

Building a Better Bird



Rebecca A. Hagge – 2011

Objective:

Students will learn about the diversity in bird morphology, with specific examples of backyard species. Morphology will be centered on beak shapes, wing form, leg length and toe placement, and feather types. Students will be introduced to a variety of nesting behaviors as well as the general reasons for and mechanics of migration.

What makes up a bird?

- Evolutionarily, the closest relation to birds is reptiles. Several hundred million years ago, some dinosaurs evolved the capacity to fly using large membrane of skin. Then about 150 million years ago some of these winged dinosaurs developed **feathers**.
- Like reptiles, birds lay **eggs**.
- However, unlike reptiles, and more like mammals, birds have evolved to be warm blooded, or **endotherms**. They can regulate their own temperature independently of outside temperatures.
- Birds have also evolved to eat primarily using **beaks** instead of teeth like mammals and reptiles.

Beak Morphology

Beaks consist of the dorsal, upper, and ventral, lower ridge of the jaw. Each is covered by a shell of keratin more like claws or your fingernails than bone.

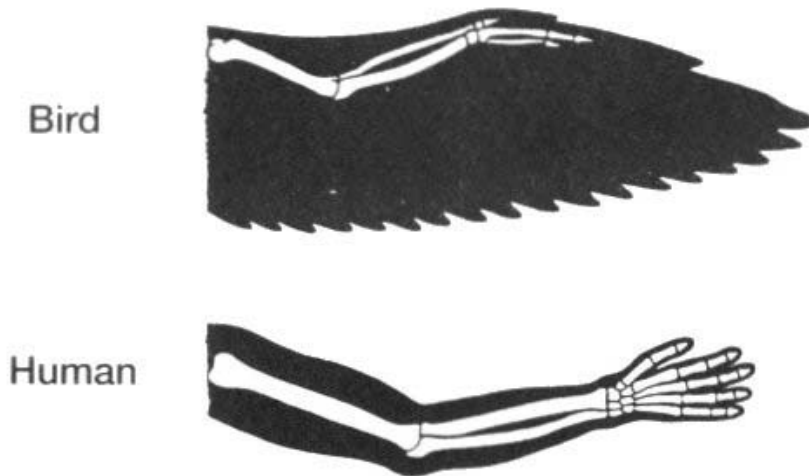
- **Seed**
 - Some birds have evolved short and tall beaks to maximize the force between two parts of their bill. This enables them to crack seeds and nuts.
 - *Sparrows, finches, cardinals, and juncos* are all birds with seed beaks
- **Probing**
 - Probing beaks are long and very thick to withstand the pressure of being hammered against trees. They taper to a chisel to chip away holes in trees. The length allows them to reach inside trees to grab beetles and grubs hiding in the wood.
 - *Nuthatches* and *woodpeckers* are the best example of such birds
- **Insect**

- Many birds have a long but thin beak which is best suited for digging insects and spiders out of the ground or picking them off the grass or trees.
- *Robins, wrens, and blue jays* are all common birds with insect beaks.
- *Swallows and swifts* have evolved a different beak for catching airborne insects. The beak is wide at the base but very short. This allows it to scoop flying insects out of the air.
- **Water Fowl**
 - Birds that are found by the water that have aquatic plants and grass in their diet have evolved bills. Bills are long wide and flat and are lined with small grinding edges and fringed to strain seeds, insects, and small animals from the water.
 - Wildfowl, *ducks, swans, and geese*, all have bills.
 - *Flamingo's* have a specialized bill that's curved. They use it to strain, in particular, shrimp from the water.
- **Fishing**
 - Many fish eating bird have evolved bills that are long and narrow like a spear to catch fish.
 - *Herons, egrets, and loons* have this kind of fishing beak.
 - Other birds that eat fish like *gulls* and *pelicans* have shorter beaks but with a small hook on the end. This helps them hang on to fish and direct the fish down their throat.
- **Hooked**
 - Birds of prey, or raptors, have all evolved hooked beaks ideal for breaking bone and tearing muscle. The top section of the beak is larger and fits over the bottom scissoring food.
 - Local birds of prey include the *Red-Tail Hawk, Osprey, Cooper's Hawk, Turkey Vulture*, and *owls*, such as the *Great Horned Owl, Barn Owl* and *Eastern Screech Owl*.
- **Nectar**
 - Some birds have become highly specialized to feed off of nectar from flowering plants.
 - *Hummingbirds* have a long very narrow beak and an even longer tongue. They reach the beak into a flower and use their tongues to suck up nectar deep inside flowers.
 - *Lorikeets*, a type of parrot, also eat nectar but go about it in a different way. They have curved short beaks like most parrots but their tongue is covered in small hairs. This lets them lick up the nectar much more efficiently. Lorikeets also use their tongues to eat fruit.

Wing Morphology

Wings on dinosaurs evolved from the front limbs; therefore, they have the same bone break up as a reptile, mammal, or human arm.

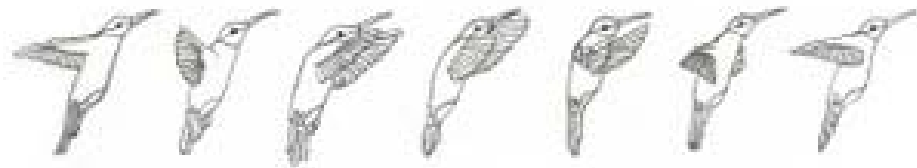
Birds have evolved to use different parts of the wing more than others to adapt them to their



chosen habitat.

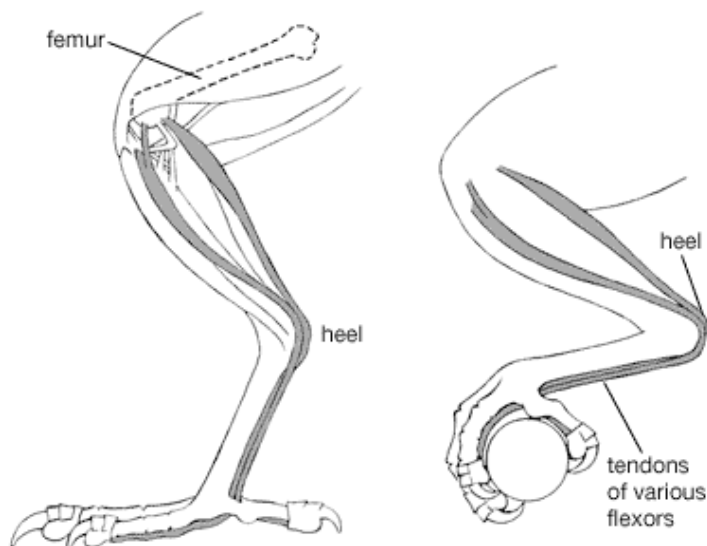
- **Elliptical Flapping**
 - An elliptical wing is shaped like a narrow oval with a joint in the middle. When used for primarily flapping, it's ideal for tight maneuvering, particularly in dense forests.
 - Most passerines, an order of birds commonly known as the perching birds, such as *sparrows*, *starlings*, *finches*, and *robins* have this wing shape.
- **Elliptical Game bird**
 - A wider elliptical wing is used by game birds to deal with their large body weight. The wings can push down with a lot of force for quick takeoff but lack the aerodynamics to remain in flight for long periods of time. Most game birds roost at night but spent the rest of their time foraging on the ground.
 - *Turkeys*, *pheasants*, and *grouse* are all game birds with elliptical wings.
- **High Speed**
 - High speed wings are long, narrow, and tapered to a point. These birds are extremely agile and have rapid beats. They are often found in open fields or over water.
 - *Swifts* and *swallows* are passerines that have high speed wings. *Falcons*, a group of raptors, are some of the fastest birds in the world. The *Peregrine Falcon* can reach speeds of 202mph when hunting making them the fastest animal on earth.

- **High Aspect Ratio**
 - High aspect wings are wider than they are far longer than they are wide and used to glide slowly in place using wind currents.
 - *Gulls* and *albatross* use this slow gliding flight to stay in one place and watch for fish before diving into the ocean.
- **Soaring**
 - Soaring wings have space between feathers to reduce drag. The shorter wings help birds of large size take off easier.
 - Buteos, the genus of raptor that included birds such as the red-tail *hawk*, *eagles*, *vultures*, *cranes*, and *herons* all have soaring wings.
- **Hovering**
 - *Hummingbirds* have specially adapted wings that move in an extremely fast forward scooping motion, opposed to up and down flapping, that enable them to fly in place. This enables them to align their long beaks with the openings of flower.
 - *Ruby-throated Hummingbirds* average 52 wing beats per second!

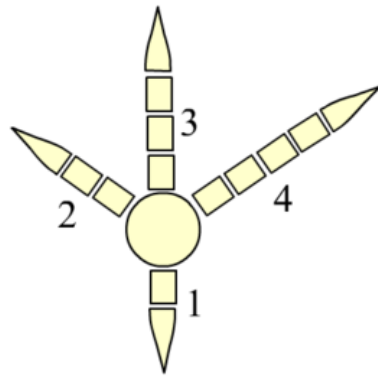


Leg Morphology

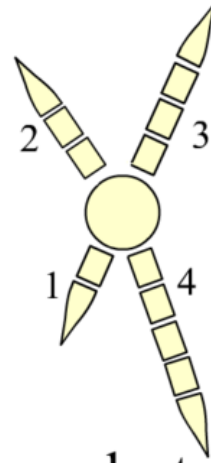
Birds have evolved to walk on their toes using their ankle bone as an additional leg joint. Toe placement is variable and dependent on the habitat and food source of the species.



- **Anisodactyl Placement**
 - This arrangement has 3 front toes and 1 rear toe.
 - Perching birds, for example *American Robins*, have very flexible and fine toes in this arrangement for grabbing small branches and perching.
- **Semipalmate**
 - Wading birds use a modified anisodactyl arrangement to walk through shallow water and mud. Their front toes are spread wider to disperse their weight.
 - *Cranes* and *Egrets* are commonly seen semipalmates
- **Palmate**
 - Also, in an anisodactyl arrangement, palmate feet have webbing between the front 3 toes to increase surface area.
 - Wildfowl, like *ducks*, *geese*, and *swans*, and *gulls* use this arrangement to paddle through water
- **Totipalmate**
 - Totipalmates have webbing between all four toes to maximize water resistance. The fourth toe is therefore closer to the front than in a true anisodactyl arrangement.
 - Swimming birds like *cormorants* and *pelicans* are good examples
- **Raptorial**
 - Most raptors use an anisodactyl arrangement with specialized nails, called talons. for grabbing and stabbing prey
 - There is variation between raptor feet. *Cooper's Hawks* have slim elongated nails for stabbing small prey. *Eagles*, on the other hand, have thicker and more muscular feet to carry large prey.
- **Zygodactyl Placement**
 - Some birds have evolved to have 2 toes situated forward and 2 in the back.
 - Woodpeckers and nuthatches use this arrangement to help cling vertically to trees
 - Unlike most raptors, osprey have a zygodactyls arrangement to help hold onto fish they catch.



Anisodactyl



Zygodactyl

Nesting

Birds use nests as both a place to rest and to raise their young. The following nest types are general designs modified by each species and individual bird to meet their needs.

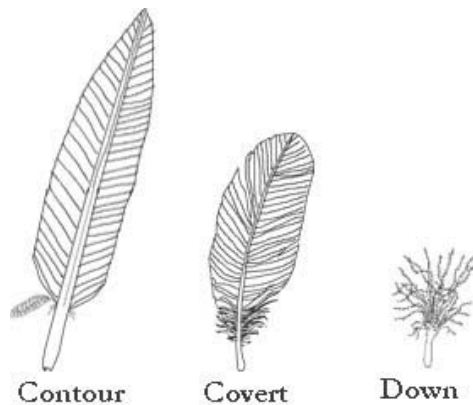
- **Cup Nest**
 - Grass and stick cup nests are the most common. They are made by weaving bits of twig and leaves into a bowl shape wedged between or woven around tree branches. Often pieces of hair, fabric, and plastic are used by birds in an attempt to insulate the nest.
 - *Sparrows*, *starlings*, and *finches* are all cup nest builders
- **Adherent Nest**
 - These nests made of mud, dirt, spit are often found in cliff areas or areas with few trees.
 - *Barn Swallows* have difficulty taking off from an upright perching position so they build mud nests under rock outcrops or manmade
- **Cavity Nest**
 - Many birds either dig holes in trees or find existing holes to line with grass and debris instead of building a nest.
 - *Woodpeckers* and *owls* both like nest in tree cavities, though some owls will take to living in rundown buildings, like barns.
- **Mounds or Ground Nests**
 - Some birds will build a cup nest or a loose pile of grass and twigs on the ground in tall grass. Though they are more exposed to ground predators, the young chicks cannot fall out of the nest.
 - The *Red Harrier*, a type of hawk, and the *Dark-eyed Junco*, a song bird, prefer this method.

- **Aquatic Nest**
 - These nests are built in shallow water or very close to shore and made of grasses, twigs, and often dried aquatic plants.
 - *Ducks, geese*, and most wildfowl build these nests.
- **Platform Nest**
 - *Eagles, hawks*, and many other raptors build huge nests of sticks and large limbs. These nests can be shallow or very deep. The size is required to rear large chicks in and support the parents' weight.

Plumage

Feathers are a unique feature to birds. They are made of keratin, like human hair, and used for flight, protection, and insulation. The soft portions of feathers, the barbs, are attached at the base to the vane. The vane itself is attached at the base to the bird's skin.

- **Important Feather Types**

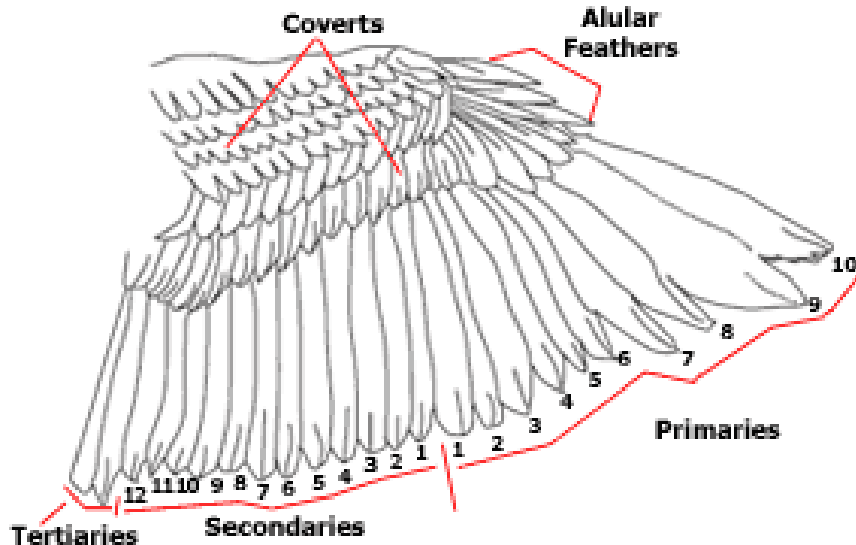


Contour Feathers cover most of the bird's body and are in two groups.

- **Flight Feathers:**
 - These stiff supporting feathers are used primarily for flight. They are broad and long.
 - There are both primaries, attached to the "forearm" and secondaries attached to the "upper arm"
 - Remiges are used for wing support
 - Rectrices are used for tail support
- **Coverts:**
 - These are shorter and smaller feathers layered over the contour flight feathers to streamline the wing.

Afterfeather (Down)

- These small, fine, and fluffy feathers, called down, are essential to trap heat close to body and keep birds warm.



• Other Feather Uses

Water Resistance

Most waterfowl, like *ducks*, have a gland at base of the tail with oil. They spread this oil into their feathers with their beaks to waterproof themselves.

Sexual Diversity

- Males of many species have feathers in bright flashy colors and patterns to compete with each other for their female's attention
- Females of these species are normally very dull colors and speckled as camouflage to blend in to their habitat and hide from predators.
- Backyard examples are *Northern Cardinals* and *Purple Finches*

Juvenile Coloration

- Similar to female coloration, juveniles of many species have speckled and brown colorations intended to camouflage them and break up their outline.
- As they age, they molt, or drop, these feathers and grow in new ones of the adult color and pattern.
- *Red-Tail Hawk* and *American Robin* young both have speckled brown feathers.

Migration

Migration is long-distance movement of individuals, often seasonally, for a variety of reasons. Sometimes many individuals of a single species migrate together in groups. There are also a few common paths that multiple species use to migrate to similar places.

- **Why Migrate?**
 - Temperature change is the most common reason to migrate. If a bird's habitat gets too cold in the winter or too warm in the summer it will fly south or north, respectively for the season.
 - Food availability, often determined by seasonal temperature variation, is another incentive to leave one's habitat temporarily. Some birds change diets as they migrate, picking places to rest along the way based on where they found good food the years before.
 - Breeding is the final most common reason birds migrate. Many species have certain locations that adults go to raise young year after year. Breeding grounds normally have favorable temperatures, plentiful food in breeding months, and a low predator population. Some birds will reuse the same breeding nest year after year!
- **Local Migration Examples**
 - Winter: *Snowy Owls* appear regularly every winter in the northeastern United States. The rest of the year they live in northern Canada. The cold weather and low abundance of food forces them south away from their breeding grounds for the season.
 - Summer: The *Cooper's Hawk* migrates northward in the summer months to breed in New York and the rest of New England. They can also be found year round in most other states.
 - Resident: Not all bird species migrate. Those that don't, for example, *sparrows*, just change their lifestyle and diet in the winter deal with a harsher environment.

Further Resources:

- **All About Birds**
 - This resource, run by the Cornell Lab of Ornithology covers everything from bird watching basics, to bird identification, to recent news in the scientific community.
 - <http://www.allaboutbirds.org/Page.aspx?pid=1189>
 - Also available from the lab's gift store or online is both Eastern U.S. and Western U.S. Bird Sleuth Game Cards. These series of flash cards have the birds' photo on the front and life facts and range map on the backs. The cards accompany the Lab's Bird Sleuth Enrichment program for kids.
 - <http://www.birds.cornell.edu/birdsleuth/top-10-tips-for-birding-with-kids>
- **Audubon Society**

- The Audubon's website focuses on bird conservation, conservation outreach, and education
- <http://www.audubon.org/>

- **Birds of New York State**
 - This site, maintained by the New York State Biodiversity Research Institute, is a great first stop for looking at local birds and their conservation status.
 - <http://www.nybiodiversity.org/summaries/birds/index.html>
- **Birds.com**
 - This resources has pages dedicated to bird care, and evolution
 - <http://www.birds.com/>