. *Habitat Suitability Index Models (HSI)* provide habitat information for evaluating impacts on fish and wildlife habitat resulting from water or land use changes. These models are used to serve as a basis for improved decision-making and increased understanding of habitat relationships because they specify hypotheses of habitat relationships that can be tested and improved (Source: USGS National Wetlands Research Center, n.d.).

### 2.4 Carrying Capacity

Carrying capacity is the maximum quantity of a species an area will support without deteriorating (Merriam- Webster, 2015). As mentioned previously, populations which become too large typically decline drastically or “crash” when their habitat is no longer able to support them. Fortunately, predator-prey relationships often regulate population numbers to decrease the chances of exceeding the carrying capacity. Similarly, the predator population is also kept in check by the size of the prey population and fluctuates accordingly. It is evident that predator-prey relationships are essential in regulating populations and therefore preventing the carrying capacity from being exceeded (Source: McGraw-Hill Companies, n.d.).

*Illinois is home to some 58 mammal species, 383 different resident and migrant birds, 104 types of reptiles and amphibians, 174 species of fish, and some 27,000 types of insects, mussels, and other invertebrates. There are more than 2500 species of plants and more than 1,000 species of fungi and algae, and hundreds of lichens and mosses. (Sources: Illinois Environmental Council, Illinois Department of Natural Resources, and the Illinois Ornithological Society)*

## Case Study – Raccoons and Songbirds in Illinois

Biodiversity is crucial to maintain healthy, resilient ecosystems. A variety of stable wildlife populations is a common indicator of ecosystem health and is important for all species in a food web.

Case Study Paper (See Illinois Envirothon Wildlife Manual Toolbox):

### **Nest Predation and Population Declines in Illinois Songbirds: a Case for Mesopredator Effects**

Researcher: Kenneth A. Schmidt

This case study illustrates the potential impacts on songbirds when the top predator is removed or declines in numbers allowing for the potential increase in mesopredator numbers. A mesopredator is defined as a medium-sized predator which often increases in abundance when larger predators are eliminated. When wolves were present in Illinois, they were considered a top predator, and coyotes were a mesopredator and were prey of wolves. However, with the expatriation of wolves from Illinois, coyotes are now a top predator throughout Illinois.

In regions of Illinois where coyote populations have been severely reduced by means such as hunting, disease, or malnutrition, other mesopredators such as raccoons, skunks, foxes, and opossums can increase in numbers. As these mesopredator numbers increase, there is an increased pressure on prey species that these mesopredators can more easily access that the primary predator may have passed up as prey, or had indirectly helped the prey numbers by keeping the mesopredators in check. This, in turn, can have a detrimental effect on the prey species that the mesopredators prey on, such as songbirds.

As seen in this case study many factors – including, but not limited to genetics, food sources, disease, and the presence of other wildlife species, such as predators – are highly influential in population dynamics in a habitat. One species can have a tremendous impact on another which reiterates the importance and value of increased biodiversity (McGraw-Hill Companies, n.d.).



## 2.5 Indicator Species

An **indicator species** is an organism whose presence, absence and/or abundance reflect specific environmental conditions. Indicator species can show a change in a specific ecosystem through biological conditions. By studying indicator species you can assess the health of an ecosystem (Jaffe et. al., 2012).

Examples of indicator species include:

- **Insects:** Honeybees and butterflies are pollinators that indicate and strongly influence the health of plant populations. They are highly sensitive to a plethora of factors, including temperature and weather, parasites, and air, water and soil quality. All of these factors can help assess the overall health of an ecosystem (Libal and Media, 2015).
- **Frogs:** Their shell-less eggs, absorbent skin, moisture dependence, predatory feeding, and their amphibious life cycles make them vulnerable to changes on land and in water. They are often used to monitor and track changes in water quality, and overall environmental health (Libal & Media, 2015).
- **Lichens:** They are indicator species for air quality due to different types of lichens being susceptible to different pollutants. Certain compounds can affect certain species differently when in an ecosystem. Some compounds can cause a certain species population to grow at exponential rates whereas that same compound could cause other species to die (Libal & Media, 2015).

## 2.6 Seasons and Wildlife

The change in seasons has a huge impact on behaviors of wildlife. From migration to hibernation, animals have to adapt to changes in the ecosystem in order to survive.

### 2.6.1 Migration

Migration is the seasonal movement of animals from one area to another area. Migration may be a means of avoiding harsh environmental conditions, to find food, or to travel to breeding grounds (Parry, 2010). Many animals throughout North America and the world practice migration, from large mammals to small insects. The act of migration may be carried out by flight, through water or on land.

### Bird Migration

Over 1000 bird species in the US are considered to be 'migratory' (US FWS, 2010). Nearly all of these birds migrate north to the US to breed and raise their offspring, and migrate south to favorable environmental conditions, food and habitat for the winter months. Some birds have relatively short flights, migrating across North American borders into the southern United States and Mexico for winter, while others travel much farther such as the arctic tern, whose journey spans nearly from pole to pole (The Arctic Tern Migration Project, n.d.).

Examples of Illinois migratory birds

- Sandhill Crane (*Grus canadensis*)
- American Golden Plover (*Pluvialis dominica*)
- American White Pelican (*Pelecanus erythrorhynchos*)
- Canvasback Duck (*Aythya valisineria*)
- Ruby-throated Hummingbird (*Archilochus colubris*)
- Turkey Vulture (*Cathartes aura*)

### **American Golden Plover**

During late April, nearly all of the American golden-plovers on the planet congregate in Illinois' open fields. There are only about 150,000 of these rare birds on Earth today due to market hunting in the 19th and early 20th centuries. Each spring, they migrate from South America up through North America to their summer breeding grounds in the Arctic. Along the way, they stop in Illinois to feed in fields and prairies, such as the Conservancy's Kankakee Sands. In fact, the American golden-plover makes one of the longest migratory journeys of any shorebird. (Top Five Must-See Migrations in Illinois, The Nature Conservancy)



Figure 5. American Golden Plover (*Pluvialis dominica*) (Audubon Guide to North American Birds)

## 2.6.2 Mammal Migration

Birds are not the only wildlife that migrate, some mammals migrate as well. These include marine mammals such as seals and whales, flying mammals such as bats, and terrestrial mammals such as caribou and polar bears. Bat species in Illinois are triggered into a migration caused by cool temperatures in the fall, forcing them to travel to either caves, or warm tree cavities much farther south in order to hibernate for the winter months (Hinterland, 2005).

Bats are the only mammals that actually migrate in Illinois, and only two species of the 12 species found in Illinois do an annual migration- the Evening Bat (*Nycticeius humeralis*) and the Hoary Bat (*Lasiurus cinereus*).

Evening bats roost in buildings (in attics or walls) and trees (under loose bark or in cavities). Maternity colonies in buildings can include hundreds of females, which typically give birth to two young in June. Evening bats are early evening fliers, and eat beetles, flies, leafhoppers, and moths. Evening bats are a rare bat in Illinois, and may migrate long distances to warmer regions in the autumn. (Source: Joyce E. Hoffman, Illinois Natural History Survey)



**Figure 6. Evening Bat (*Nycticeius humeralis*) (Heather Kaarakka/Wisconsin Department of Natural Resources)**

## 2.6.3 Invertebrate Migration

Many different species of insects including beetles, dragonflies, butterflies and moths migrate. Most invertebrate species found in Illinois have developed strategies to withstand the cold such as entering into dormant states, using a type of 'antifreeze' or simply having adults die off leaving larval stages of the invertebrate to lie dormant and overwinter (McDonough, 2011). For some species, however, avoiding the winter entirely has been the strategy to survive the cold, harsh winters Illinois provides. These invertebrates often travel by flight from Illinois to the southern states of the U.S., however some make a much further journey, such as the monarch butterfly travelling into Mexico (The Nature Conservancy, 2015b).

Examples of Illinois Migratory Invertebrates:

- Monarch Butterfly (*Danaus plexippus*)
- Green Darner (*Anax junius*)
- Giant Swallowtail Butterfly (*Papilio cresphontes*)
- Black Saddlebag (*Tramea lacerata*)

## Monarch Butterflies

One of the most well-known species of migratory insects is the monarch butterfly (*Danaus plexippus*) (Figure 7). Though there are different populations, eastern populations of monarch butterflies migrate annually from their winter home in Mexico to the United States and Canada once the weather begins to change. Female monarchs lay their eggs in their northern residence between March and April, giving life to the first new generation of monarchs (The Nature Conservancy, 2015b). However, only monarchs that are born late in the summer have a prolonged life span and make the 2796 miles journey to Mexico in autumn (WWF, n.d.). Western populations behave in a similar manner; however they migrate west of the Rocky Mountains and overwinter in California (WWF, n.d.).



Figure 7. Monarch Butterflies - *Danaus plexippus* (Smith, 2015)

## 2.7 North American Flyways

No two bird species travel the exact same migration route or distance and many migration routes have varying levels of complexity. Despite these differences, bird migrations all tend to follow general land masses such as coast lines, mountain ranges, and large river systems. These North and South migration routes have been given the name 'flyways' and have been divided into four distinct routes based on geographic structure (e.g. mountain ranges or water sheds), habitat requirements (e.g. tall grass prairie, wetlands), and/or food requirements (Figure 8).

### Pacific Flyway

The Pacific Flyway stretches from the Arctic Archipelago, through Alaska, British Columbia, the Yukon, and throughout the western states of the U.S. (with some species travelling to Mexico and beyond) (Ducks Unlimited, n.d.). This flyway covers diverse terrain from the arctic tundra, through the Rocky Mountains, as well as desert regions further south. Species like the varied thrush (*Ixoreus naevius*), snowy plover (*Charadrius nivosus*) and least tern (*Sternula antillarum*) migrate along this flyway (Audubon, 2015).



Figure 8. North American Flyways (Ducks Unlimited, n.d.)

### Central Flyway

The Central Flyway covers many arctic islands south to Central and South America, travelling through the Prairie Provinces in Canada, as well as the mid-western Great Plains states. Many grassland species such as the lesser prairie-chicken (*Tympanuchus pallidicinctus*) and whooping crane (*Grus americana*) migrate along this flyway (Audubon, 2015). Modern agriculture has resulted in the disappearance of many grasslands, which is threatening the existence of these migrating birds found along this flyway (Audubon, 2015).

### Mississippi Flyway

The Mississippi Flyway is quite geographically flat, with no significant ridges, mountains or hills large enough to interfere with bird migration (The Nutty Birdwatcher, 2001). The flyway encompasses Illinois, Saskatchewan, Manitoba, and the central-eastern states (Ducks Unlimited, n.d.). This flyway also encompasses the Great Lakes as well as the large Mississippi river system and the Gulf Coast. Nearly half of North America's bird species spend at least some time on the Mississippi flyway (Audubon, 2015). Species such as the mottled duck (*Anas fulvigula*), little blue heron (*Egretta caerulea*), and brown pelican (*Pelecanus occidentalis*) use this flyway during migration (Audubon, 2015).

### Atlantic Flyway

The Atlantic Flyway encompasses Newfoundland, Labrador, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and some of the eastern US. This flyway is used by small land birds such as wood thrushes (*Hylocichla mustelina*), prothonotary warblers (*Protonotaria citrea*), and American woodcocks (*Scolopax minor*), as well as sea and shore birds such as the Arctic tern and the piping plover (*Charadrius melodus*) (Audubon, 2015). This flyway is the most densely populated by humans, and therefore most susceptible to human interference (Ducks Unlimited, n.d.).



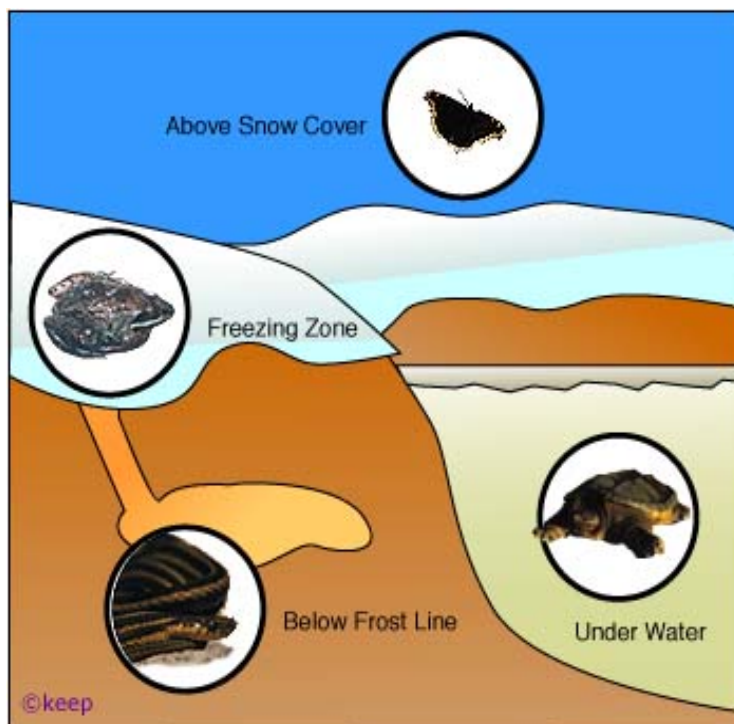
Geese in formation in December, DeWitt County, IL, E. Burns

## 2.8 Hibernation

**Hibernation** is a response to colder temperatures, in which an animal finds or makes a living space that protects it from winter weather and predators, and so that the animal can slow its metabolism using only its stored energy sources to survive the winter (Scientific American, 1997). Animals hibernate in a living space called a **hibernacula**.

### ***Animals that hibernate in Illinois:***

- Amphibians
  - Frogs – hibernate within mud, under leaf litter, or in cracks and crevices of logs or rocks and emerge in spring
- Reptiles
  - Turtles – hibernate underwater in ponds, rivers, wetlands and other freshwater sources and emerge in spring
- Mammals
  - Meadow Jumping Mouse- hibernates in 20 inch deep small earthen chambers plugged with earth and curled up in a nest of dry plant fibers. Many do not survive hibernation because of insufficient fat reserves.
  - Little Brown Bat – hibernates and over winter in caves or abandoned mines that are above freezing



### ***Surviving Winter with different strategies:***

***Mourning Cloak*** (*Nymphalis antiopa*)  
Winters as an adult in cracks in tree bark or under roof shingles.

***Wood Frog*** (*Rana sylvatica*) Can freeze beneath forest litter.

***Garter Snakes*** spend winter below the frost line in holes or rock caves.

***Snapping Turtle*** (*Chelydra serpentina*) Can breathe underwater during winter!

(Source: Nature North website)



## 3.0 Humans and Wildlife

### 3.4 Global Change

Five main changes are expected to occur across the globe that will have impacts on the diversity of species found within Illinois. These changes and impacts are outlined in Table 1. Global change will not only have local impacts on biodiversity, but will impact the levels of biodiversity worldwide leading to a massive decline in the number of plant and wildlife species.

**Table 1. Impacts of Global Change on Biodiversity (Sage 2008)**

<b>Expected Changes</b>	<b>Impacts of Changes</b>
1. Atmospheric Carbon Dioxide Enrichment	• increased photosynthesis
	• faster plant growth
	• reduced transpiration
	• increased occurrence and intensity of
	• change in competitive patterns
	• altered quality of forage
	• ocean acidification and calcification
2. Climate Change -warming of 1.5-2 degrees F in Illinois in the long-term	• drier soils
	• warmer winters
	• disruptions in natural cycles
	• increased frequency of storms
	• altered photosynthesis
3. Land Use Change	• increased agricultural production
	• reduced diversity of crops
	• increased occurrence and intensity of
4. Terrestrial Eutrophication -increase in the amount of terrestrial nitrogen through use of fertilizers	• increased growth of weeds
	• reduced biodiversity due to the lack of ability to compete with weeds
5. Invaders	• infected and consume natives
	• altered hydrology of an area
	• altered soil properties
	• altered regional climate
	• loss of species
	• altered disturbance regimes
	• out-compete native species

The above impacts of global change can ultimately have devastating impacts on local **biodiversity**. Reduced resiliency of an area can result in increased **vulnerability**. With fewer species contributing to the overall functioning of an ecosystem there is a reduced ability to respond to large disturbances.

## 3.2 Threats to Wildlife

The threats facing Illinois's plant and animal species are constantly increasing. There are five main threats that are impacting all species across Illinois: habitat loss, pollutants, invasive species, unsustainable use, and climate change.

### 3.2.1 Habitat loss

Habitat loss and degradation are perhaps the most important pressures facing wildlife today. Certain types of habitat are disappearing at a tremendous rate in almost all parts of Illinois. Wetlands are being filled in, forests are being fragmented and clear cut of forested areas and grasslands have been plowed under. Unfortunately, these mechanical means aren't the only harm humans are causing.

One of the greatest contributors to habitat loss is **population expansion**, or urbanization. Urbanization has converted many species' habitats into neighborhoods, industrial plants, airports, and shopping malls (Champagne, 2005). Although urbanization has destroyed many species' habitats, it has not removed species altogether. Many species, such as coyotes and raccoons, have adapted to these human interferences, which unfortunately, has resulted in more negative human-wildlife interactions.

### 3.2.2 Pollutants

There are few places left on the planet where there is an absence of human impact. In addition to the effects that urbanization has on wildlife habitat loss, the by-products of our daily lives (sewage, exhaust, trash, agricultural and lawn chemicals, industrial emissions and more) make their way into the natural environment through the air and water (NWF, 2015). As pollutants enter these systems, they make their way through the ecosystem and into wildlife species living in that area.

Illinois residents have depended on and continue to depend to a great extent on chemical products as part of their modern lifestyle. These products may be used in industry, around the house, and/or in agriculture both historically and currently (e.g. PCBs, DDTs, dioxins, fertilizers, and pesticides). Unfortunately, these some of these products in the past posed, and in some cases continue to pose, a serious risk to the health of wildlife species directly and indirectly (Champagne, 2005).



Some of the banned pollutants that have affected aquatic and terrestrial wildlife are:

- Mercury
- Polychlorinated biphenyls (PCBs)
- Dioxins
- Mirex/photomirex
- DDT – pesticides
- Toxaphene

The issue with some pollutants and their metabolites entering the water systems is that they are hydrophobic (water-hating) and lipophilic (fat-loving), meaning they are not easily diluted with water and they like to attach to the fatty tissue of organisms.

These characteristics lead to bioaccumulation. **Bioaccumulation** (Figure 6) is the build-up of persistent contaminants in an organism from poisons in water, sediment and/or food sources. Bioaccumulation occurs within an organism, where a concentration of a substance builds up in the tissues and is absorbed faster than it is metabolized or removed.

**Biomagnification** refers to an increase in the concentration of a substance as it moves up the food chain. This often occurs because the pollutant is persistent, meaning that it cannot be, or is very slowly, broken down by natural processes. These persistent pollutants are transferred up the food chain faster than they are broken down or excreted (Van Der Hoop, 2013). For example, a Polar Bear, as the top predator (tertiary consumer) in a food chain, will consume the greatest accumulated amount of chemical (see Figure 9).

### Bioaccumulation in Action

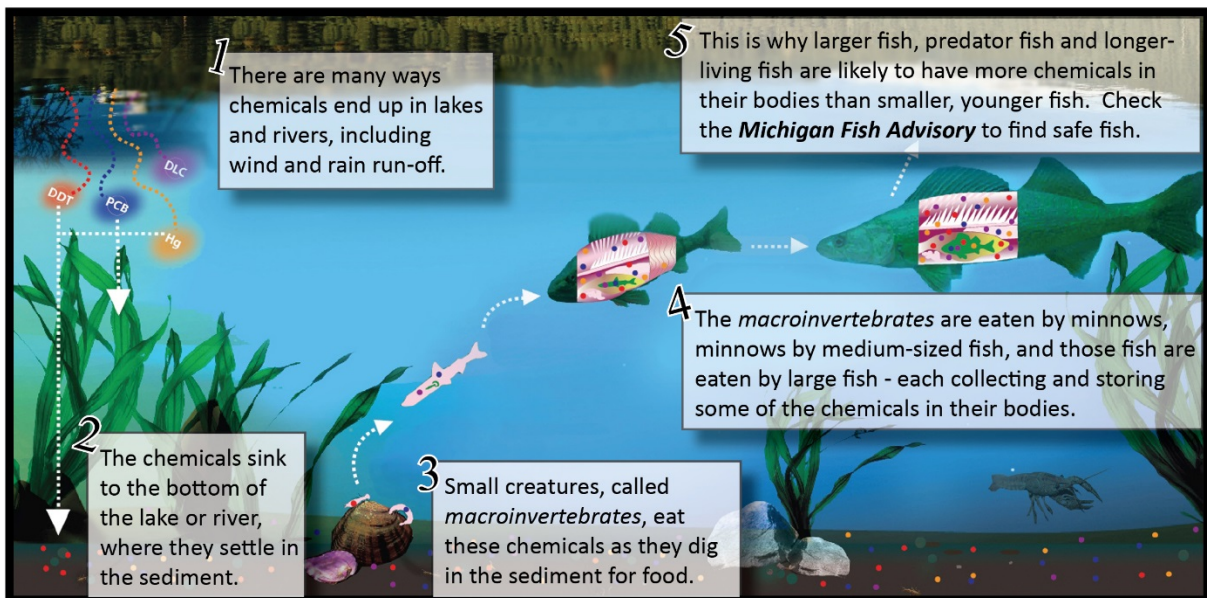


Figure 9. Bioaccumulation and Biomagnification (Michigan State Department of Health)

### 3.2.3 Invasive Species

**Non-native** species or “**alien** species” are species or subspecies which are introduced, often by human activity, to an environment which is outside of that species’ natural past or present distribution. Non-native species can be non-invasive or **invasive**. Invasive non-native species refer to those that spread and cause damage to the introduced ecosystem and can also damage the economy and human health. Invasive species pose a huge threat to biodiversity by outcompeting native species and altering ecosystems (OFAH & OMNR, n.d.). Some examples of non-native invasive species are the Asian carp, European green crab, purple loosestrife, zebra mussel, sea lamprey, emerald ash borer, didymo, gypsy moth, Asian long-horned beetle, and round goby.

Invasive species are becoming more and more of an issue in Illinois. The spread of invasive species can have negative effects on the environment, the economy and society. These species often compete with native Illinois species over resources and habitat, resulting in a reduction of native flora and fauna. One example of such a species is the zebra mussel (Figure 10). This fresh water mussel was introduced into Illinois’s lakes and has disrupted ecosystem composition and structure, clogged water intake pipes and effected public beaches.



Figure 10. Zebra Mussel (World Customs Organization, 2007)

Many non-native species such as the European starling have become very common (Figure 11). It was first introduced to North America in 1890 when 60 of them were released in Central Park in New York. While native to Europe and Asia they thrived in North America and spread across the continent. These aggressive birds compete with native species, claiming native birds’ nesting sites and displacing the birds and their eggs. They also compete with native birds for food and are responsible for spreading disease, ticks, and mites which are detrimental to native bird populations. They’re especially well adapted to urban areas and farmland, and have decimated crops (Royal BC Museum, 2011).



Figure 11. European Starling (Royal BC Museum, 2011)

### 3.2.4 Unsustainable Use

Unsustainable use is the harvest of individuals at a rate higher than can be sustained by the natural reproductive capacity of the species. Reduction in population levels due to harvesting can have dramatic impacts on the population, such as reduced genetic variability. Wildlife managers attempt to control harvesting rates by using permits and licenses for certain game species. (Refer to the Illinois Envirothon Wildlife Manual Toolbox – Illinois Hunting and Trapping Guide).

### 3.2.5 Climate Change

Current concerns regarding climate change and the impacts on the environment have focused a great deal on impacts on biodiversity. Increasing global temperatures will result in altered conditions and changing landscapes. These changes will result in changes in habitat for many plant and animal species. Climate change is expected to impact biodiversity in the following ways:

- insect and/or disease breakout patterns may change or become more severe (European Gypsy Moth spread);
- plant species will change their distribution, resulting in new types of forest (Kudzu spread northward in Illinois);
- animal species distributions will continue to change (movement north in Illinois of the Nine-Banded Armadillo); and,
- an increase in the frequency of extreme events may affect habitats (droughts and floods).

#### **Impacts of Climate Change on the Midwest**

“The Midwest’s agricultural lands, forests, Great Lakes, industrial activities, and cities are all vulnerable to climate variability and climate change. Climate change will tend to amplify existing risks climate poses to people, ecosystems, and infrastructure. Direct effects will include increased heat stress, flooding, drought, and late spring freezes. Climate change also alters pests and disease prevalence, competition from non-native or opportunistic native species, ecosystem disturbances, land-use change, landscape fragmentation, atmospheric and watershed pollutants, and economic shocks such as crop failures, reduced yields, or toxic blooms of algae due to extreme weather events. These added stresses, together with the direct effects of climate change, are projected to alter ecosystem and socioeconomic patterns and processes in ways that most people in the region would consider detrimental.

Most of the Midwest’s population lives in urban environments. Climate change may intensify other stresses on urban dwellers and vegetation, including increased atmospheric pollution, heat island effects, a highly variable water cycle, and frequent exposure to new pests and diseases. Further, many of the cities have aging infrastructure and are particularly vulnerable to climate change related flooding and life-threatening heat waves. The increase in heavy downpours has contributed to the discharge of untreated sewage due to excess water in combined sewage-overflow systems in a number of cities in the Midwest.”  
(NCA Highlights, p.74)

### 3.3 Species at Risk

A species at risk is the classification of any wildlife species that is at-risk of extinction or extirpation (USFWS, 2005). In Illinois, the **Endangered Species Protection Board (ESPB)** is responsible for determining which species should be listed at-risk (IDNR). The Board may list, as endangered or threatened, species of animals or plants which have reproduced in or otherwise significantly use, as in migration or overwintering, the area which is now the State of Illinois, if there is scientific evidence that the species qualify as endangered or threatened as defined by the Act. Federally designated endangered and threatened species are automatically placed on the Illinois List. The first Illinois List was published in 1981. Since then, there have been six 5-year reviews and revisions of the entire List, as well as some administrative and editorial revisions, resulting in the current (2015) Illinois List of 480 endangered and threatened species. (Source: Illinois Department of Natural Resources ESPB)

#### The **United States Fish and Wildlife Service (USFWS)**

The U.S. Fish and Wildlife Service's mission is, working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. This is the only agency of the U.S. Government with that primary mission. The Service's origins date back to 1871, when Congress established the U.S. Fish Commission to study the decrease of the nation's food fishes and recommend ways to reverse the decline. The Service helps protect a healthy environment for people, fish and wildlife, and helps Americans conserve and enjoy the outdoors and our living treasures. The Service's major responsibilities are for migratory birds, endangered species, certain marine mammals, and freshwater and anadromous fish. (Source: USFWS)

A series of codes has been developed to identify the current status of each listed species in the USFWS endangered species database. See below for descriptions of some of the more commonly used codes.

**E** = endangered. A species "in danger of extinction throughout all or a significant portion of its range."

**T** = threatened. A species "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."

**C** = candidate. A species under consideration for official listing for which there is sufficient information to support listing.

**Emergency Endangered** - A temporary (240 days) listing for emergency purposes when species is at significant, immediate risk.

**Delisted** - Species that has been removed from the list due to recovery, original data in error, or extinction.

**Species of Concern (SC)** - Species that have not been petitioned or been given E, T, or C status but have been identified as important to monitor.

### **Species at Risk in Illinois**

CRITERIA FOR STATE LISTING 1) Species or subspecies designated as federally endangered or threatened , 2) Species proposed for Federal Endangered or Threatened status that occur in Illinois, 3) Species that formerly were widespread in Illinois but have been nearly extirpated from the State due to habitat destruction, collecting, or other pressures resulting from the development of Illinois, 4) Species that exhibit very restricted geographic ranges of which Illinois is a part, 5) Species that exhibit restricted habitats or low populations in Illinois, or 6) Species that are significant disjuncts in Illinois i.e., the Illinois population is far removed from the rest of the species' range.

- 19 endangered and 16 threatened fish species
- 3 endangered and 6 threatened amphibian species
- 10 endangered and 8 threatened reptile species
- 24 endangered and 7 threatened bird species
- 5 endangered and 4 threatened mammal species
- 44 endangered and 10 threatened invertebrate species
- 251 endangered and 73 threatened plant species

(IDNR Final Checklist, 2015) For an official and up to date lists of species at risk in Illinois refer to the Illinois Envirothon Wildlife Toolbox Resources.

#### **3.3.1 Why are they at Risk?**

The number of Illinois wild plant and animal species that are at-risk of disappearing is growing. Species face a number of ongoing threats that vary in complexity, although the destruction of their habitat and contamination of their environment through human involvement is most prevalent (Environment Canada, 2014). Other factors involved with the decline of species population include the spread of diseases, invasive species infringement on natural habitats, and overexploitation of exhausted species for food, clothing and trophies (Hogan, 2014).

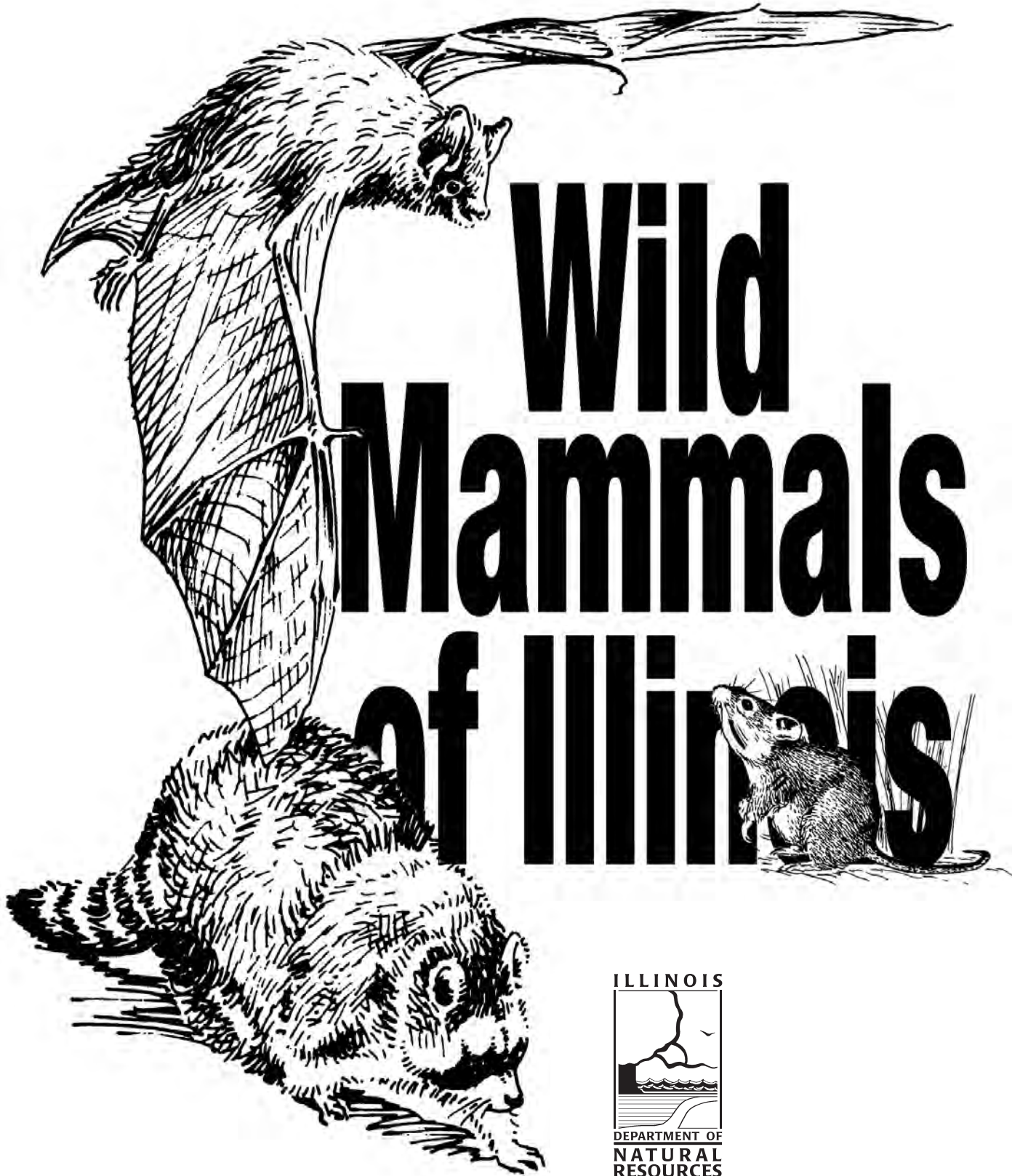
The international trade of millions of plants and animals is estimated to be worth billions of dollars annually. This wildlife trade is diverse and is comprised of live plants and animals, along with a vast array of wildlife products derived from them. Some species have become heavily exploited. As a result, those species and their products gain higher trading values, which, combined with other factors (e.g. habitat loss), is enough to severely deplete at-risk populations, bringing these species close to extinction.

#### **Questions for Discussion**

1. Are there any species at risk in your area? What is the main reason for the decline of this species? How can your school try to help recovery efforts?
2. How have humans impacted local plant and wildlife populations in your region? List both the positive and negative impacts.
3. Can you think of any major or minor disturbances/natural disasters that have occurred in Illinois in your lifetime? What were its impacts on biodiversity in your area?



State of Illinois  
Illinois Department of Natural Resources



**GRADE LEVELS:** 4 - 6

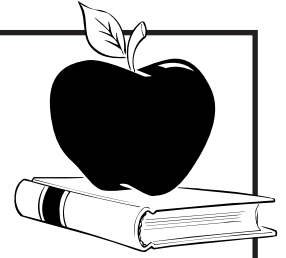
**CORRELATION TO ILLINOIS LEARNING STANDARDS:**

English language arts: 4.B.2b, 5.A.2b, 5.C.2a  
science: 12.A.2a, 12.B.2b

**SKILLS/PROCESSES:** observation, analysis, comparison & generalization, identification, creativity

**OBJECTIVE:** Students will be able to identify the five characteristics by which mammals are determined.

# TEACHER'S GUIDE



## UNIT ONE • LESSON ONE

# What Makes a Mammal a Mammal?

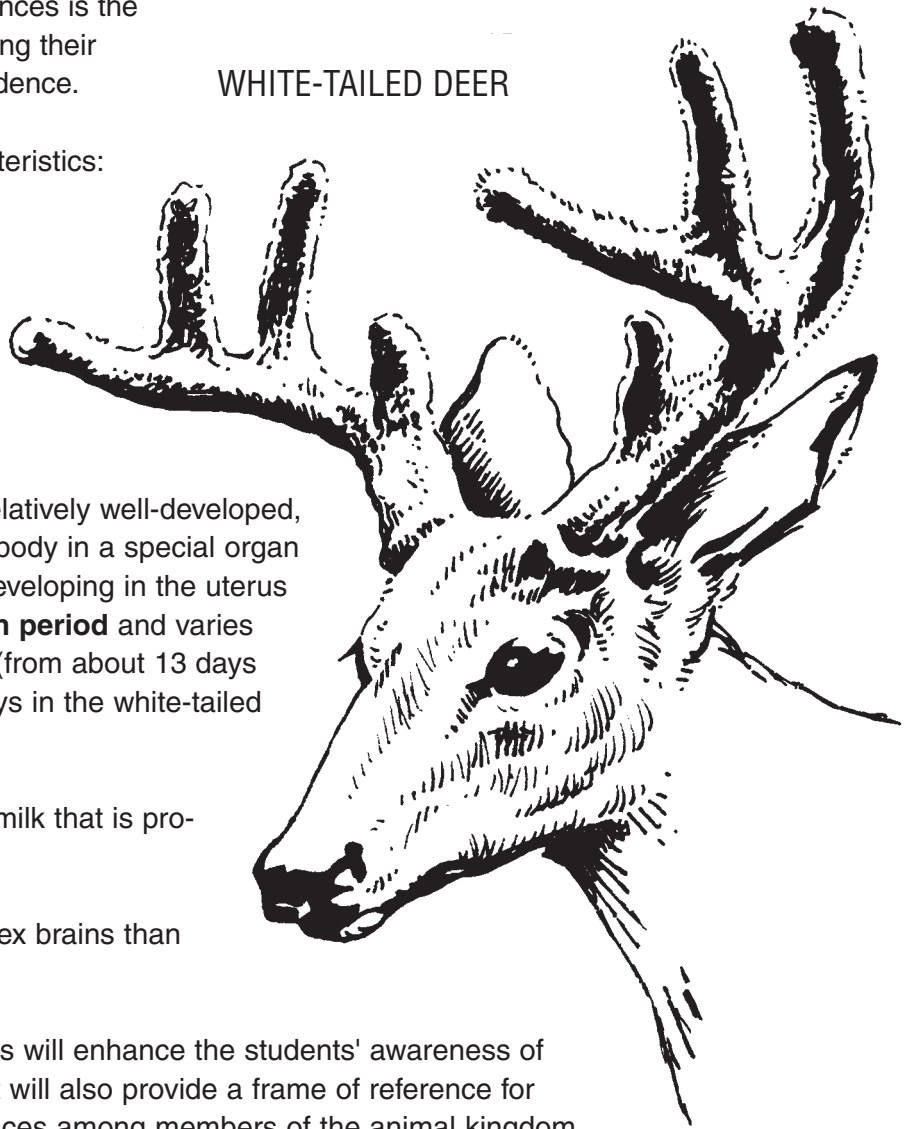
### BACKGROUND

Classifying animals into categories and groups based on their similarities and differences is the first step in studying and understanding their origins, development and interdependence.

WHITE-TAILED DEER

**Mammals** have the following characteristics:

1. They are covered with hair or fur.
2. They are **warm-blooded** (meaning their internal body temperature is maintained at a constant level regardless of external conditions).
3. They are usually born alive and relatively well-developed, having grown inside the mother's body in a special organ called a **uterus**. The time spent developing in the uterus before birth is called the **gestation period** and varies in length from species to species (from about 13 days in the Virginia opossum to 210 days in the white-tailed deer).
4. After birth the young are fed with milk that is produced by **mammary glands**.
5. They have larger and more complex brains than any other group of animals.



Focusing on these five characteristics will enhance the students' awareness of and interest in mammals of Illinois. It will also provide a frame of reference for exploring the similarities and differences among members of the animal kingdom and how those characteristics relate to the environment and lifestyle of individual species.

**GRADE LEVELS:** 4 - 6

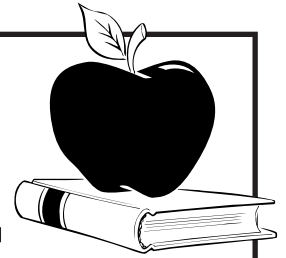
**CORRELATION TO ILLINOIS LEARNING STANDARDS:**

English language arts: 3.C.2a  
science: 12.A.2a

**SKILLS/PROCESSES:** observation, data collection & interpretation, analysis, comparison & generalization, grouping, identification

**OBJECTIVE:** Students will become familiar with evidence showing that mammals inhabit a given area.

# TEACHER'S GUIDE



## UNIT ONE • LESSON TWO

# Mammal Signs

### BACKGROUND

Wherever they live, mammals produce evidence of their presence. This evidence is most commonly seen in the form of footprints or **tracks** in the soil or snow, indications of feeding activity and obvious kinds of habitation. Any walk in the wild will present numerous examples of each . . . if you know what you're looking for and where to look.

Areas of soft soil, mud, sand or snow are the best places to look for tracks. Along stream banks or at the edge of any body of water you're likely to find the footprints of many kinds of animals which come there to drink or feed. Using a field guide, you should be able to identify many of the tracks.

Evidence of feeding activity includes any collection of nuts, seeds or fruits stored in a concealed spot (under logs and tree roots, or inside log piles and hollow stumps). Tooth marks on anything indicate feeding—look for gnawed mushrooms or chewed nuts, fruits, leaves or twigs. Areas of bark are often chewed or stripped off as food—look for tooth marks on the exposed wood.

Signs of habitation can be especially interesting. Any natural cavity in a tree, stump or fallen log is likely to contain signs of use by some animal. Look for tracks, droppings and bits of food around the opening or signs of nesting within (piles of leaves, grasses or twigs).

Many mammals live underground, and any undeveloped area will reveal many openings to such **dens** and **burrows**.

Finally, some mammals build easily recognizable homes of their own. Squirrel nests are a common and highly visible sight in the trees of woodlands, parks and urban areas. Lakes, ponds, streams and swamps are likely to contain muskrat or beaver lodges.



RACCOON



GRADE LEVELS: 4 - 6

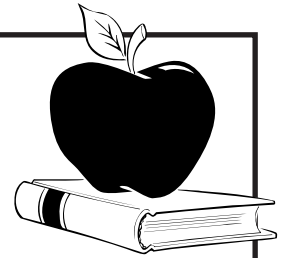
**CORRELATION TO ILLINOIS LEARNING STANDARDS:**

English language arts: 4.B.2b  
science: 12.B.2a, 12.B.2b

**SKILLS/PROCESSES:** comparison & generalization, grouping, fact finding, creativity, relationships

**OBJECTIVE:** Students will understand the difference between nocturnal and diurnal behavior among mammals.

# TEACHER'S GUIDE



## UNIT ONE • LESSON THREE

# Mammals Night and Day

### BACKGROUND

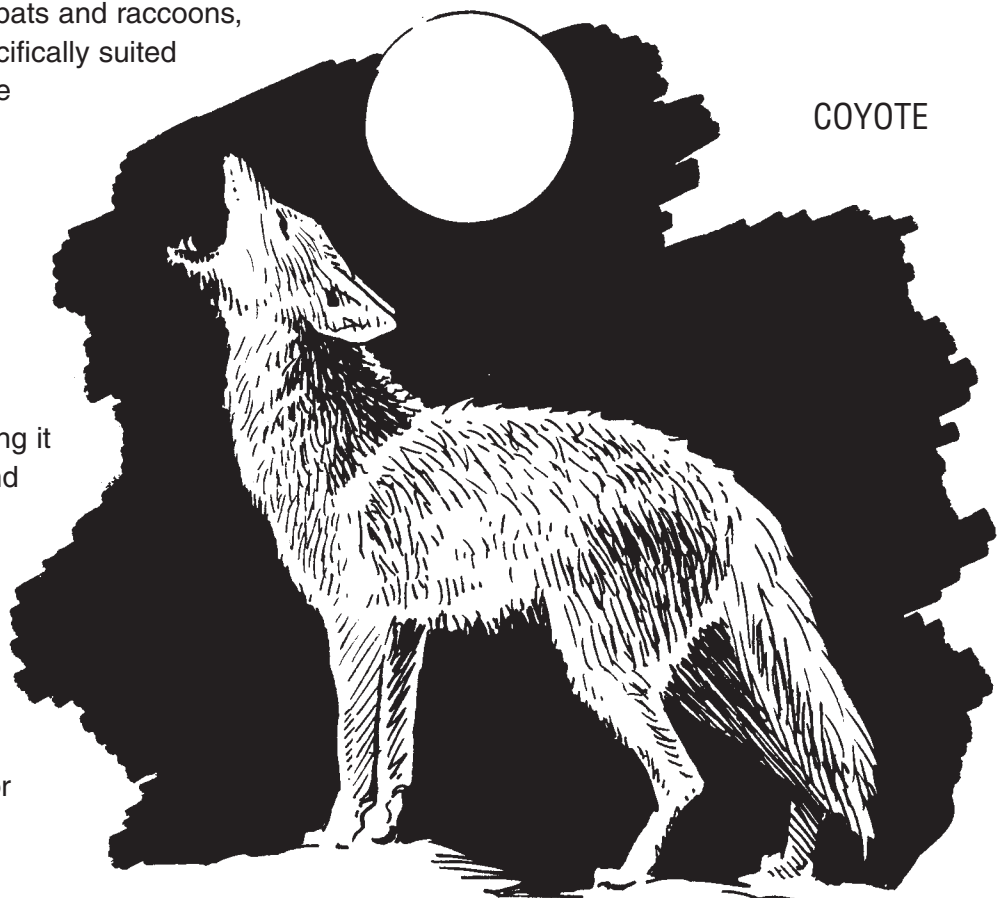
All mammals require some period every day or night for rest and sleep. Whether a mammal sleeps primarily during the day or at night depends on an individual species' particular habits and survival techniques. All mammals adapt to either daytime or nighttime activity.

Those mammals that rest during the day and engage in feeding, mating and other activities at night are called **nocturnal**. Those that rest at night and are active during the day are called **diurnal**.

Nocturnal mammals, like bats and raccoons, have evolved in ways specifically suited to life in the dark. Bats use **echolocation**, a unique system in which their extremely sensitive ears help them navigate through the dark. Most other nocturnal mammals have light-sensitive eyes and darkly colored fur or natural **camouflage** making it difficult for predators to find them. These mammals spend most of the day sleeping in dens or burrows.

Diurnal mammals, like tree squirrels, have evolved beneficial ways for daytime living. Most have developed protective col-

oration or camouflage appropriate to their daytime habitat which makes them less visible to predators. Such mammals' eyes are adapted to bright light, and each mammal has its own special means of escape or protection from predators. For instance, squirrels are very fast and agile, allowing them to outrun or outmaneuver their enemies. Diurnal mammals take their rest at night in dens or burrows.



COYOTE

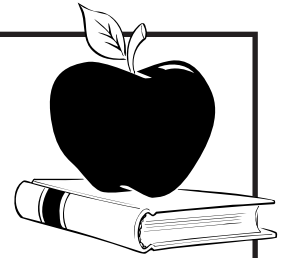
**SUGGESTED GRADE LEVELS:** 4 - 6

**CORRELATION TO ILLINOIS LEARNING STANDARDS:**  
mathematics: 6.B.2, 10.A.2a, 10.A.2c, 10.B.2b, 10.B.2d  
science: 12.A.2a

**SKILLS/PROCESSES:** observation, data collection & interpretation, analysis, fact finding, evaluation, computation/calculation, charting/graphing

**OBJECTIVES:** Students will become familiar with the processes of mammalian birth and nurturing.

# TEACHER'S GUIDE



## UNIT ONE • LESSON FOUR

# Raising Mammal Young

### BACKGROUND

Most mammals are **viviparous**, which means they give birth to living young, as opposed to hatching their young from eggs. (Exceptions are the duck-billed platypus and the echidna of Australia. These mammals lay eggs.) Some young mammals, like mice, rabbits and bats, are born blind and totally hairless, while others, such as deer, are developed enough to move about with the parent soon after birth.

After birth, all newborn mammals are nourished with milk produced in the mother's **mammary glands**, (see Unit 1, Lesson 1). This milk is composed of water, fats, proteins, sugars and mineral salts. Mammals whose young grow the fastest produce milk with the highest protein content.

**Weaning** generally occurs after the young can eat solid food. Small rodents generally nurse for a week and a half to three weeks.

Badgers can eat solid food in the first month but are suckled for four or five weeks.

As physical development progresses, behavioral development also occurs. Behavior patterns are either instinctive, learned or a combination of both. **Instinctive behavior** is automatic and triggered internally, while **learned behaviors** are picked up through imitation of the parent and through play among siblings or other young.

As young mammals mature, their dependency on parents decreases, and they become independent.



RACCOON  
WITH YOUNG

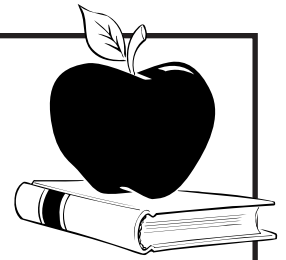
**SUGGESTED GRADE LEVELS:** 4 - 6

**CORRELATION TO ILLINOIS LEARNING STANDARDS:**  
English language arts: 3.C.2a  
science: 12.B.2b

**SKILLS/PROCESSES:** observation, data collection & interpretation, comparison & generalization, identification, application

**OBJECTIVE:** Students will become aware of the variety of mammalian locomotive techniques and adaptations.

# TEACHER'S GUIDE



## UNIT TWO • LESSON ONE

# Mammals on the Move



EASTERN COTTONTAIL

### BACKGROUND

Almost all animals are mobile. To find food, shelter and mates, avoid predators and interact with their environment, animals must have the ability to move.

Mammals live in a variety of environments and have adapted different strategies for locomotion. These strategies are as varied as the animals themselves but are directly related to the specific kind of environment in which they live.

Most mammals have four limbs with their appendant paws, claws and hooves, which are their means of locomotion. These **limbs** and **appendages** are specifically adapted to each species' particular needs.

Mammals that live underground in burrows, such as moles and badgers, have

claws on their forelimbs designed for digging and crawling through dirt.

Predatory mammals that chase their prey, like bobcats, have feet with thick, rough pads for traction and sharp claws for grabbing. Deer and other grazers have flat, hard hooves for solid support on soft earth and kicking for defense. Beavers and muskrats, which spend most of their lives in water, have webbing between their toes. Mammals that climb, like squirrels, have very sharp, short claws for holding.

Perhaps the most fascinating examples of locomotive adaptation among mammals are bats and flying squirrels. In the former, the forelimbs, especially the "finger bones" and the skin between them, have evolved into fully functional wings. Flying squirrels have large flaps of skin connecting their "wrists" to their "ankles" enabling them to glide great distances between trees and branches.

In most cases, the greater a mammal's need for speed, the longer its legs will be in proportion to the rest of its body.

**SUGGESTED GRADE LEVELS:** 4 - 6

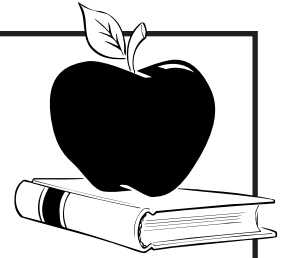
**CORRELATION TO ILLINOIS LEARNING STANDARDS:**

English language arts: 3.C.2a  
science: 12.A.2a, 12.B.2a

**SKILLS/PROCESSES:** observation, data collection & interpretation, comparison & generalization, grouping, fact-finding, identification, charting/graphing

**OBJECTIVE:** Students will become familiar with hibernation and its function as a survival technique for certain mammals.

# TEACHER'S GUIDE



## UNIT TWO • LESSON TWO

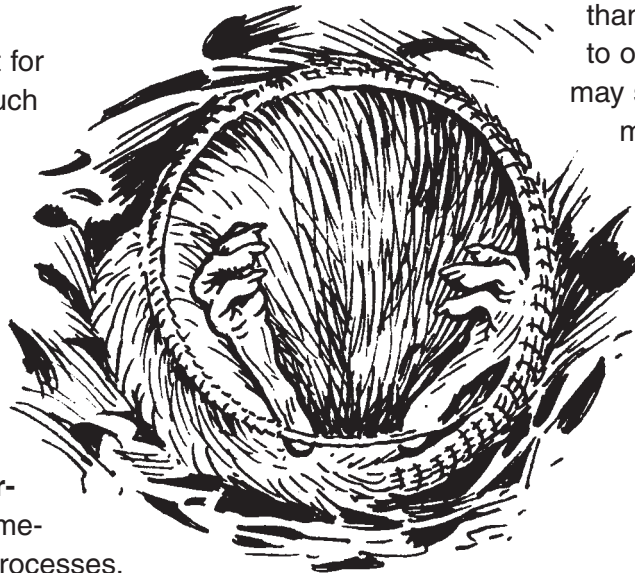
# Hibernation

### BACKGROUND

Survival may be difficult for mammals in climates such as we have in Illinois, particularly when harsh, prolonged winters drastically reduce the natural food supply. One of the most fascinating techniques some mammals use to deal with such conditions is **hibernation**, a state of extremely reduced **metabolic** processes.

Hibernation is seldom an all-or-nothing condition. Many mammals use varying degrees and lengths of **dormancy**, or inactivity, to conserve energy and survive periods of limited food supply. Skunks and raccoons, for instance, “den up” during extremely cold weather, remaining in their burrows and living off excess body fat, while not actually hibernating.

True hibernation involves drastic reductions in a mammal’s bodily functions as well as physical activity. Body temperature drops dramatically, as do heart and breathing rates. From a normal body temperature of 95°F, the temperature of a hibernating mammal may be as low as 36°F. A normal heart rate of more



HIBERNATING  
MEADOW JUMPING MOUSE

than 100 beats per minute may drop to only four or five, and breathing may slow to less than one breath per minute. Woodchucks are an example of a true hibernator.

Prior to the hibernation period, these mammals accumulate a thick layer of excess body fat, which supplies them with the energy needed to survive. A hibernating mammal may lose as much as one-third of its total body weight during hibernation.

Others gather and store a supply of food to eat during brief periods of wakefulness.

Scientists have discovered that even during hibernation there are periods of wakefulness, which become more frequent as the hibernation period comes to an end. External temperature is a factor in these periods of sporadic activity. For each species there is a **critical temperature** above which they will waken, and all will waken temporarily if the temperature drops so low that they are in danger of freezing. Wakening allows mammals to move to a deeper, warmer chamber or to warm up a little—by shivering or moving around—until the temperature moderates.

As spring approaches the air warms, food supplies are once again sufficient, and the hibernating mammals return to normal activity.

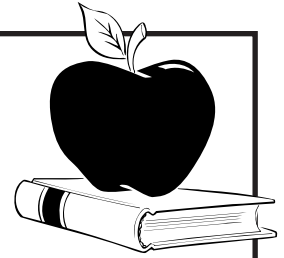
**SUGGESTED GRADE LEVELS:** 4 - 6

**CORRELATION TO ILLINOIS LEARNING STANDARDS:**  
science: 12.B.2b

**SKILLS/PROCESSES:** observation, data collection & interpretation, analysis, grouping, fact-finding, identification, application, inference

**OBJECTIVE:** Students will become familiar with the basic categories and functions of mammal teeth.

# TEACHER'S GUIDE



## UNIT TWO • LESSON THREE

# The Right Teeth

### BACKGROUND

There are three types of mammal teeth: **incisors** (used for cutting and gnawing) located in the front and center of one or both jaws; **canines** (used for stabbing and tearing) located on each side of the incisors; and **premolars** and **molars** (for grinding and shearing) situated along the sides of the jaws.

Because each tooth type is designed for specific functions, they have evolved differently in different mammal species, depending on eating habits. Based on these relationships, mammals are categorized into four groups:

1. **Herbivores** are mammals that eat mainly vegetation. There are two sub-groups: plant-tearing mammals (deer) and plant-gnawing mammals (beavers, squirrels and mice). Plant-tearing mammals have incisors in their lower jaws only, no canines at all and flat, sharp-edged molars. This arrangement is best for tearing leaves, stems, bark and grasses.

Plant-gnawers have sturdy, sharp incisors on both jaws for cutting through nuts, bark, wood and grasses. They lack canines and have flat molars for grinding.

2. **Carnivores**, or meat-eating mammals (such as coyotes, bobcats and foxes), have small but sharp incisors in both jaws for grabbing and holding; long, fanglike canines for stabbing and tearing; and large, sharply edged premolars and molars for slicing through flesh, bone, skin, scales, fur and feathers.
3. **Insectivores**, or insect-eating mammals (like shrews, moles and some bats), have long incisors for picking insects out of dirt and leaves and small but sharply edged canines, premolars and molars for chewing hard-shelled beetles, other insects and worms.
4. **Omnivores** (such as raccoons, opossums and humans) eat almost anything edible. These mammals develop all three types of teeth, with no one category more prominent than the others.

AMERICAN  
BEAVER



**SUGGESTED GRADE LEVELS:** 4 - 6

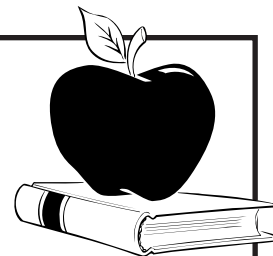
**CORRELATION TO ILLINOIS LEARNING STANDARDS:**

English language arts: 4.B.2b  
science: 12.B.2a

**SKILLS/PROCESSES:** observation, comparison & generalization, grouping, fact-finding, identification, group planning, relationships, inference

**OBJECTIVE:** Students will become familiar with the concept of predation and the relationship between prey and predator.

# TEACHER'S GUIDE



## UNIT TWO • LESSON FOUR

# The Predator-Prey Relationship

### BACKGROUND

Among the mammal species in Illinois are some known as **predators**. From bobcats and foxes to raccoons and weasels, they share a common behavioral trait: they catch, kill and eat other animals (called **prey**).

There are different degrees of predation. Some strict predators, such as bobcats, eat only meat. But other mammals, such as raccoons and opossums, eat berries, nuts and plants in addition to catching and eating prey.

Most predators are prey to other, larger predators. A weasel that eats a field mouse may then be dinner for a bobcat. Those few predators that are not prey to others are called **top predators**.

Both predators and prey are links in what is called a **food chain**. Food chains are the routes along which energy flows through the living world.

This energy always starts with the sun. Through the process of **photosynthesis**,

plants use the sun's energy to produce food. Animals such as rabbits and deer eat the plants and transfer the energy from the plants' stored food into their own bodies . . . only to become prey to the predators, who again transfer the energy to themselves.

But the flow of energy doesn't end there. Even top predators eventually die, and their bodies become food for **scavengers**, those animals that eat dead animals and plants. Bacteria and fungi break down bones, scales, fur and feathers into the simplest chemical compounds. These compounds become the nutrients in the soil that are the raw materials for plant growth. Thus the food chain becomes a closed cycle with no real beginning and no real end.

Most food chains overlap (individual species of plants and animals may be links in the food chains of several species of predator) and the entire system becomes a food web.



GRAY FOX

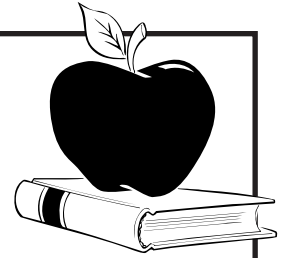
**SUGGESTED GRADE LEVELS:** 4 - 6

**CORRELATION TO ILLINOIS LEARNING STANDARDS:**  
English language arts 5.A.2b, 5.C.2a, 5.C.3a  
science 12.A.2a, 12.B.2b  
social science 17.C.2c

**SKILLS/PROCESSES:** comparison & generalization,  
analysis, fact-finding, evaluation, creativity, application,  
inference, relationships

**OBJECTIVE:** Students will be able to: 1) identify and describe  
some causes for extinction of animal species; and 2) define  
rare, threatened and endangered as they apply to animal  
populations.

# TEACHER'S GUIDE



## UNIT THREE • LESSON ONE

# Endangered and Threatened Species

## BACKGROUND

Although **extinction** is a natural process, extensive and excessive human interaction with the environment has greatly increased its rate. Habitat destruction is the single greatest cause of extinction. Other human-related causes include habitat damage, unregulated or illegal commercial and personal use, disruption of migration routes and breeding behaviors, contamination by pollutants, and competition or predation from artificially introduced species. Some experts expect extinctions of plants and animals to increase from the current rate of one species per year to 100 per year in the near future.

In Illinois, in 2009, a total of 355 species of plants and animals are **endangered**, and 128 species are **threatened**. There are five species of endangered mammals and four species of threatened mammals.

**Rare** species, though not in immediate danger, are few in number. Some species have always been rare because their natural range does not include much of Illinois or because they have limited habitat preferences. Threatened species are those still present in their natural range, but whose numbers are declining and are likely to become endangered in the foreseeable future. Endangered species are those in immediate danger of extinction as a breeding species. **Extirpated** species are those that have become eliminated from a portion of their range. For instance, elk and bison have been extirpated from Illinois.



NORTH AMERICAN RIVER OTTER

**SUGGESTED GRADE LEVELS:** 4 - 6

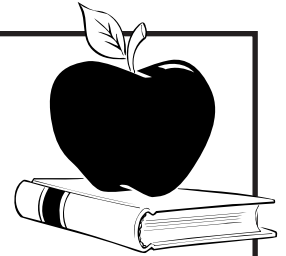
**CORRELATION TO ILLINOIS LEARNING STANDARDS:**

English language arts: 5.C.2a  
science: 13.B.2e, 13.B.2f  
social science: 17.C.2c

**SKILLS/PROCESSES:** observation, data collection & interpretation, analysis, group planning, creativity, application, inference, relationships, organization

**OBJECTIVE:** Students will: 1) understand the need to conserve and manage natural resources; and 2) learn different ways currently in use to preserve habitat.

# TEACHER'S GUIDE



## UNIT THREE • LESSON TWO

# Maintaining Mammals

### BACKGROUND

Early settlers in Illinois found a vast array of plants and animals living in the territory's clear streams, wide prairies and extensive forests.

In the 1820s, forests covered about 38 percent of the state; the remainder was mostly tallgrass prairie and wetlands. Today, about 14 percent of the forest and one percent of the original prairie remain. More than nine million acres of natural wetlands have been reduced to less than 500,000 acres.

Such drastic loss of **habitat**—whether the result of modern agricultural practices, urban sprawl, pollution, sedimentation, **habitat fragmentation** or flood-control activities—is the most serious threat to the ultimate survival of Illinois' wild mammals.

Since human activity is the primary cause for this habitat reduction, humans are also responsible for controlling and/or reversing this devastating trend.



The Illinois Department of Natural Resources (IDNR) administers a number of programs which help to maintain current habitats and slow further habitat loss.

Illinois Acres For Wildlife, a voluntary program, involves rural and urban landowners who want to help provide wildlife habitat on their property. The landowners, in cooperation with an IDNR biologist, set goals for their land. Participants receive assistance in conserving or improving habitat and can get free tree and shrub seedlings, food patch seed mixes and help in obtaining financial assistance for habitat improvement.

Hunting and trapping are highly regulated activities in Illinois. Laws limit when, where and how many animals may be taken by hunters and trappers and keep these species from becoming endangered. Fees collected from hunters and trappers for licenses, special stamps and excise taxes go toward conservation programs which benefit all wildlife species.

The Illinois Nature Preserve System includes more than 350 nature preserves across the state, encompassing a total of more than 46,000 acres (as of 2009). These preserves were created to keep unique areas of the state undeveloped for scientific research, education and public enjoyment. These areas provide homes to a wide diversity of biological treasures and harbor many of Illinois' rare and endangered species.

Through education and a commitment to the importance of preserving our natural heritage, we must all strive, both individually and as a society, to learn to share the world with all living things.



# GLOSSARY

**abundant** – more than enough; plentiful

There was an abundant supply of nuts for the squirrels to eat.

**adaptable or adapt** – able to adjust to new conditions or surroundings

River otters reintroduced from Louisiana had to adapt to their new surroundings.

**appendages** – the “hands” and “feet” of an animal; in the case of mammals, usually paws or hooves

The raccoon used its appendages to catch a crayfish.

**burrow** – a tunnel or system of tunnels dug underground by an animal and used for a home

The badger lives in a burrow in the soil.

**camouflage** – a disguise or false appearance that is used to hide something

The mink’s dark fur camouflages it at night when it hunts for prey.

**canines** – teeth located on either side of the incisors, in one or both jaws, used for stabbing and tearing

The long canines of the coyote help it to capture mice and other prey.

**carnivore** – any animal that eats only the flesh of other animals

The bobcat is a carnivore, catching and eating squirrels, mice and other species.

**conservation** – the protection and wise use of the forests, rivers, animals, minerals and other natural resources

Conservation of our natural resources is important so that wild mammals can continue to exist.

**critical temperature** – the temperature at which a hibernating mammal will automatically waken (varies from species to species)

A thirteen-lined ground squirrel will awaken from hibernation when the air in its burrow reaches a critical temperature.

**den** – a hollowed chamber or space used as a home by an animal

Fox young are born and raised in a den.

**diurnal** – of or occurring during the day

Squirrels are diurnal animals, active throughout the daylight hours year round.

**domestic** – not wild; tame

Pets are considered to be domestic animals.

**dormancy** – a condition of inactivity or sleep

Skunks use dormancy to help protect them when the outside temperature is very cold.

**echolocation** – a technique of sound and hearing used by bats to navigate in the dark

Bats use echolocation to help them navigate and locate prey in the dark.

**endangered** – threatened with danger of extinction

The Indiana bat is an endangered mammal in Illinois.

**environment** – the surroundings in which an organism lives

A good environment helped the mammal species to survive.

**extinction** – the elimination of a species

The rate of species extinction has been increased by the actions of humans.

**extirpated or extirpation** – the elimination of a species from a portion of its historic range

The porcupine has been extirpated from Illinois.

**food chain** – the route of energy flow through a community of organisms

The transfer of energy from sun to plant to grasshopper to white-footed mouse is an example of a food chain.

**gestation period** – the length of time a mammal develops inside the mother’s body prior to birth

The gestation period for the white-tailed deer is about 210 days.

**habitat** – the natural environment in which living things can thrive

Woodlands and forest edges are the preferred habitats for the fox squirrel.

**habitat fragmentation** – separation of areas of natural habitat by agricultural or urban development

Construction for the new highway caused habitat fragmentation of the forest.

**herbivore** – any animal that eats only plants

The white-tailed deer is an herbivore.

**hibernation** – a state of reduced metabolism, like a very deep sleep, which allows an animal to survive periods of food scarcity

Hibernation is used by the thirteen-lined ground squirrel as a survival technique in winter.

**home range** – a large area of land on which animals live

The home range of a white-tailed deer can cover many square miles.

**incisors** – teeth located in the front and center of one or both jaws, used for holding, cutting or gnawing

A beaver’s strong incisors let it gnaw tree bark.

**insectivore** – any animal that eats only insects

Insectivores, such as the northern short-tailed shrew, feed on insects.

**instinctive behavior** – an inborn, automatic response or behavior pattern

Instinctive behavior by mammals does not have to be learned.

**learned behavior** – behavior acquired through imitation and play

Learned behavior comes from watching or playing with other members of a mammal’s species.

**limbs** – the “arms” and “legs” of an animal

The front limbs of a bat are modified for flying.

# GLOSSARY

**mammals** – animals having these five characteristics: hair or fur; warm-blooded; usually born alive; young are fed milk produced by the mother; a more complex brain than other animals

Mammals include bats, mice, squirrels and many other species.

**mammary glands** – special organs in female mammals that produce milk to feed the young

A young mammal feeds on milk from its mother's mammary glands.

**management** – the act of directing or controlling

Management practices for wildlife can involve habitat protection.

**metabolism** – the rate at which a living creature uses up the energy it gets from its food

During hibernation, the metabolism of a mammal slows down.

**natural resources** – materials, plants and animals found in nature that are useful or necessary for people to live

Water, wildlife and forests are just some of Illinois' natural resources.

**nocturnal** – of or occurring at night

Bats are nocturnal mammals.

**omnivore** – any animal that eats plants, the flesh of other animals or anything else

Raccoons are omnivores, eating fishes, fruits, grain and other items.

**photosynthesis** – the process by which a plant makes simple sugar using light, chlorophyll, carbon dioxide and water

Photosynthesis is an important step in all food chains.

**predator** – animal that lives by hunting other animals for food

As a predator, the bobcat feeds on prey, such as mice and squirrels.

**premolars/molars** – teeth located along the sides and back of one or both jaws, used for grinding and shearing

The large premolars and molars of a white-tailed deer grind the plant material that it eats.

**prey** – animal that is caught, killed and eaten by another animal

The grasshopper was prey for the white-footed mouse.

**rare** – low, but stable, in number

The population of some rare species may have always been low due to their specific habitat requirements.

**restocking** – replacing a supply of something, refilling

Biologists raise and restock wildlife into their natural habitats, such as wetlands.

**scavenger** – any animal that eats the dead bodies of other animals but does not catch and kill them itself

A Virginia opossum can be a scavenger on road-killed animals.

**sedimentation** – filling up of streams, ponds, lakes and other bodies of water by silt and runoff

Sedimentation can cause many problems for aquatic mammals.

**small game** – small wild animals or fishes hunted or caught for sport or food

The group went hunting for rabbits and other small game species.

**species** – a type of living thing

Gray squirrels and fox squirrels are two different species of mammals.

**survive** – to live longer than; live through; to continue to exist

The rabbit survived the harsh, cold winter.

**terrain** – the physical features of a piece of land

Eastern woodrats prefer a hilly, rocky terrain to live in.

**threatened** – to be in danger of harm; any animal or plant species which is likely to become endangered in the foreseeable future

Four mammal species in Illinois are listed as threatened (as of 2009).

**top predator** – any predator in a food chain on which no others prey

The bobcat is a top predator.

**tracks** – the footprints left by an animal in soft soil, mud, sand or snow

Many animal tracks can be seen in the mud along the river.

**uterus** – the organ in a female mammal in which the developing young grow

Development of mammals before birth occurs in the mother's uterus.

**viviparous** – giving birth to live young (not hatched from eggs)

All mammals, except the duck-billed platypus and echidna, are viviparous.

**wean** – the progression of a young mammal from dependence on its mother's milk to independent eating

The fawn was weaned and now eats only plant materials.

**warm-blooded** – maintaining a constant internal body temperature

One of the traits of a mammal is that it is warm-blooded.



State of Illinois  
Illinois Department of Natural Resources

# Illinois Birds



Illinois  
Department of  
**Natural  
Resources**

# Birds of Illinois

The scientific name for each wild bird species found in Illinois can be obtained from this list. Bird species that are extinct or extirpated from Illinois are not included. Other species of birds referenced in the text will have their scientific name listed following their common name.

## Family Anatidae

fulvous whistling-duck  
black-bellied whistling duck  
greater white-fronted goose  
snow goose  
Ross's goose  
Canada goose  
brant  
cackling goose  
mute swan  
trumpeter swan  
tundra swan  
wood duck  
gadwall  
Eurasian wigeon  
American wigeon  
American black duck  
mallard  
mottled duck  
blue-winged teal  
cinnamon teal  
northern shoveler  
white-cheeked pintail  
northern pintail  
garganey  
green-winged teal  
canvasback  
redhead  
ring-necked duck  
tufted duck  
greater scaup  
lesser scaup  
king eider  
common eider  
harlequin duck  
surf scoter  
white-winged scoter  
black scoter  
long-tailed duck  
bufflehead  
common goldeneye  
Barrow's goldeneye  
hooded merganser  
common merganser  
red-breasted merganser  
ruddy duck

*Dendrocygna bicolor*  
*Dendrocygna autumnalis*  
*Anser albifrons*  
*Chen caerulescens*  
*Chen rossii*  
*Branta canadensis*  
*Branta bernicla*  
*Branta hutchinsii*  
*Cygnus olor*  
*Cygnus buccinator*  
*Cygnus columbianus*  
*Aix sponsa*  
*Anas strepera*  
*Anas penelope*  
*Anas americana*  
*Anas rubripes*  
*Anas platyrhynchos*  
*Anas fulvigula*  
*Anas discors*  
*Anas cyanoptera*  
*Anas clypeata*  
*Anas bahamensis*  
*Anas acuta*  
*Anas querquedula*  
*Anas crecca*  
*Aythya valisineria*  
*Aythya americana*  
*Aythya collaris*  
*Aythya fuligula*  
*Aythya marila*  
*Aythya affinis*  
*Somateria spectabilis*  
*Somateria mollissima*  
*Histrionicus histrionicus*  
*Melanitta perspicillata*  
*Melanitta fusca*  
*Melanitta americana*  
*Clangula hyemalis*  
*Bucephala albeola*  
*Bucephala clangula*  
*Bucephala islandica*  
*Lophodytes cucullatus*  
*Mergus merganser*  
*Mergus serrator*  
*Oxyura jamaicensis*

## Family Odontophoridae

northern bobwhite

*Colinus virginianus*

## Family Phasianidae

gray partridge  
ring-necked pheasant  
ruffed grouse  
greater prairie-chicken  
wild turkey

*Perdix perdix*  
*Phasianus colchicus*  
*Bonasa umbellus*  
*Tympanuchus cupido*  
*Meleagris gallopavo*

## Family Gaviidae

red-throated loon  
Arctic loon  
Pacific loon  
common loon  
yellow-billed loon

*Gavia stellata*  
*Gavia arctica*  
*Gavia pacifica*  
*Gavia immer*  
*Gavia adamsii*

## Family Podicipedidae

pied-billed grebe  
horned grebe  
red-necked grebe  
eared grebe  
western grebe  
Clark's grebe

*Podilymbus podiceps*  
*Podiceps auritus*  
*Podiceps grisegena*  
*Podiceps nigricollis*  
*Aechmophorus occidentalis*  
*Aechmophorus clarkii*

## Family Ciconiidae

wood stork

*Mycteria americana*

## Family Fregatidae

magnificent frigatebird

*Fregata magnificens*

## Family Sulidae

northern gannet

*Morus bassanus*

## Family Phalacrocoracidae

Neotropic cormorant  
double-crested cormorant

*Phalacrocorax brasilianus*  
*Phalacrocorax auritus*

## Family Anhingidae

anhinga

*Anhinga anhinga*

## Family Pelecanidae

American white pelican  
brown pelican

*Pelecanus erythrorhynchos*  
*Pelecanus occidentalis*

## Family Ardeidae

American bittern  
least bittern  
great blue heron  
great egret  
snowy egret  
little blue heron  
tricolored heron  
reddish egret  
cattle egret  
green heron  
black-crowned night-heron  
yellow-crowned night-heron

*Botaurus lentiginosus*  
*Ixobrychus exilis*  
*Ardea herodias*  
*Ardea alba*  
*Egretta thula*  
*Egretta caerulea*  
*Egretta tricolor*  
*Egretta rufescens*  
*Bubulcus ibis*  
*Butorides virescens*  
*Nycticorax nycticorax*  
*Nyctanassa violacea*

## Family Threskiornithidae

white ibis  
glossy ibis  
white-faced ibis  
roseate spoonbill

*Eudocimus albus*  
*Plegadis falcinellus*  
*Plegadis chihi*  
*Platalea ajaja*

## Family Cathartidae

black vulture  
turkey vulture

*Coragyps altratus*  
*Cathartes aura*

## Family Pandionidae

osprey

*Pandion haliaetus*

## Family Accipitridae

swallow-tailed kite  
white-tailed kite  
Mississippi kite  
bald eagle  
northern harrier  
sharp-shinned hawk  
Cooper's hawk  
northern goshawk  
red-shouldered hawk  
broad-winged hawk

*Elanoides forficatus*  
*Elanus leucurus*  
*Ictinia mississippiensis*  
*Haliaeetus leucocephalus*  
*Circus cyaneus*  
*Accipiter striatus*  
*Accipiter cooperii*  
*Accipiter gentilis*  
*Buteo lineatus*  
*Buteo platypterus*

## Birds of Illinois —continued

<p>Swainson's hawk red-tailed hawk ferruginous hawk rough-legged hawk golden eagle</p>	<p><i>Buteo swainsoni</i> <i>Buteo jamaicensis</i> <i>Buteo regalis</i> <i>Buteo lagopus</i> <i>Aquila chrysaetos</i></p>	<p>Wilson's phalarope red-necked phalarope red phalarope</p>	<p><i>Phalaropus tricolor</i> <i>Phalaropus lobatus</i> <i>Phalaropus fulicarius</i></p>
<b>Family Falconidae</b>		<b>Family Laridae</b>	
<p>American kestrel merlin gyrfalcon peregrine falcon prairie falcon</p>	<p><i>Falco sparverius</i> <i>Falco columbarius</i> <i>Falco rusticolus</i> <i>Falco peregrinus</i> <i>Falco mexicanus</i></p>	<p>black-legged kittiwake ivory gull Sabine's gull Bonaparte's gull black-headed gull little gull Ross's gull laughing gull Franklin's gull mew gull ring-billed gull western gull California gull herring gull Thayer's gull Iceland gull lesser black-backed gull slaty-backed gull glaucous-winged gull glaucous gull great black-backed gull sooty tern least tern gull-billed tern large-billed tern Caspian tern black tern common tern Arctic tern Forster's tern royal tern sandwich tern black skimmer</p>	<p><i>Rissa tridactyla</i> <i>Pagophila eburnea</i> <i>Xema sabini</i> <i>Chroicocephalus philadelphia</i> <i>Chroicocephalus ridibundus</i> <i>Hydrocoloeus minutus</i> <i>Rhodostethia rosea</i> <i>Leucophaeus atricilla</i> <i>Leucophaeus pipixcan</i> <i>Larus canus</i> <i>Larus delawarensis</i> <i>Larus occidentalis</i> <i>Larus californicus</i> <i>Larus argentatus</i> <i>Larus thayeri</i> <i>Larus glaucooides</i> <i>Larus fuscus</i> <i>Larus schistisagus</i> <i>Larus glaucescens</i> <i>Larus hyperboreus</i> <i>Larus marinus</i> <i>Onychoprion fuscatus</i> <i>Sterna antillarum</i> <i>Gelochelidon nilotica</i> <i>Phaetusa simplex</i> <i>Hydroprogne caspia</i> <i>Chlidonias niger</i> <i>Sterna hirundo</i> <i>Sterna paradisaea</i> <i>Sterna forsteri</i> <i>Thalasseus maximus</i> <i>Thalasseus sandvicensis</i> <i>Rynchops niger</i></p>
<b>Family Rallidae</b>		<b>Family Stercorariidae</b>	
<p>yellow rail black rail king rail Virginia rail sora purple gallinule common moorhen American coot</p>	<p><i>Coturnicops noveboracensis</i> <i>Laterallus jamaicensis</i> <i>Rallus elegans</i> <i>Rallus limicola</i> <i>Porzana carolina</i> <i>Porphyrio martinica</i> <i>Gallinula chloropus</i> <i>Fulica americana</i></p>	<p>pomarine jaeger parasitic jaeger long-tailed jaeger</p>	<p><i>Stercorarius pomarinus</i> <i>Stercorarius parasiticus</i> <i>Stercorarius longicaudus</i></p>
<b>Family Gruidae</b>		<b>Family Alcidae</b>	
<p>sandhill crane whooping crane</p>	<p><i>Grus canadensis</i> <i>Grus americana</i></p>	<p>dovekie ancient murrelet</p>	<p><i>Alle alle</i> <i>Synthliboramphus antiquus</i></p>
<b>Family Charadriidae</b>		<b>Family Columbidae</b>	
<p>black-bellied plover American golden-plover snowy plover semipalmated plover piping plover killdeer</p>	<p><i>Pluvialis squatarola</i> <i>Pluvialis dominica</i> <i>Charadrius alexandrinus</i> <i>Charadrius semipalmatus</i> <i>Charadrius melodus</i> <i>Charadrius vociferus</i></p>	<p>rock pigeon band-tailed pigeon Eurasian collared-dove white-winged dove mourning dove inca dove common ground-dove</p>	<p><i>Columba livia</i> <i>Patagioenas fasciata</i> <i>Streptopelia decaocto</i> <i>Zenaida asiatica</i> <i>Zenaida macroura</i> <i>Columbina inca</i> <i>Columbina passerina</i></p>
<b>Family Recurvirostridae</b>		<b>Family Psittacidae</b>	
<p>black-necked stilt American avocet</p>	<p><i>Himantopus mexicanus</i> <i>Recurvirostra americana</i></p>	<p>monk parakeet</p>	<p><i>Myiopsitta monachus</i></p>
<b>Family Scolopacidae</b>		<b>Family Cuculidae</b>	
<p>spotted sandpiper solitary sandpiper greater yellowlegs willet lesser yellowlegs upland sandpiper Eskimo curlew whimbrel long-billed curlew Hudsonian godwit marbled godwit ruddy turnstone red knot sanderling semipalmated sandpiper western sandpiper least sandpiper white-rumped sandpiper Baird's sandpiper pectoral sandpiper sharp-tailed sandpiper purple sandpiper dunlin curlew sandpiper stilt sandpiper buff-breasted sandpiper ruff short-billed dowitcher long-billed dowitcher Wilson's snipe common snipe American woodcock</p>	<p><i>Actitis macularius</i> <i>Tringa solitaria</i> <i>Tringa melanoleuca</i> <i>Tringa semipalmata</i> <i>Tringa flavipes</i> <i>Bartramia longicauda</i> <i>Numenius borealis</i> <i>Numenius phaeopus</i> <i>Numenius americanus</i> <i>Limosa haemastica</i> <i>Limosa fedoa</i> <i>Arenaria interpres</i> <i>Calidris canutus</i> <i>Calidris alba</i> <i>Calidris pusilla</i> <i>Calidris mauri</i> <i>Calidris minutilla</i> <i>Calidris fuscicollis</i> <i>Calidris bairdii</i> <i>Calidris melanotos</i> <i>Calidris acuminata</i> <i>Calidris maritima</i> <i>Calidris alpina</i> <i>Calidris ferruginea</i> <i>Calidris himantopus</i> <i>Tryngites subruficollis</i> <i>Philomachus pugnax</i> <i>Limnodromus griseus</i> <i>Limnodromus scolopaceus</i> <i>Gallinago delicata</i> <i>Gallinago gallinago</i> <i>Scolopax minor</i></p>	<p>black-billed cuckoo yellow-billed cuckoo groove-billed ani</p>	<p><i>Coccyzus erythrophthalmus</i> <i>Coccyzus americanus</i> <i>Crotophaga sulcirostris</i></p>
		<b>Family Tytonidae</b>	
		<p>barn owl</p>	<p><i>Tyto alba</i></p>
		<b>Family Strigidae</b>	
		<p>eastern screech-owl great horned owl snowy owl northern hawk owl</p>	<p><i>Megascops asio</i> <i>Bubo virginianus</i> <i>Bubo scandiacus</i> <i>Surnia ulula</i></p>

## Birds of Illinois —continued

burrowing owl	<i>Athene cunicularia</i>	American crow	<i>Corvus brachyrhynchos</i>
barred owl	<i>Strix varia</i>	fish crow	<i>Corvus ossifragus</i>
long-eared owl	<i>Asio otus</i>		
short-eared owl	<i>Asio flammeus</i>	<b>Family Alaudidae</b>	
boreal owl	<i>Aegolius funereus</i>	horned lark	<i>Eremophila alpestris</i>
northern saw-whet owl	<i>Aegolius acadicus</i>		
<b>Family Caprimulgidae</b>		<b>Family Hirundinidae</b>	
common nighthawk	<i>Chordeiles minor</i>	purple martin	<i>Progne subis</i>
Chuck-will's-widow	<i>Caprimulgus carolinensis</i>	tree swallow	<i>Tachycineta bicolor</i>
eastern whip-poor-will	<i>Caprimulgus vociferus</i>	violet-green swallow	<i>Tachycineta thalassina</i>
		northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>
<b>Family Apodidae</b>		bank swallow	<i>Riparia riparia</i>
chimney swift	<i>Chaetura pelagica</i>	cliff swallow	<i>Petrochelidon pyrrhonota</i>
		barn swallow	<i>Hirundo rustica</i>
<b>Family Trochilidae</b>		<b>Family Paridae</b>	
ruby-throated hummingbird	<i>Archilochus colubris</i>	Carolina chickadee	<i>Poecile carolinensis</i>
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	black-capped chickadee	<i>Poecile atricapillus</i>
rufous hummingbird	<i>Selasphorus rufus</i>	boreal chickadee	<i>Poecile hudsonicus</i>
Allen's hummingbird	<i>Selasphorus sasin</i>	tufted titmouse	<i>Baeolophus bicolor</i>
<b>Family Alcedinidae</b>		<b>Family Sittidae</b>	
belted kingfisher	<i>Megaceryle alcyon</i>	red-breasted nuthatch	<i>Sitta canadensis</i>
		white-breasted nuthatch	<i>Sitta carolinensis</i>
<b>Family Picidae</b>		brown-headed nuthatch	<i>Sitta pusilla</i>
red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	<b>Family Certhiidae</b>	
red-bellied woodpecker	<i>Melanerpes carolinus</i>	brown creeper	<i>Certhia americana</i>
Williamson's sapsucker	<i>Sphyrapicus thyroides</i>	<b>Family Troglodytidae</b>	
yellow-bellied sapsucker	<i>Sphyrapicus varius</i>	rock wren	<i>Salpinctes obsoletus</i>
downy woodpecker	<i>Picoides pubescens</i>	Carolina wren	<i>Thryothorus ludovicianus</i>
hairy woodpecker	<i>Picoides villosus</i>	Bewick's wren	<i>Thryomanes bewickii</i>
red-cockaded woodpecker	<i>Picoides borealis</i>	house wren	<i>Troglodytes aedon</i>
black-backed woodpecker	<i>Picoides arcticus</i>	winter wren	<i>Troglodytes hiemalis</i>
northern flicker	<i>Colaptes auratus</i>	sedge wren	<i>Cistothorus platensis</i>
pileated woodpecker	<i>Dryocopus pileatus</i>	marsh wren	<i>Cistothorus palustris</i>
<b>Family Tyrannidae</b>		<b>Family Polioptilidae</b>	
olive-sided flycatcher	<i>Contopus cooperi</i>	blue-gray gnatcatcher	<i>Polioptila caerulea</i>
eastern wood-pewee	<i>Contopus virens</i>	<b>Family Regulidae</b>	
yellow-bellied flycatcher	<i>Empidonax flaviventris</i>	golden-crowned kinglet	<i>Regulus satrapa</i>
Acadian flycatcher	<i>Empidonax virescens</i>	ruby-crowned kinglet	<i>Regulus calendula</i>
alder flycatcher	<i>Empidonax alnorum</i>	<b>Family Turdidae</b>	
willow flycatcher	<i>Empidonax traillii</i>	northern wheatear	<i>Oenanthe oenanthe</i>
least flycatcher	<i>Empidonax minimus</i>	eastern bluebird	<i>Sialia sialis</i>
eastern phoebe	<i>Sayornis phoebe</i>	mountain bluebird	<i>Sialia currucoides</i>
Say's phoebe	<i>Sayornis saya</i>	Townsend's solitaire	<i>Myadestes townsendi</i>
vermillion flycatcher	<i>Pyrocephalus rubinus</i>	veery	<i>Catharus fuscescens</i>
ash-throated flycatcher	<i>Myiarchus cinerascens</i>	gray-cheeked thrush	<i>Catharus minimus</i>
great crested flycatcher	<i>Myiarchus crinitus</i>	Swainson's thrush	<i>Catharus ustulatus</i>
western kingbird	<i>Tyrannus verticalis</i>	hermit thrush	<i>Catharus guttatus</i>
eastern kingbird	<i>Tyrannus tyrannus</i>	wood thrush	<i>Hylocichla mustelina</i>
scissor-tailed flycatcher	<i>Tyrannus forficatus</i>	American robin	<i>Turdus migratorius</i>
fork-tailed flycatcher	<i>Tyrannus savana</i>	varied thrush	<i>Ixoreus naevius</i>
<b>Family Laniidae</b>		<b>Family Mimidae</b>	
loggerhead shrike	<i>Lanius ludovicianus</i>	gray catbird	<i>Dumetella carolinensis</i>
northern shrike	<i>Lanius excubitor</i>	sage thrasher	<i>Oreoscoptes montanus</i>
<b>Family Vireonidae</b>		northern mockingbird	<i>Mimus polyglottos</i>
white-eyed vireo	<i>Vireo griseus</i>	brown thrasher	<i>Toxostoma rufum</i>
Bell's vireo	<i>Vireo bellii</i>	curve-billed thrasher	<i>Toxostoma curvirostre</i>
yellow-throated vireo	<i>Vireo flavifrons</i>	<b>Family Sturnidae</b>	
blue-headed vireo	<i>Vireo solitarius</i>	European starling	<i>Sturnus vulgaris</i>
warbling vireo	<i>Vireo gilvus</i>	<b>Family Motacillidae</b>	
Philadelphia vireo	<i>Vireo philadelphicus</i>	American pipit	<i>Anthus rubescens</i>
red-eyed vireo	<i>Vireo olivaceus</i>	Sprague's pipit	<i>Anthus spragueii</i>
<b>Family Corvidae</b>		<b>Family Bombycillidae</b>	
Stellar's jay	<i>Cyanocitta stelleri</i>	Bohemian waxwing	<i>Bombycilla garrulus</i>
blue jay	<i>Cyanocitta cristata</i>	cedar waxwing	<i>Bombycilla cedrorum</i>
western scrub-jay	<i>Aphelocoma californica</i>		
Clark's nutcracker	<i>Nucifraga columbiana</i>		
black-billed magpie	<i>Pica hudsonia</i>		

## Birds of Illinois —continued

### Family Calcariidae

Lapland longspur  
Smith's longspur  
chestnut-collared longspur  
snow bunting

*Calcarius lapponicus*  
*Calcarius pictus*  
*Calcarius ornatus*  
*Plectrophenax nivalis*

### Family Parulidae

blue-winged warbler  
golden-winged warbler  
Tennessee warbler  
orange-crowned warbler  
Nashville warbler  
northern parula  
yellow warbler  
chestnut-sided warbler  
magnolia warbler  
Cape May warbler  
black-throated blue warbler  
yellow-rumped warbler  
black-throated gray warbler  
black-throated green warbler  
Townsend's warbler  
hermit warbler  
Blackburnian warbler  
yellow-throated warbler  
pine warbler  
Kirtland's warbler  
prairie warbler  
palm warbler  
bay-breasted warbler  
blackpoll warbler  
cerulean warbler  
black-and-white warbler  
American redstart  
prothonotary warbler  
worm-eating warbler  
Swainson's warbler  
ovenbird  
northern waterthrush  
Louisiana waterthrush  
Kentucky warbler  
Connecticut warbler  
mourning warbler  
MacGillivray's warbler  
common yellowthroat  
hooded warbler  
Wilson's warbler  
Canada warbler  
yellow-breasted chat

*Vermivora cyanoptera*  
*Vermivora chrysoptera*  
*Oreothlypis peregrina*  
*Oreothlypis celata*  
*Oreothlypis ruficapilla*  
*Parula americana*  
*Dendroica petechia*  
*Dendroica pensylvanica*  
*Dendroica magnolia*  
*Dendroica tigrina*  
*Dendroica caerulescens*  
*Dendroica coronata*  
*Dendroica nigrescens*  
*Dendroica virens*  
*Dendroica townsendi*  
*Dendroica occidentalis*  
*Dendroica fusca*  
*Dendroica dominica*  
*Dendroica pinus*  
*Dendroica kirtlandii*  
*Dendroica discolor*  
*Dendroica palmarum*  
*Dendroica castanea*  
*Dendroica striata*  
*Dendroica cerulea*  
*Mniotilta varia*  
*Setophaga ruticilla*  
*Protonotaria citrea*  
*Helmitheros vermivorum*  
*Limnothlypis swainsonii*  
*Seiurus aurocapilla*  
*Parkesia noveboracensis*  
*Parkesia motacilla*  
*Oporornis formosus*  
*Oporornis agilis*  
*Oporornis philadelphia*  
*Oporornis tolmiei*  
*Geothlypis trichas*  
*Wilsonia citrina*  
*Wilsonia pusilla*  
*Wilsonia canadensis*  
*Icteria virens*

### Family Emberizidae

green-tailed towhee  
spotted towhee  
eastern towhee  
Cassin's sparrow  
Bachman's sparrow  
American tree sparrow  
chipping sparrow  
clay-colored sparrow  
Brewer's sparrow  
field sparrow  
vesper sparrow  
lark sparrow  
black-throated sparrow  
lark bunting  
savannah sparrow  
grasshopper sparrow

*Pipilo chlorurus*  
*Pipilo maculatus*  
*Pipilo erythrophthalmus*  
*Peucaea cassinii*  
*Peucaea aestivalis*  
*Spizella arborea*  
*Spizella passerina*  
*Spizella pallida*  
*Spizella breweri*  
*Spizella pusilla*  
*Pooecetes gramineus*  
*Chondestes grammacus*  
*Amphispiza bilineata*  
*Calamospiza melanocorys*  
*Passerculus sandwichensis*  
*Ammodramus savannarum*

Henslow's sparrow  
Le Conte's sparrow  
Nelson's sparrow  
fox sparrow  
song sparrow  
Lincoln's sparrow  
swamp sparrow  
white-throated sparrow  
Harris's sparrow  
white-crowned sparrow  
golden-crowned sparrow  
dark-eyed junco

*Ammodramus henslowii*  
*Ammodramus leconteii*  
*Ammodramus nelsoni*  
*Passerella iliaca*  
*Melospiza melodia*  
*Melospiza lincolni*  
*Melospiza georgiana*  
*Zonotrichia albicollis*  
*Zonotrichia querula*  
*Zonotrichia leucophrys*  
*Zonotrichia atricapilla*  
*Junco hyemalis*

### Family Cardinalidae

hepatic tanager  
summer tanager  
scarlet tanager  
western tanager  
northern cardinal  
rose-breasted grosbeak  
black-headed grosbeak  
blue grosbeak  
lazuli bunting  
indigo bunting  
painted bunting  
dickcissel

*Piranga flava*  
*Piranga rubra*  
*Piranga olivacea*  
*Piranga ludoviciana*  
*Cardinalis cardinalis*  
*Pheucticus ludovicianus*  
*Pheucticus melanocephalus*  
*Passerina caerulea*  
*Passerina amoena*  
*Passerina cyanea*  
*Passerina ciris*  
*Spiza americana*

### Family Icteridae

bobolink  
red-winged blackbird  
eastern meadowlark  
western meadowlark  
yellow-headed blackbird  
rusty blackbird  
Brewer's blackbird  
common grackle  
great-tailed grackle  
brown-headed cowbird  
orchard oriole  
Baltimore oriole  
Scott's oriole

*Dolichonyx oryzivorus*  
*Agelaius phoeniceus*  
*Sturnella magna*  
*Sturnella neglecta*  
*Xanthocephalus xanthocephalus*  
*Euphagus carolinus*  
*Euphagus cyanocephalus*  
*Quiscalus quiscula*  
*Quiscalus mexicanus*  
*Molothrus ater*  
*Icterus spurius*  
*Icterus galbula*  
*Icterus parisorum*

### Family Fringillidae

gray-crowned rosy-finch  
pine grosbeak  
purple finch  
house finch  
red crossbill  
white-winged crossbill  
common redpoll  
hoary redpoll  
pine siskin  
American goldfinch  
evening grosbeak

*Leucosticte tephrocotis*  
*Pinicola enucleator*  
*Carpodacus purpureus*  
*Carpodacus mexicanus*  
*Loxia curvirostra*  
*Loxia leucoptera*  
*Acanthis flammea*  
*Acanthis hornemanni*  
*Spinus pinus*  
*Spinus tristis*  
*Coccothraustes vespertinus*

### Family Passeridae

Eurasian tree sparrow  
house sparrow

*Passer montanus*  
*Passer domesticus*

### Sources:

American Ornithologists' Union. 2010. *Check-list of North American birds*. <http://www.aou.org/checklist/north/index.php>  
Illinois Natural History Survey. 2010. *Birds of Illinois*. [http://www.inhs.uiuc.edu/animals\\_plants/birds/illbirds.html](http://www.inhs.uiuc.edu/animals_plants/birds/illbirds.html)

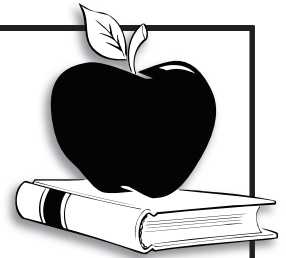
**SUGGESTED GRADE LEVELS:** 4 - 6

**ILLINOIS LEARNING STANDARDS:** science 12.B.2b

**SKILLS/PROCESSES:** observation, classification

**OBJECTIVE:** Students will be able to identify the three characteristics by which birds are defined.

# TEACHER'S GUIDE



## UNIT 1 • LESSON 1

# What Makes a Bird a Bird?

## BACKGROUND

There are more than 9,000 species of birds in the world, with about 800 found in North America. More than 400 species have been recorded in Illinois, and more than 200 bird species have been recorded as nesting in the state.

Birds evolved from small reptiles more than 160 million years ago. They still share some characteristics with reptiles, such as laying eggs and having scales on their legs and feet. Development of the ability to fly required not only feathers and wings but good eyesight, a sense of balance and fine muscle coordination.

Like mammals, birds are **warm-blooded** vertebrates, meaning their internal body temperature is maintained at a constant level regardless of external conditions. This characteristic allows birds to maintain high levels of energy and a **metabolic rate** necessary for flight. By comparison, reptiles and amphibians are cold-blooded, meaning they rely on the temperature of the air and/or water to regulate their body temperature.

Birds have three characteristics that distinguish them from other animals: feathers; hard-shelled eggs; and hollow bones.

**FEATHERS:** Feathers are an adaptation of reptilian scales. They range in size from 0.05 inch on a bird eyelid to the tail feathers of a male peacock (*Pavo cristatus*) which may be five feet long. In number they range from 1,000 on a hummingbird to 25,000 on a swan, and generally comprise 15-20 percent of the entire weight of the bird. Feathers perform a variety of functions, such as flight, regulation of body temperature (**thermoregulation**), protection of the body and skin, attraction of mates and differentiation of species.

The feathers most commonly observed are contour and down feathers. **Contour feathers** cover the body of a bird and have a strong, hollow **shaft** and network of hooks or **barbules** (see diagram on page 2). The contour feathers

on the tail and wings have been modified for flight. **Down feathers** are small and lie under the contour feathers. The purpose of these feathers is to insulate the bird from the cold and protect against sunburn.

Birds must take care of their feathers so they can continue to fly and remain warm. **Preening** feathers spreads oils over the feathers and "re-hooks" the barbules. Even though they are kept clean, feathers become worn and are usually replaced at least once a year. This process is called **molting**.

**HARD-SHELLED EGGS:** Birds lay hard-shelled eggs made mostly of **calcium carbonate**. The hard shell keeps an egg from **dehydrating** and allows parents to sit on the eggs during **incubation**. Even though bird eggs are hard-shelled, they possess microscopic pores which allow oxygen to pass into and carbon dioxide to exit the shell.

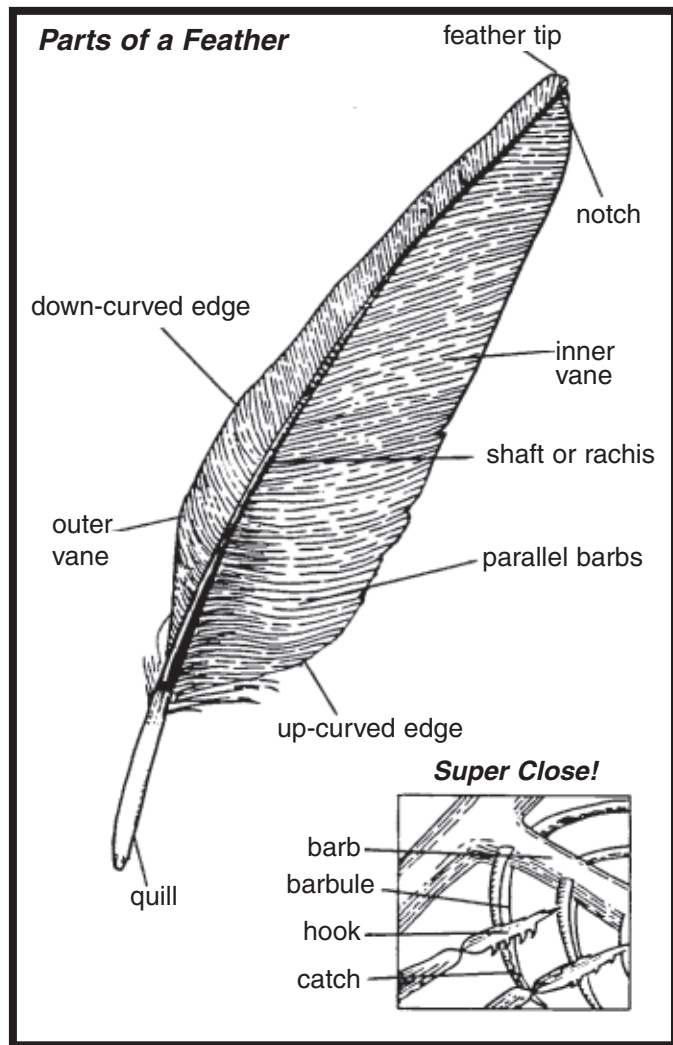
Eggs come in a variety of colors and patterns. Colored and speckled eggs are laid in areas where they need to be **camouflaged**. Blue or green eggs are laid by birds that nest in shady places such as trees or shrubs (American robin). Eggs in these locations are less visible in the dappled sunlight. White eggs are laid by birds nesting in **cavities** (owls, wood duck). Patterned eggs blend in with grass or small stones and are laid by birds that nest on the ground (gulls, sandpipers).

The shape of the egg is related to where the bird nests. The most common shape for eggs is oval. Birds that lay their eggs on ledges need eggs with a pointed end so they will not roll off the ledge (vultures). Round eggs are generally laid by birds nesting in a protected area, such as a cavity (owls). Birds that lay many eggs typically have eggs that are pointed, allowing incubation of several eggs in a small area (northern bobwhite). The number of eggs laid varies by species from as few as one for a seabird to nearly 30 for the northern bobwhite.



The texture of an egg may vary from smooth (smaller birds) to coarse (chicken, *Gallus gallus domesticus*). The smallest eggs (one-half inch) are laid by a hummingbird, the largest (eight inches) by an ostrich (*Struthio camelus*).

**HOLLOW BONES:** Simply having feathers does not permit birds to be creatures of the sky. Extremely light-weight bones are also necessary for flight. Bird bones are strong and hollow, with internal braces (see diagram in Student's Guide). Many bird bones are fused together which increases the strength of the bones.



## PROJECTS AND ACTIVITIES

State and federal laws prohibit possession of **migratory** bird feathers. You can purchase feathers legally to use in this activity at a craft supply store or in the craft section of other stores.

1. By displaying a feather on an overhead projector and by using a hand lens, students will discover the major parts of a feather (quill, shaft, **vane**, barbule, **barb**).
2. After discussing background information on types of feathers, provide students with feathers or photo-

graphs of feathers and ask them to identify various types of feathers. Compare an owl feather, which has a filled shaft and fringed edges to cushion sound, with a rock pigeon feather, which is hollow.

3. Examine cleaned chicken or turkey bones which have been cracked or cut open. Discuss why most bones are hollow (aids flight).

## EVALUATION

1. Ask students to make educated guesses and support their ideas about the purposes and usefulness of specific types of feathers.
2. Have students list and discuss in a paragraph the three characteristics of birds.
3. Bring a down jacket to school. Have students compare the warmth of a down jacket to another type of coat or no coat. Birds have adapted to remain warm in winter by fluffing their feathers and to not over-heat in summer by compressing their feathers.

## EXTENSIONS

- Invite students to attempt to crush a raw chicken egg in their hands. They'll discover it is not possible because the shape of the egg distributes the pressure points.
- Research and conduct an experiment on how natural and artificial oils and soaps affect feathers. Discuss oiled birds and how they are cleaned.
- Reconstruct a chicken or turkey skeleton and label the parts.
- Research the uses of feathers by humans through history. Include such uses as feather pens, headdresses, pillow/mattress stuffing, clothes, art and more.
- Research and discuss the theory of evolution of birds and how birds are related to reptiles.

## VOCABULARY

barbs	incubation
barbule	metabolic rate
calcium carbonate	migratory
camouflaged	molting
cavity	preening
contour feather	shaft
dehydrating	thermoregulation
down feather	vane
	warm-blooded

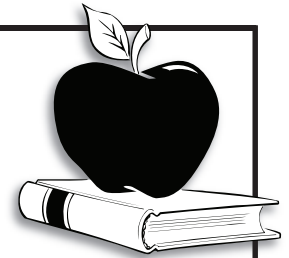
**SUGGESTED GRADE LEVELS:** 4 - 6

**ILLINOIS LEARNING STANDARDS:** science 12.B.2a; social science 17.A.2a, 17.B.2b; fine arts 26.B.2d

**SKILLS/PROCESSES:** observation, classification, inference, prediction

**OBJECTIVE:** Students will be able to identify the four major **habitats** of Illinois and generalize how habitats provide for the specific needs of birds. Students will also recognize that birds may live in many different areas.

# TEACHER'S GUIDE



## UNIT 1 • LESSON 2

# Home Tweet Home

## BACKGROUND

Habitat consists of food, **cover**, water and **space**. These components are necessary for all living things to survive. Food is the material a species consumes, allowing it to perform life functions. Cover provides protection for animals, enabling them to nest, hide, sleep and travel. All wildlife needs water. Some drink water; others obtain it from food they eat. The area required by an animal to survive is called space.

At the time of pioneer settlement, Illinois consisted largely of three habitat types: **wetland**; **prairie**; and **forest**. Today, Illinois has four basic habitat types: wetland; forest; **agricultural**; and **urban/suburban**. The plants and animals typical of each habitat type are unique. Additional variation is possible based on geographic distribution and, for birds, the season.

Wetlands, which are low-lying areas filled with water at least part of the year, support water-loving plants. The basic categories of wetlands in Illinois are ponds, marshes, lakes, reservoirs, swamps, fens, peatlands, rivers and streams.

Wetlands provide a variety of feeding and nesting opportunities for birds. Herons, egrets and kingfishers feed mostly on fishes, with an occasional frog, mussel or crayfish eaten. Ducks feed primarily on aquatic plants but may also eat aquatic insects, clams, snails, frogs, small fishes and worms. Migrating shorebirds use shallow wetlands and mudflats for feeding areas. **Shelter** for birds residing in wetlands may include natural or human-made features. Natural features include trees in swamps and along rivers and streams and cattails around ponds and marshes. Humanmade structures enhance nesting habitats for birds and vary from nest platforms for cormorants, egrets and herons to nest boxes for wood ducks and nest cones for Canada geese.

Forests covered almost 14 million acres of Illinois prior to settlement. Now, only slightly more than four million

acres remain. Forest communities are classified by the dominant tree species. Oak-hickory, elm-ash-cottonwood, maple-beech-birch, oak-gum-cypress, white-red-jack pine, oak-pine and loblolly-shortleaf pine are the major forest communities in Illinois.

Forests provide a diversity of food sources for resident and visiting birds. Many species (thrushes, wild turkey, ruffed grouse) prefer fruits, berries and nuts produced by woodland trees and shrubs. Woodpeckers, nuthatches, warblers, vireos and many other birds feed on insects found on trees. Some woodland birds eat other animals: the American woodcock feeds primarily on worms; and owls feed on mice and small birds. Birds find a variety of shelter in woodlands, from high in the trees to leaf litter on the ground, as well as cavities in trees.

Prairies once covered 22 million acres of Illinois. Grasses and **forbs** (flowering plants) were the primary plants in these fire-dependent communities. Fire not only removed dead leaves and stems, but also kept trees and shrubs from taking over the prairies.

In the early 1830s farmers found that prairie soils were more fertile than forest soils and began to convert prairie to agricultural land. This change, followed by conversions for industrial and urban needs, has left fewer than 2,300 acres of prairie in Illinois. Today, many of our remaining prairies are in small, isolated areas, such as along cemeteries, roadsides, railroad tracks, hilltops and areas too wet or sandy to cultivate.

Many birds typical of prairie and agricultural habitats are insect-eaters or seed-eaters (meadowlarks, horned lark). Populations of some grassland-dependent species, such as the upland sandpiper, greater prairie-chicken and Henslow's sparrow, have declined due to the loss of prairie, pasture and old **field** habitats and are now uncommon. Grassland birds find nesting shelter within the dense grasses and forbs.

Urban and suburban areas also are plant and animal habitat types. Cities have changed dramatically over time. What were once small communities have become large metropolitan areas. The forests, wetlands and prairies that once surrounded cities have been replaced by businesses and residential areas. Trees, shrubs and other plants have been removed and replaced with buildings, concrete or asphalt.

Even though natural habitats are lost or altered due to urbanization, new habitats are created and some wildlife species adapt and move into the area. Parks, cemeteries, golf courses, ponds and backyards all provide habitat for urban birds. Animals that are common to urban areas tolerate humans and are able to adapt to urban foods and home sites. House sparrows, rock pigeons and European starlings have adapted to feeding on insects, seeds and garbage found even in concrete canyons. Northern cardinals, blue jays, mourning doves and American robins nest in suburban yards. Juncos, goldfinches, tree sparrows and chickadees are winter visitors to bird feeders. Peregrine falcons have been introduced to the Chicago and St. Louis areas where they feed on rock pigeons and live on ledges of tall buildings. It is important to note, though, that some species do not tolerate the change in habitat. Conserved areas just for habitat preservation are vital to the survival of these species.

Many birds use more than one habitat. For instance, the American robin feeds on worms and berries from yards but may visit wetlands to gather nest materials. Sandhill cranes roost in wetlands and marshy areas but move to upland areas in search of food. Many birds require different foods at different ages. For example, pheasant and duck chicks require large numbers of insects during the growing stage, but these foods may be unimportant to the birds as adults.

The habitat picture is not all gloom and doom. Efforts to preserve and manage habitats occur at various levels throughout the state and nation. Habitat programs range from national programs such as the agricultural land Conservation Reserve Program and the North American Waterfowl Management Plan to state efforts involving land acquisition, wetland restoration, prairie burns and landowner assistance programs. At the local level, county forest preserves and park districts are actively managing and preserving habitats. Private organizations, such as Ducks Unlimited, Quail Unlimited, the Wild Turkey Federation and Pheasants Forever, undertake a variety of habitat projects.

## PROJECTS AND ACTIVITIES

1. Find photographs that represent the four basic Illinois habitats. Name one example of a bird species typical of each area. Is it present as a nesting or year-round resident? What does it eat?
2. Develop a wildlife habitat area on the school grounds. Use it to attract birds.
3. Make a habitat diorama, 3-D drawing or sculpture using arts and crafts materials to represent plants and animals typical of a select habitat type.

## EVALUATION

1. Discuss the impact of **urban sprawl** and habitat loss on birds. Discuss bird species that have adapted well to human (urban) habitat and why it is important for some to adapt. Are there species that do not adapt? What happens to those birds?
2. Have students identify their habitat needs. What are their daily requirements for food, cover, space and water? Do those needs ever change? How are their habitat needs similar and different from those of birds?
3. Have students name the four habitat types in Illinois, describe them and give two examples of birds that inhabit each.

## EXTENSION

- Have students develop a variation of the game featured on the activity page by adding hazard cards such as predators, pesticides and habitat destruction or modification.

### VOCABULARY

agricultural	prairie
cover	shelter
field	space
forb	urban
forest	urban sprawl
habitat	wetlands

SUGGESTED GRADE LEVELS: 4 - 6

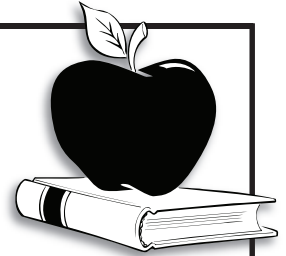
**ILLINOIS LEARNING STANDARDS:**

science 12.B.2a, 12.B.2b; fine arts 26.B.2d

**SKILLS/PROCESSES:** observation, classification, data collection, writing

**OBJECTIVE:** Students will distinguish the major **classifications** of birds and the **characteristics** of related birds.

# TEACHER'S GUIDE



## UNIT 1 • LESSON 3

# Birds of a Feather

### BACKGROUND

**Scientists** use **keys** to classify relationships of birds. Keys list **primitive** birds first and the more advanced birds, requiring more steps to identify, later in the key. Birds that have similar characteristics are placed together in a category known as a "family." The major families of birds common to Illinois are listed below in order from the least to most advanced.



#### heron, bittern

These large, fish-eating birds wade rather than swim.



#### duck, goose, swan

These birds are common to wet areas and usually have webbed feet. Their eggs are not spotted.



#### hawk

Hawks are **diurnal** (day) birds of prey.



#### pheasant, turkey

Birds in this family have relatively short, rounded wings, are more apt to walk than fly and are year-round residents.



#### owl

Most owls are **nocturnal** (night) birds of prey. Their feathers are modified to allow them to fly quietly, and their eyes are adapted for ability to judge distances.



#### pigeon

Birds in this family have a plump body, small head and small beak. Pigeons are known for their "homing" ability.



#### cuckoo

Cuckoos have short legs with two toes forward and two back. Their bill is heavy and curved.



#### nighthawk

Having a weak bill and a large mouth, nighthawks feed at night by sweeping insects out of the air as they fly.



#### hummingbird

Birds in this family are small and have a long, thin bill. They can hover when feeding.



#### kingfisher

The kingfisher has a large head and bill. It feeds by diving into water to catch fishes.



#### woodpecker

These birds drill into trees searching for insects. They have two toes pointing forward and two backward.



#### flycatcher

These birds perch upright while waiting for insects, which they catch in flight. Their flat bill has bristles at the base.

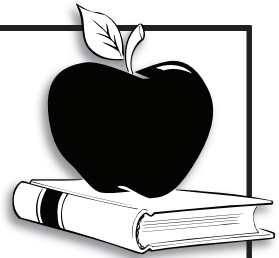
**SUGGESTED GRADE LEVELS:** 4 - 6

**ILLINOIS LEARNING STANDARDS:**  
science 12.B.2a

**SKILLS/PROCESSES:** mapping, observation, communication,  
data collection

**OBJECTIVE:** Students will recognize some bird **songs** of  
common Illinois species and the importance and differences  
between songs and **calls**.

# TEACHER'S GUIDE

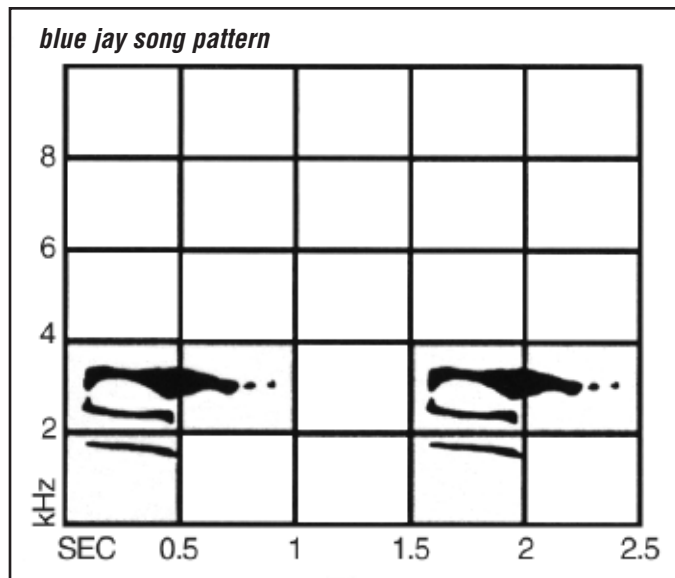


## UNIT 2 • LESSON 2

# Bird Banter

### BACKGROUND

Communication is important to birds, especially in habitats where vegetation impedes vision, such as forests, grasslands and wetlands. Birds communicate by vocalizations, such as songs and calls, other noises, like tapping and **drumming**, and behaviors such as courtship flights and dances.



Songs are specific patterns of notes repeated with few variations. They are used to attract mates and mark the territory necessary for production and rearing of young. Birds use the peaceful "war of words" to settle boundary disputes, instead of the dangerous "war of weapons" people sometimes use.

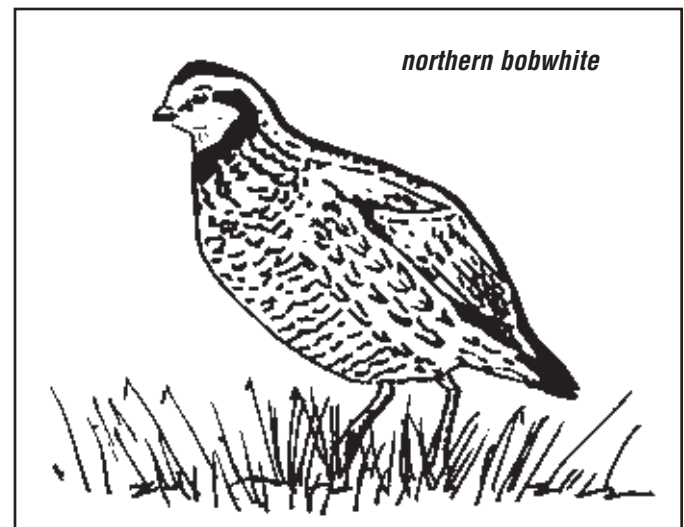
Each species has its own specific song or songs. Some birds have over a dozen calls and songs (northern cardinal). Some birds are able to mimic the songs of other birds (gray catbird, northern mockingbird), humans and our products (European starlings can imitate a car alarm). Just like humans, bird songs have regional dialects. Some birds are born knowing how to sing.

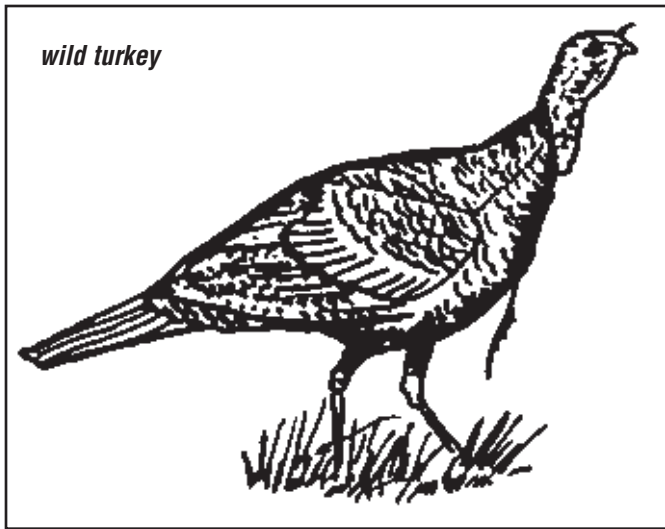
Others must listen to calls of adult birds of their kind and practice the calls before perfecting them.

When alerting others of danger, birds call. Calls are also made when feeding or **migrating**. **Precocial** (independent) young communicate with their parents through a location call. When a **covey** of northern bobwhite is split up, they locate each other and rejoin the group through a gathering call.

Birds do not have vocal cords. To produce sounds, vibrations are sent across the **syrix** (voice box) of a bird. The more muscles a bird has attached to the syrix, the more vocalizations it can make. For instance, northern mockingbirds have many muscles and can produce a variety of sounds, while rock pigeons' singular pair of muscles results in only the single "coo" sound.

A variety of other types of communications are used by birds. Hungry nestlings peck at their parents' beak or open their mouth widely to beg for food. Male ruffed grouse "drum" and greater prairie-chickens "**boom**" to attract a mate. Sandhill cranes and American woodcocks have elaborate mating dances and flights. A male



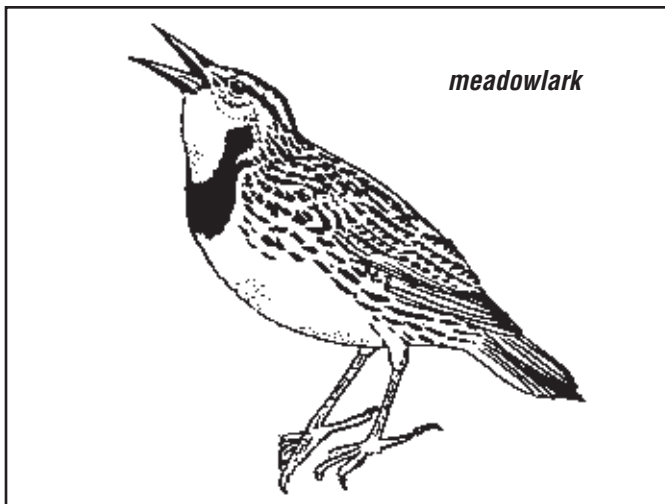


wild turkey will spread its tail and drop and "rattle" its wings to attract a mate.

Communication is very important to birds. Without communication, many birds would starve, lose their way during migration or be unable to defend a territory or find a mate.

### PROJECTS AND ACTIVITIES

1. Learn to attract birds with sound. One of the easiest sounds you can make is to suck on the back of your hand, which will attract chickadees.



2. Listen to the audio section of these lessons, use the *Biodiversity of Illinois* CD-ROM series and/or the audio CD-ROMs in the *Illinois Birds Resources Trunk* from the Illinois Department of Natural Resources or borrow or purchase audio CD-ROMs that contain bird songs and calls. Learn the songs and calls of a variety of species.

### EVALUATION

1. After listening to bird call tapes, take students outdoors and identify bird songs and calls. Have a class bird sounds contest, seeing who can call like a robin or caw like a crow.
2. Test the students to see if they can recognize the calls of species you've studied. For hearing-impaired students, describe the calls in words.

### EXTENSIONS

- Bring a duck/goose call from home and have children share examples of the sounds they can make. Sanitize the call, if shared.
- Visit a nature center where a naturalist can escort you on a bird walk and point out birds and calls. Featured birds may include chickadees, northern cardinals, European starlings, meadowlarks, ducks and geese.

### VOCABULARY

booming	migration
call	precocial
covey	song
drumming	syrinx

**SUGGESTED GRADE LEVELS:** 4 - 6

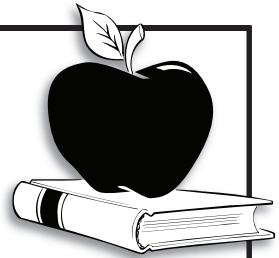
**ILLINOIS LEARNING STANDARDS:**

English language arts 3.C.2a; science 12.A.2b; social science 17.A.2b

**SKILLS/PROCESSES:** observation, inference, prediction

**OBJECTIVE:** Students will recognize why some birds **migrate**, describing the complex processes, and identify the hazards encountered during **migration**.

# TEACHER'S GUIDE



## UNIT 3 • LESSON 1

# Moving Day

### BACKGROUND

More than one-third of the world's birds migrate.

Migration is a mechanism which allows birds to adapt to changes in the environment. Generally these changes are seasonal (weather, lack of food) and would make



continuing to live in that habitat difficult. From the small ruby-throated hummingbird to the large bald eagle, birds move from the area where they raise young to their winter home. Migration is instinctive. Most birds

migrate in flocks, even if they normally live alone.

Migration in groups increases the chances for survival of individuals.

Migration moves birds from areas with dwindling food supplies to warmer winter feeding grounds with more abundant food. Only the fittest individuals will survive migration, insuring that the strongest birds are able to reproduce.

Some birds are **diurnal** migrators, others **nocturnal**.

Daytime, or diurnal, migrators are generally larger (geese) and predatory species (hawks) that navigate by sight and have few, if any, predators. Many hawks begin their flight in mid-day taking advantage of rising warm air columns (**thermals**). Songbirds are nocturnal migrators, flying in darkness. Their daylight hours are spent searching for food and resting for the next leg of their trip.

The urge to migrate may be stimulated by a variety of factors. Changes in the angle and amount of light rays which occur seasonally may trigger migration. Low pressure areas in the fall trigger a southward migration, while high pressure areas in the spring encourage movement to the north. The lack of food sources in the fall and winter may also send birds toward areas where food supplies are more readily available.

The ability of birds to migrate great distances and return to the same general vicinity year after year is a subject which has fascinated people for centuries. Diurnal migrators fly along broad air routes established by physical features such as major rivers, coastlines, mountains and lakes. Many birds use the Mississippi River as a **flyway**. The position of the stars and moon and the earth's magnetic field are used by nocturnal migrators.

Birds encounter many hazards during their migration. Nocturnal and low-flying migrants risk flying into an assortment of humanmade objects such as tall buildings, power lines and towers, windows and aircraft. Hunting seasons are established for some species (ducks, geese, mourning doves) during the fall migration. Even though birds are harvested, hunting is within limits that a population can withstand. Predatory species, such as hawks, are often migrating at the same time that songbirds do. Habitat destruction and pollution are serious migrational hazards. Destruction and pollution of the northern breeding grounds affect spring migrations. Likewise, peoples' actions on southern feeding grounds, such as tropical deforestation, result in the death of untold numbers of birds. Late snow and ice storms and severe rain and lightning which occur on the spring breeding grounds also kill many migrants.

### nocturnal migration



## PROJECTS AND ACTIVITIES

1. Write a story or develop a journal entry with the author being a migrating bird. Include illustrations. Some suggested points to include are:
  - the urge to fly;
  - numbers of birds preparing for migration; mostly young, inexperienced flyers that may not complete the migration;
  - eating like crazy to increase fat reserves;
  - waiting for proper weather (low pressure--rain and cold) to head south;
  - losses of flock before heading south due to **predation**, starvation, poisons, etc.;
  - cruising at heights around 4,000 feet and appearing on airport radar screens;
  - flying at speeds up to 30 mph and distances of 270 miles per day;
  - reviewing a map and selecting resting locations that include food and cover;
  - hazards encountered during flight such as power lines and ice storms;
  - arrival on the winter grounds (where, when, losses occurring due to starvation, loss of habitat, predation and hunting).

## EVALUATION

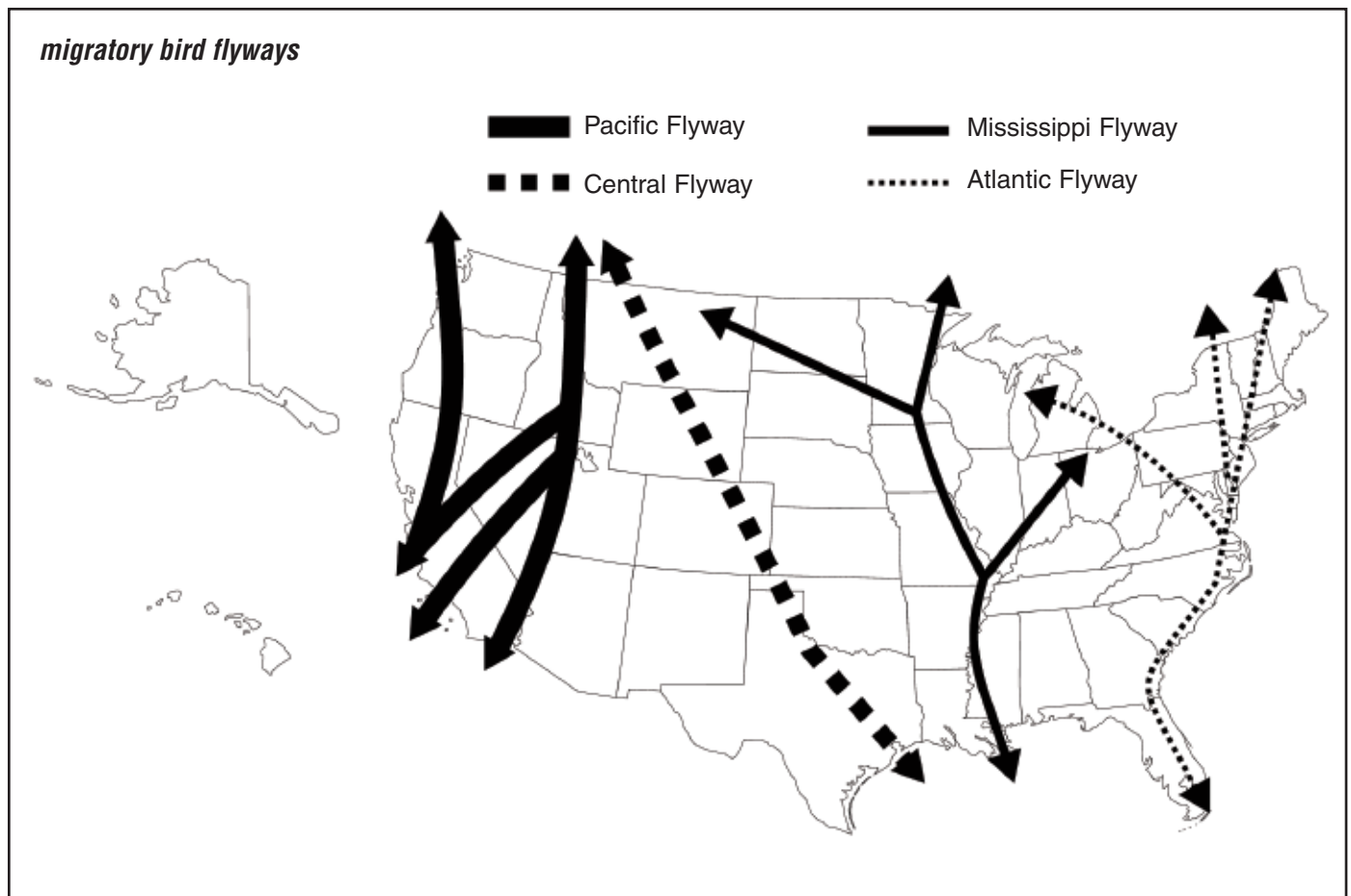
1. In a written report, students will explain how and why birds migrate and the hazards encountered during the trip.

## EXTENSIONS

- Research other migratory animals such as bats, monarch butterflies and salmon. Compare why, when and how each migrates.
- Complete some or all of the activities from the *One Bird—Two Habitats* unit.
- Complete the “Migration Mural” activity.

### VOCABULARY

diurnal  
flyway  
migration  
nocturnal  
predation  
thermals





# Glossary

**acre** – a unit of land measurement; equal to 43,560 square feet and slightly smaller than a football field

Aunt Grace plants a one-**acre** garden every spring and sells the vegetables in town.

**adapt (adapted, adaptation)** – to adjust to new conditions or surroundings in an effort to survive

When our family moved to Minnesota we had to **adapt** to the cold winters.

**agricultural** – land planted to harvest, such as hay or row crops

Corn is the primary **agricultural** crop in our state.

**altricial** – the condition of being helpless and naked when hatched, such as blue jays and doves

The baby blue jays are **altricial** and hatch without feathers.

**barb** – the part of the feather that sticks out of the shaft; collectively, a vane

The structures that look like little hairs growing out of the shaft of a feather are **barbs**.

**barbule** – structures that grow out of the barbs of a feather; have hooks and rolled edges to lock the barbs together

Under the microscope the **barbules** look like the hook and eye on our garden gate.

**binoculars** – a device that makes distant objects look larger and closer

Viewing the bird through the **binoculars** let us identify it as a yellow warbler.

**biologist** – a person who studies living and once-living things

The **biologist** showed our class the differences between birds and mammals.

**birding** – to watch birds

We went **birding** with a biologist and learned six new bird calls.

**booming** – to make a deep, hollow sound to attract mates

Each spring prairie-chicken males attract females by **booming** and dancing.

**boycott** – people that join together to protest a person or business

I joined the **boycott** of products from the business that was dumping chemicals in the river.

**brood** – collectively, all the offspring from one nesting of a bird

The hen wood duck led her **brood** to the stream.

**calcium carbonate** – a white compound (CaCO<sub>3</sub>) found in bones, teeth and shells

The shells and bones of birds contain **calcium carbonate**.

**call** – a vocalization that is not a song; made during courtship, feeding, migration or as a warning

The **call** of the northern bobwhite parents warns their young of approaching danger.

**camouflage** – protective coloring that helps hide an animal

The hen ring-necked pheasant's brown color helps to **camouflage** her while sitting on the nest.

**cavity** – hollow place or hole

The red-headed woodpeckers are nesting in a **cavity** in the elm tree.

**characteristic** – a quality or feature that makes something different from others

One **characteristic** used to identify the meadowlark is the black "v" on its breast.

**classification** – to arrange things in groups or classes

The **classification** of birds is based in part on their feeding habits and types of beaks.

**clutch** – a nest of eggs or brood of chicks

The nest in the evergreen tree contained a **clutch** of song sparrow eggs.

**common** – ordinary or average

The northern cardinal and blue jay are birds **common** to both the city and country.

**communicate** – to exchange information

Birds **communicate** through songs, calls and body posture.

**competition (compete)** – the act of trying to win or gain something from another or others

The **competition** between woodpeckers for the suet was intense.

**contour feather** – a feather having a strong, hollow shaft and a network of hooks

**Contour feathers** hide the fluffy, soft, down feathers that lie close to the bird's body.

**courtship** – a behavior pattern that leads to mating

**Courtship** behavior for birds includes singing, strutting, booming and posturing.

**cover** – the vegetation and debris that provide areas for animals to hide, sleep, feed and breed

The brushy fence row provides excellent **cover** for songbirds.

**covey** – a small flock or group, often a family

On our walk through the field, we disturbed a **covey** of northern bobwhite that scattered noisily in every direction.

**crop** – the organ at the bottom of the esophagus where food is stored for later digestion

While sitting under the bird feeder, the dove filled its **crop** with millet seed.

**dehydrating** – the process of drying out

The eggshell prevents the embryo from **dehydrating**.

**dimorphism** – having two distinct forms; males and females of the same species having different appearances

**Dimorphism** occurs in the northern cardinal: the male has red feathers while the female's feathers are brown.

**diurnal** – active during the day

The American robins, northern cardinals and blue jays we saw on our picnic at the park are **diurnal** birds.

**down feather** – soft feather next to the body that provides insulation; the covering of young birds

The newly hatched owlets look soft because they are covered with **down feathers**.

**drumming** – to make a loud, reverberating sound by quivering the wings

Each spring, male ruffed grouse attract females by **drumming**.

**ecological balance** – an environment that is healthy and fully functional

Removing the food supply from a habitat upsets the **ecological balance**.

**egg tooth** – a small, sharp tip on the upper bill used during hatching to chip out of the shell

I held a newly hatched chicken and felt its **egg tooth**.

**endangered** – a species which is in danger of extinction

The greater prairie-chicken is an **endangered** species in Illinois.

**embryo** – a bird developing inside an egg

The **embryo** is protected by the egg's shell.

**energy expense** – the amount of energy used in performing a task

The **energy expense** of a bird feeding young is greater than for one without young.

**environment** – the surrounding area in which an organism lives

Our zoo tries to make each animal's cage like its natural **environment**.

**ethical** – having to do with ethics or morals

**Ethical** sportsmen harvest only their legal limit of birds.

**extinct (extinction)** – a species that is no longer existing

Passenger pigeons became **extinct** when the last one died in 1914.

**feeding station** – structures filled with bird seed and placed outdoors

During breakfast we watch birds at the **feeding station** outside our dining room window.

**field** – a piece of open or cleared land

The weeds growing in the **field** provide food for many birds.

**field guide** – a book used to identify organisms or other objects.

For our picnics we always pack a bird **field guide** so we can identify the birds we see.

**flight feather** – a type of contour feather on the wing used during flight

For a few weeks each summer geese molt their **flight feathers** and are unable to fly.

**flyway** – a migratory route followed by birds to and from breeding areas

The Mississippi River serves as a **flyway** for many birds.

**forb** – a broad-leaved flowering plant that grows in a field or prairie

Prairies contain grasses as well as a variety of **forbs**, such as Indian paintbrush.

**forest** – an area covered with trees and other plants that form a closed canopy

The **forest** floor is a favorite feeding area for thrushes.

**fragmentation** – creating smaller areas of habitat from a large continuous habitat tract, such as removing a block of trees from a forested area

The road built through the forest resulted in **fragmentation** of the habitat.

**game bird** – a bird hunted for food and sport

My Dad's favorite **game bird** to hunt is the wild turkey.

**habitat** – the natural environment providing food, water, shelter and space for animals

The **habitat** for a Canada goose is a wetland.

**hover** – to stay in the air, flying in one place

The American kestrel **hovers** above the grassy roadside waiting to catch a mouse.

**imitate** – to copy the behavior of another animal

European starlings **imitate** many other birds' songs.

**incubate (incubation)** – to sit on eggs, keeping them warm until they hatch

The female American robin sat on her nest for two weeks to **incubate** the eggs.

**instinct** – a way of acting that an animal is born with

The urge to fly south for the winter is an **instinct**.

**intrinsic** – inherent qualities

The right to exist is an **intrinsic** value.

**key** – a chart showing grouping characteristics used to identify different classifications of organisms

The bird **key** helped us to decide that the bird at our feeder was a song sparrow.

**mandible** – the lower half of a bird's bill

Seed-eating birds, such as the northern cardinal, have a strong **mandible**.

**mate (mating)** – the process of male and female coming together to join egg and sperm cells; one of a pair of animals brought together for breeding

**Mating** takes place to produce offspring.

**mating ritual** – a practice conducted at regular intervals

Booming and drumming **rituals** occur during the mating season.

**mating season** – the time of year when mating occurs

The **mating season** for most birds is spring and early summer.

**metabolism (metabolic rate)** – chemical changes that provide the energy required for life; amount of food consumed, heat produced or oxygen used; speed at which the changes occur is the metabolic rate

Birds eat a lot of food because of their high **metabolic rate**.

**migrate (migration, migrating, migrants, migratory, migratory species)** – to move from one place to another

Warblers **migrate** from Central and South America each spring to nest in North America.

**molt (molting)** – to shed worn feathers and replace with new ones

Geese are unable to fly for a short period each summer when they **molt** their flight feathers.

**monogamous** – having only one mate

Bald eagles are **monogamous**.

**naturalist** – a person who knows a great deal about plants and animals

The park **naturalist** led our field trip and named plants and animals seen along the trail.

**nectar** – the sweet liquid produced by flowers

Ruby-throated hummingbirds are **nectar**-feeding birds.

**Neotropical migrant** – bird that spends the winter months in Central and South America and summers in North America

Scarlet tanagers are **Neotropical migrants**, spending part of the year in North America and the rest of the year in South America.

**nocturnal** – active at night

Owls are **nocturnal** birds because they hunt for food when it is dark.

**ornithologist** – a biologist specializing in the study of birds

The **ornithologist** showed the children the marks made by the woodpecker.

**parasite (parasitize)** – an animal that lives at the expense of another animal

The brown-headed cowbird is a nest **parasite** that relies on other birds to raise its young.

**passerine** – songbirds or perching birds

Warblers, blackbirds, finches, sparrows and vireos are types of **passerines**.

**pesticide** – any chemical used to control insects or weeds

Our neighbor applies **pesticides** to his yard and garden to control insect pests.

**phenology** – the study of natural phenomena that recur periodically, such as migration

Comparing daily records of birds at our feeding station for many years is called **phenology**.

**pecking** – to break through the shell

Twenty-eight days after the eggs were laid the chicks began **pecking**.

**population** – the number of organisms of one species living in a specific place at a specific time

Biologists estimated the **population** of mallards on the lake to be 125.

**prairie** – a type of habitat characterized by native grasses and forbs

**Prairies** once covered most of Illinois.

**precocial** – newly hatched birds that are covered in down and able to walk away from the nest with their parents as soon as they have dried off

Ring-necked pheasants and northern bobwhite have **precocial** young.

**predator (predation)** – an animal that feeds on other animals

Hawks and owls are **predators**.

**preening** – to clean, straighten and fluff feathers

The house sparrows sat in the road dusting and **preening** themselves.

**prehensile** – adapted to grasp or seize; flexible

The American woodcock's **prehensile** bill allows it to probe the ground and, when it finds an earthworm, open only the tip to grasp the worm and pull it out.

**prey** – an animal that is hunted by another animal for food

Insects, crayfish and songbirds are **prey** for the screech owl.

**primitive** – an organism that has evolved little from early ancestral types

Hawks and owls are more **primitive** birds than warblers.

**rally** – to bring or come together

When scattered, northern bobwhite whistle their **rally** call to locate and rejoin members of their covey.

**range** – the land on which an animal lives

The home **range** of birds contains the food, cover, shelter and water required for living.

**rare** – something not seen or found often

The black rail is **rare** in Illinois because much of its nesting habitat in wetlands has been destroyed.

**scientific** – having to do with or used in science

The **scientific** name for the barn owl is *Tyto alba*.

**scientist** – a person who knows a great deal about a branch of science

An ornithologist is a **scientist** who specializes in the study of birds.

**scold** – sharp vocalizations

Blue jays **scold** squirrels that get too close to their nest.

**shaft** – the hard center "tube" of a feather

The **shaft** of a feather pen holds the ink.

**shelter** – cover from the weather for purposes such as nesting, breeding and travel

Our apple tree provided **shelter** for the nesting mourning dove.

**soar** – to fly high in the air and barely flap wings

Bald eagles **soar** up and down the river in search of fishes.

**song** – the notes repeated by a bird in a regular pattern, used to defend territory and attract mates

Hearing the **songs** of birds is one of the first signs of spring.

**space** – a certain-sized area an animal needs to live

Larger animals require more **space** than smaller ones.

**species** – groups of animals with shared characteristics that can reproduce and produce fertile offspring

Red-headed and red-bellied woodpeckers are two different **species** of woodpeckers.

**strut** – to walk in a stiff manner

The **strut** of a male turkey is part of the mating ritual.

**suburban** – having to do with a suburb; an area with homes and stores between a city and the country

Landscaped **suburban** yards attract many birds.

**suet** – animal fats

Woodpeckers are attracted to **suet** hung in bags from trees.

**syrinx** – the vocal organ of birds

Air passing over the **syrinx** produces songs and calls.

**territory** – a defended area used for nesting or feeding

The northern mockingbird flew at the cat that entered its **territory**.

**thermal** – a rising mass of warm air

The hawk flew in a spiral on the **thermals**.

**thermoregulation** – keeping the temperature of a living body at a constant level

Cormorants hold their wings out for **thermoregulation** and to dry their feathers.

**threatened** – any species likely to become endangered in the foreseeable future

On our trip to the nature preserve we saw a **threatened** bird, the black-billed cuckoo.

**toxin** – a poison

Oils and acids are **toxins** to eggs and will cause a developing chick to die.

**urban** – having to do with a city

Peregrine falcons, rock pigeons, European starlings and house sparrows have adapted to an **urban** life.

**urban sprawl** – the spread of development in a way that is extensive and not efficiently planned

The **urban sprawl** of new homes and businesses into the countryside destroys natural habitats.

**vane** – the flat, weblike part of a feather emerging from the shaft; there are two vanes per feather

The **vane** of one flight feather overlaps the vane of the next feather.

**volunteer** – a person who offers to help or does something of his or her own free will and without pay

The statewide spring bird count is conducted by **volunteers**.

**warm-blooded** – maintaining a constant internal body temperature regardless of external conditions

Birds and mammals are **warm-blooded** animals while snakes are cold-blooded.

**wetland** – land that holds water for at least a portion of the year, has hydric soils and has water-loving plants

**Wetland** types range from cattail marshes and cypress swamps to the Mississippi River.

**wildlife sanctuary** – a place of refuge for animals

The area where bald eagles roost was dedicated as a **wildlife sanctuary**.

**wind resistance** – drag produced by the shape of a bird's body

Canada geese fly in a "v" to reduce the **wind resistance** on any one bird.

**wing span** – the distance between the tips of a bird's wings when extended

One of the largest birds in Illinois is the bald eagle, with a **wing span** of seven and one-half feet.

**yolk** – the food source in an egg for the developing bird

As a developing bird grows, the **yolk** shrinks.