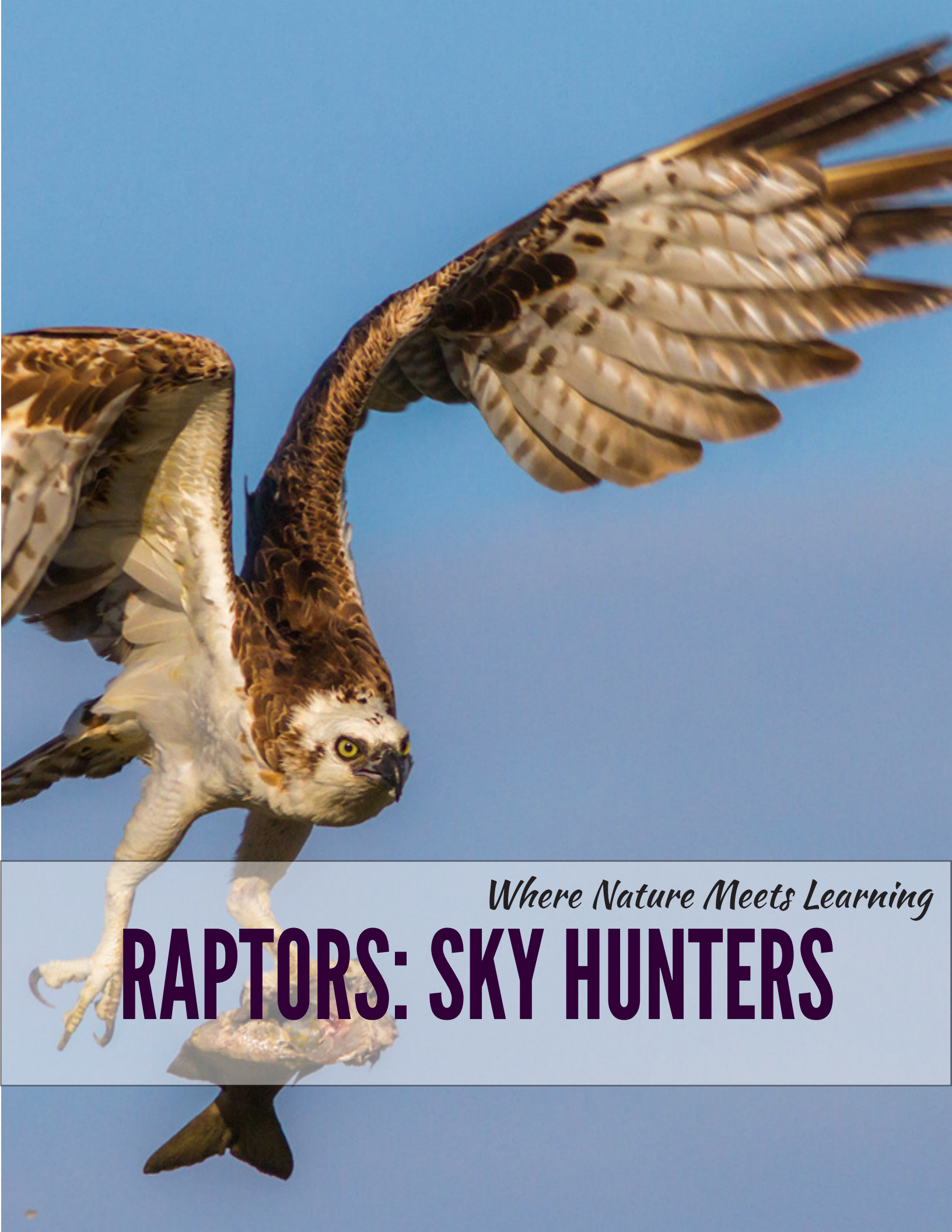

Where Nature Meets Learning

RAPTORS: SKY HUNTERS

Unit 4:
Raptors: Sky Hunters

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UNIT 4

RAPTORS: SKY HUNTERS

"But what I love, is the gray stubborn hawk Who floats alone beyond the frozen vines" - On Winter's Margin, by Mary Oliver

As the howler monkeys use their strong limbs to jump from tree to tree across the tangled branches of the forest canopy, they barely notice the young blue-crowned manakins in the nest below. The monkeys are busy foraging on the green leaves and fruit of a *Ficus* tree. As the adults feed, the young monkeys scamper about - more interested in playing than in filling their bellies. One young female monkey, only a few months old, practices using her prehensile tail to hang upside down from a thick branch. She reaches her arm to grab a fruit that dangles nearly out of reach. She bites the fig in half, exposing its seeds, before dropping it to the forest floor. The half-eaten fruit tumbles down, bounces off a rock and lands in a slow flowing river. Just then, a **Machaca, a** large fish, swims by, engulfing the water-swept fruit and its seeds in its mouth. But the Machaca doesn't get to enjoy its meal for too long. Above, the shadow of a hungry osprey darkens the water below.

Birds of Prey

Introduction to Raptors

Imagine stepping out into the open - whether a desert, a savannah, or a forest clearing. From above, you hear a loud, sharp cry. As you look up, you can make out the silhouette of a large, broad-winged bird soaring in wide circles among the clouds. It is likely that what you are seeing is a bird of prey (also known as a **raptor**) of one kind or another.

There are over 500 species of raptors worldwide, and they are found on every continent of the world except Antartica. Generally speaking, we can describe raptors as strong, carnivorous, hunting birds that are known for using their powerful feet to capture prey. However, there are some exceptions.

Vultures are raptors, but they mostly scavenge. Seriemas are raptors, but often kill their prey with their beaks. Some raptors have even been known to eat fruit and other vegetable matter! Apart from being beautiful and fascinating animals, raptors also play very important roles in maintaining the balance and health of the

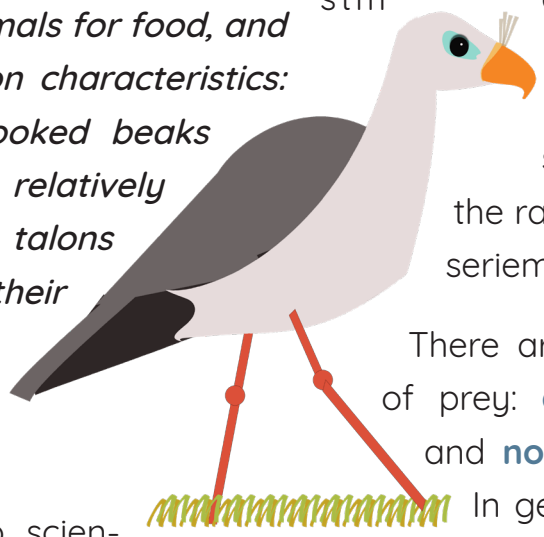
ecosystems in which they live. They are very beneficial to humans, too! Sadly, many predators, such as bears, wolves, snakes, big cats, sharks, and raptors have long been misunderstood and feared by people. Around the world, predators were, and still are, facing many threats, including human persecution.

We hope that as you read and learn more about raptors in this unit, or on your own, you will begin to see why raptors are so interesting, why they are important, and why they should be protected. In short, we hope you will begin to love raptors as much as we do!

What is a Raptor?

Many types of birds eat meat. Gulls, pelicans, herons, and kingfishers eat fish, robins and flycatchers eat invertebrates, and storks eat frogs, fish, and even other birds. So, why is a hawk a bird of prey, but a heron is not?

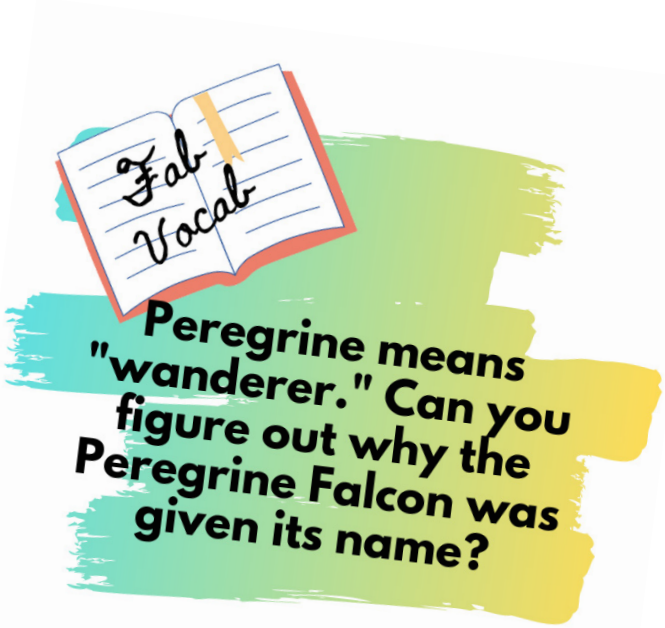
In actuality, scientists have been debating what makes a raptor a raptor for a long time. A broad, long-standing definition has been: ***birds that hunt other animals for food, and that share three common characteristics: exceptional eyesight, hooked beaks with sharp edges, and relatively long, curved and sharp talons for catching and killing their prey***.

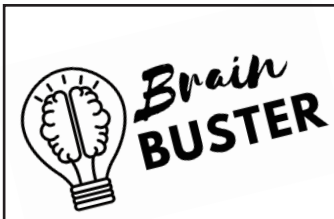


However, as you learned in the introduction, there are some exceptions. So scientists have begun looking at different ways to understand what makes a raptor a raptor. Recently, scientists looked at evolution to help them create a new definition for birds of prey. Today, raptors are defined as "land birds... that evolved from vertebrate-eaters in which most species of the group maintained that vertebrate-eating lifestyle." So, what does this mean? While all the birds we traditionally thought of as raptors, such as eagles, hawks, and falcons, are still considered birds of prey, this new definition means that another group of birds, the seriemas, are now included in the raptor family. Welcome aboard, seriemas!

There are two basic groups of birds of prey: **diurnal** or daytime hunters, and **nocturnal** or nighttime hunters. In general, diurnal raptors include hawks, eagles, kites, vultures, seriemas, osprey, falcons, and the secretarybird; and nocturnal birds of prey include the owls.

Some raptors are migratory, which we will learn more about in Unit 5, while others are **residents** - meaning they stay in the same area all year round. Some raptors build stick nests, others lay their eggs in natural cavities, or even on the ground. Some raise a large number of young each year, others raise just a single young in two or three years. Some are big, some are small, some are fast flyers, others use deep, slow wing-beats to travel through the sky. Some are **endemic** to one small area, others are cosmopolitan - found nearly all over the world! Read on to learn more about this diverse and interesting group of birds.





As you know, many birds share some physical, dietary, and behavioral adaptations with raptors, but aren't considered birds of prey. Take a look at the pairs of birds below that share some raptor characteristics. Can you identify which one in each box is a bird of prey?

1. Both eat fish


Heron


Opsrey

3. Both have hooked beaks


Falcon


Macaw

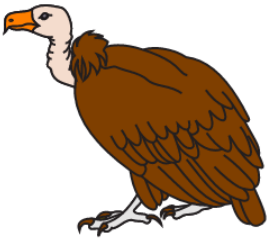
2. Both have feet for grabbing

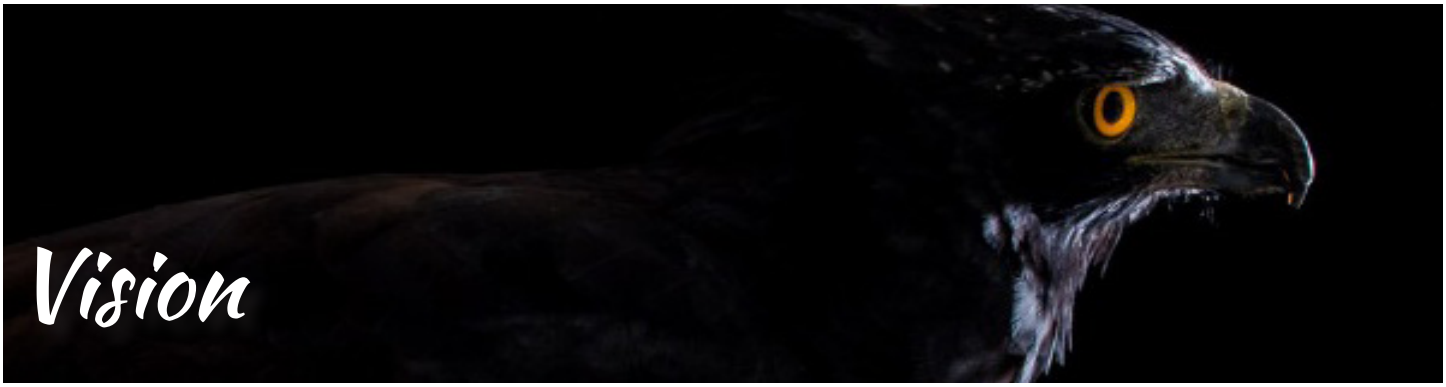

Owl


Parrot

4. Both eat carrion


Crow


Vulture



Vision

Expressions like “eagle-eyed” or “eyes like a hawk” refer to the keen eyesight of raptors. Many raptors can easily detect the slightest movement and some can spot a moving rabbit from more than a mile away. Owls see in black and white, but diurnal raptors have good color vision. Scientists are learning more and more about raptor's incredible eyesight. How do you think your eyes compare to that of a raptor?

You might be wondering how scientists know how well a raptor sees. After all, it would be very difficult to have one sit for an eye exam! So, to understand how and what an animal sees, scientists must look at the eye itself. One clue to how well an animal sees is the size of its eyes! The volume the eye occupies in the skull is a good indication of the eye's importance, and some raptors' eyes occupy nearly half the skull's volume. Raptor eyes make up about 15% of the weight of their heads, while our eyes only make up about 1%!

The shape of a raptor's eye is also quite important. Instead of a spherical shape like ours, their eyes are slightly elongated - which helps them see better. If a raptor and a human were looking at the same thing from the same distance and angle, the raptor would see a slightly more magnified image.

The eye muscles of birds of prey are designed for rapid focus changes. Daytime hunters have full color vision and two concentrations of **cones** in each eye which control color perception. The point of sharpest vision is at these concentrations, called **fovea**. Hawks have two fovea in each eye, one directed to the side and one directed forward. Humans only have one fovea. Working in unison, these fovea give birds very accurate depth perception, something that is very important for birds chasing moving objects.

Nocturnal raptors have a high number of **rod receptors** in their eyes, which help them see better in low light. Because owls have far more rods than cones, they likely don't have as good color vision as diurnal raptors. How well can you see color at night? At night, turn off the lights and let your eyes adjust to the darkness. Try to see the colors of the clothing that you're wearing. Can you?

If all of this weren't amazing enough, some raptors, such as kestrels, can see in the **ultraviolet spectrum**. If you have ever seen a black-light poster glow, you will get an idea of what this means. But how does this help a bird of prey? Seeing on the ultraviolet (UV) spectrum helps them find places where lots of rodents hang out. How does this work? As it turns out, mouse urine reflects UV light, and mice leave urine markings along their runs and outside their dens. With their special vision, kestrels easily pick up on the glowing urine trails, and use it as a road map to find their prey.

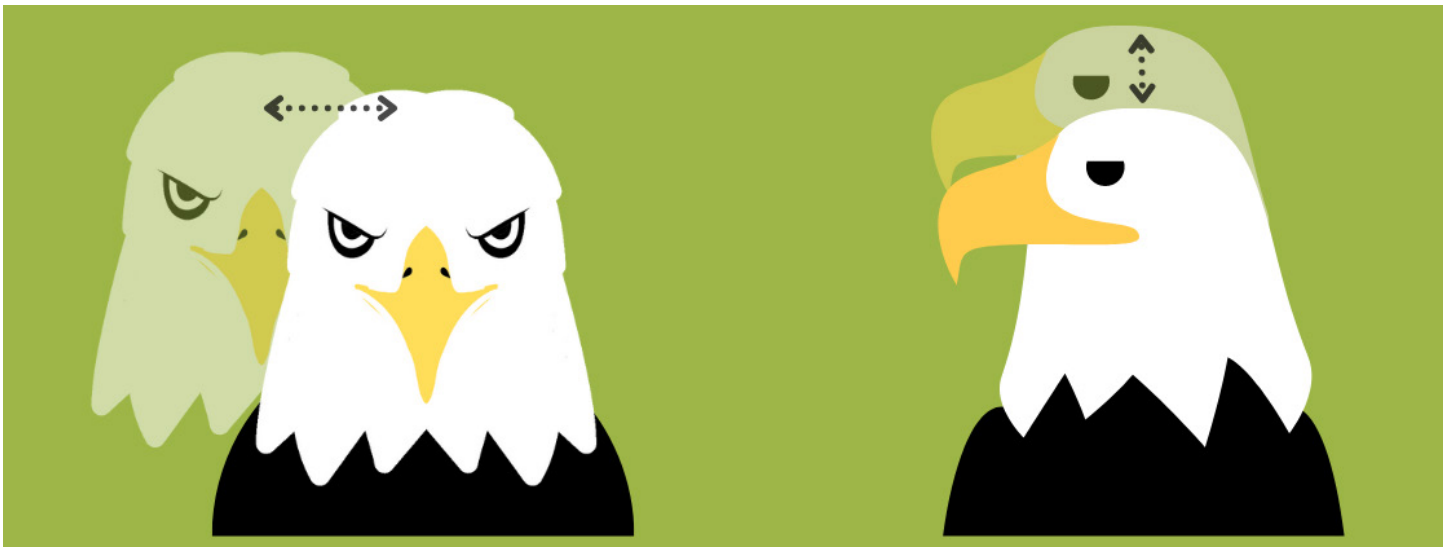
Now, as you can imagine, eyesight is one of the most important senses for a raptor. So, naturally, they have many **adaptations** that help them keep their eyes safe and healthy. Their eyes are set within a bony ring, called a **sclerotic ring**, which protects their eyes and holds them in place. This means that raptors can't move their eyes side to side like we can. To look left or right a bird must move its entire head.

Raptors are also equipped with three eyelids. Two which move up and down just like ours. The third is known as the **nictitating membrane**. It moves from side to side and is a thin lid which is semi-transparent. This helps to protect the bird's eyes but still allows it to have some vision.

Raptors also have a bony ridge above their eye. Feel above your eye, where the eyebrow grows. Humans have a bony ridge, too! In raptors this is more pronounced in order to help better protect their eyes. In some people's opinion it gives them a stern look but it has nothing to do with the bird's character.

A CLOSER LOOK

Raptors are known for bobbing their heads from side to side and up and down. Why would they do this? Evidence suggests that raptors may do this to help them triangulate the object they are looking at, which helps to determine distances. Combined with their forward-facing eyes (**binocular vision**), they can accurately calculate how far an object is and makes them more successful hunters!



Beaks

Birds do not have teeth. Their upper and lower mandibles (or jaws) are called beaks or bills. By observing a bird's beak, it is often possible to tell what it eats. In the case of raptors, their hooked, curved beaks indicate that they mostly eat meat. However, there is a great variety in the size and shape of raptor beaks., just as there is a wide variety in the prey that different raptor species feed on. Read on to learn more!

All birds have beaks, of course. And some birds, like toucans and hornbills, have very-large, colorful and unique-looking beaks. While raptor's beaks are not as flashy, they are one important feature used to separate them from other kinds of birds. Like parrots, raptors have strong, hooked beaks with sharp edges. But unlike a parrot, a raptor uses its beak to tear meat, and in some species, to kill its prey. But, not all raptor beaks are alike.

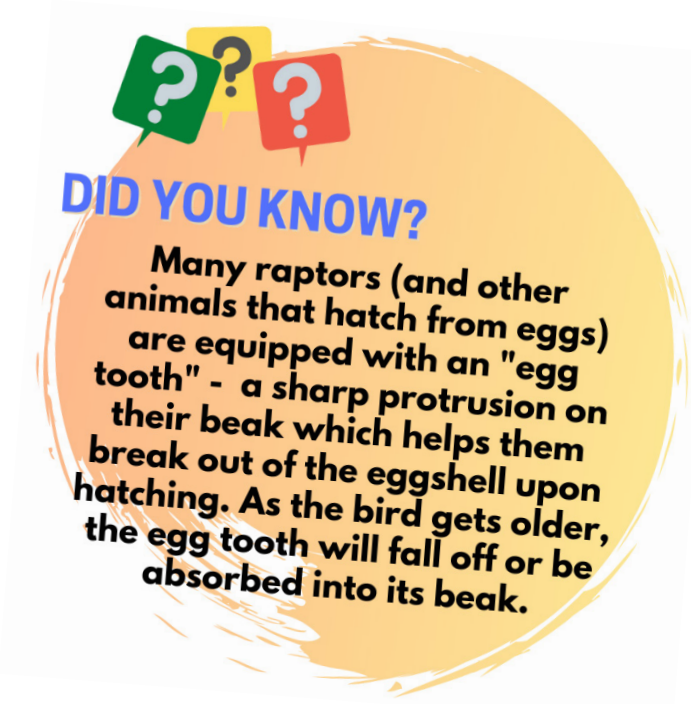
For example, let's take a look at the **snail kite**. Based on its name, you probably guessed that this kite specializes in eating snails. And you would be right! In fact, it mainly feeds on apple snails. Now imagine you were going to eat snails, what sort of utensil would you need to remove the snails from their shells? Would it be the same utensils you might use to eat a piece of steak? Probably not! So the snail kite doesn't need a thick, strong bill to tear into its prey's tough skin, like an eagle might. Instead, the snail kite's beak is long and deeply curved - perfect for probing inside snail shells.

Some raptors, like the **American kestrel**, feed on small prey such as insects, lizards and mice. Such a diet doesn't require a very large beak. Instead, kestrels have short, but strong beaks. They, like other falcons, also have a special triangular-shaped notch on their bill, called a **tomial tooth**. When a falcon bites down on its prey's neck, this sharp notch breaks the vertebrae. This allows the falcon to kill its prey more quickly, than if it only used its feet.

The **bearded vulture** specializes in feeding on bone and bone marrow! As you can imagine, it must have a pretty strong beak

to do that. While its beak is strong, it actually is not strong enough to break into the large bones. This bird has cleverly taken to flying high with the bones and dropping them onto rocks until they break, allowing the bird to get to the treasure inside. Other vultures have very strong, sharp beaks which they use to tear into the tough hides of the carrion they feed on.

A raptor's beak is composed of keratin, the same material our fingernails are made of! A raptor's beak will continue to grow throughout its life. But raptors, of course, don't own beak clippers or go to salons. So, how do they keep their beak from growing too long? Feeding on tough bones, and scraping their bills againt tree branches to clean them, help keep a raptor's beak filed into perfect form.



Legs & Feet

All birds have legs and feet. Depending on the species, birds may use them for swimming, perching, scratching, or walking.

Most raptors have found another important use for their feet - killing their prey. They can also use their feet in defense.

Powerful leg and toe muscles coupled with sharp talons make a raptor's feet the bird's deadliest weapons. The length of the toes, and the size, curvature, and thickness of the **talons** is relative to the type of prey typically pursued. Raptors that eat mammals have short, strong toes while raptors that eat other birds tend to have long, thin legs and toes. This helps them reach through their prey's feathers, and grab on to its body. Raptors that eat snakes have short, strong toes and thick scales on their legs and feet in order to help protect them from snake bites. Some fish-eating raptors are equipped with special scales, called **spicules**, on the bottom of their feet as well as extra deeply curved talons to help them keep a better grip on their slippery meal!

Harpy eagles, which feed on large mammals such as monkeys and sloths, have the longest talons of all raptor species. Their talons are the size of grizzly bear claws – approximately 5 inches. Their feet also have the strongest grip known in the raptor world!

As you can imagine, when a raptor grabs its prey, the prey often fight back. This could prove dangerous for the raptor, so it needs to be able to kill its quarry as quickly as possible. Some raptor feet have a unique adaptation to help them do so. Their toes are equipped with a locking mechanism. When they squeeze down their toes will lock in place, almost like a vice grip! The more the prey moves, the tighter the grip becomes.

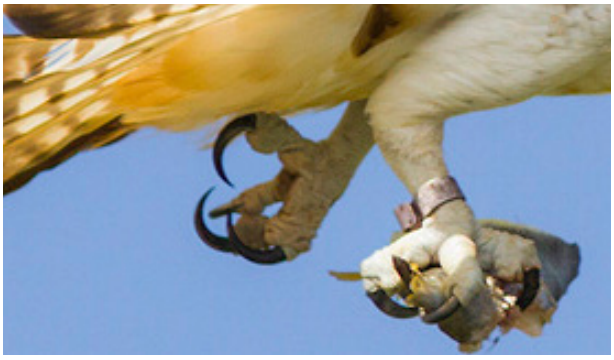
As you think about raptor feet, you might be wondering about vultures! As you know, vultures feed mainly on animals that are already dead. Because they don't need to use their feet for killing prey, their legs, feet and toes and much weaker compared to most other birds of prey. They lack the thick, protective scales, and their legs and feet can be surprisingly soft.

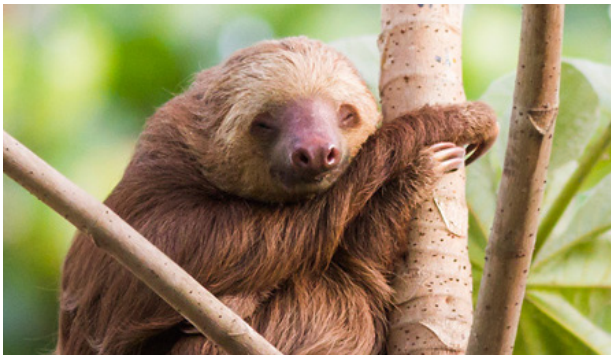
A Raptor's Feet and What it Eats

Take a look at the different types of raptor legs nd feet in the photos below on the left. Each raptor pictured eats something different. Can you tell what it eats based on the size and shape of its legs and feet? Match the raptor to the prey in the photos on the right.

Fab Vocab

A raptor's rear toe, which is often the longest, is called the hallux





Diet & Digestion

As you know, raptors are almost strictly carnivorous. While a very few have been known to feed on fruits and other plant matter, as a general rule, their diets consist of animals or animal parts. Invertebrates, fish, mammals, reptiles, and amphibians, as well as bones and feces are consumed by some raptors. Whether a raptor has a varied diet or a very specialized one, digestion plays a very important part in its health.

As you just learned, birds don't have teeth! They swallow their food without chewing. Some raptors, like owls, often swallow their prey whole. Other raptors, especially when feeding on large prey, tear off smaller pieces to ingest bit by bit. Either way, the food travels down their esophagus and into their stomach. But in some cases, their food makes a pitstop along the way.

Most raptors, with the exception of owls, have something called a **crop**. The crop is where a bird temporarily stores its food before it travels to the stomach to be digested. Having a crop allows birds to eat a lot very quickly, allowing them time to then find a safe place to digest, away from predators or other animals that might want to steal its food.

Just like we do, raptors have digestive juices in their stomachs which help break down their food. But let's think for a minute about what raptors are eating. We know they eat meat, of course. But did you also know they swallow fur, feathers, bones, claws, and other bits, too? It might surprise you to learn that raptors can't actually digest these extra animal parts. But don't worry, nature has found a solution! All the indigestible matter is neatly packed into a **pellet** - a small package containing all the bones, fur and other undigested material. The raptor then regurgitates the pellet out of its mouth! It can take at least six hours after a raptor eats for these pellets to form!

Hearing

Birds use calls and songs to warn of danger, to maintain territories, and to engage in mating rituals. So, it stands to reason that they need to have excellent hearing in order for these songs and calls to be meaningful. Some raptors have a more keenly developed sense of hearing because they also need to use this sense in order to locate their prey.

Imagine it is night time. There are no lights except for the soft glow of a new moon. An owl perches on a bare branch. Below, a rodent is stirring beneath a bush. What do you think will happen? Will the rat escape without being detected? Or has the owl already discovered it?

Species that hunt in darkness and semi-darkness have very keen hearing. Even if this owl hasn't seen the rat, it knows it is there, because it can hear it. **Barn owls**, for example, can successfully hunt in complete darkness, and some owls can detect the sound of voles moving beneath the snow. They know exactly where they are and catch them without ever laying eyes on them!

Raptors, in general, have very good hearing, and many have **asymmetrical** ears. This means one ear is higher up on the head than the other. This helps them to triangulate sounds and hone in on prey. Owls, and other raptors, such as harriers, have feathers surrounding their faces in the shape of a disc. This **facial disc** helps direct sound waves to their ears, kind of like a parabolic dish that catches sound.

To get an idea of what this is like, try cupping your hands behind your ears and lisenting. Are the sounds louder and more pronounced?

With all this talk about ears, you might be wondering where exactly bird's ears are! They are located on the sides of their heads, just like ours. However, birds don't have ear lobes like we do. They have ear canals which are hidden beneath their feathers.

Some owls have what are known as "ear tufts" like the owl in the picture above. These aren't ears at all. They are feathers that can be lifted and lowered in a form of non-verbal communication, but they have nothing to do with how this owl hears.

Sense of Smell

A widely believed myth is that if you touch a baby bird, its mother will abandon it because she will be able to smell the human scent on her chick. This is completely untrue. Most birds are doting parents and put a lot of effort into protecting and caring for their young. In fact, as far as we know, most birds, including raptors, do not have a very well-developed sense of smell at all, at least when we compare them to other animals. However, there are always exceptions to the rule. Read on to learn more!

The wonderful thing about science is that we are discovering new things every day about our natural world. While today, it is believed that birds do not have a good sense of smell, as scientists continue to study our avian friends, we might one day discover new things about how birds use this sense. We already know, for example, that to smell, an organism usually needs **olfactory glands**. However, in most birds, they aren't very well developed. It is also interesting to note that birds only have around 50 taste buds, while we humans have thousands! Taste, of course, is related to our sense of smell. So, what does this all mean? Clearly it is very difficult to truly know whether a bird is smelling or tasting its food, though it stands to reason that at least some odor-detection would help birds navigate, find food, and select a mate!

In fact, scientists discovered that some seabirds can smell compounds emitted by krill, and New Zealand's kiwis can smell insects beneath the soil. But what about raptors?

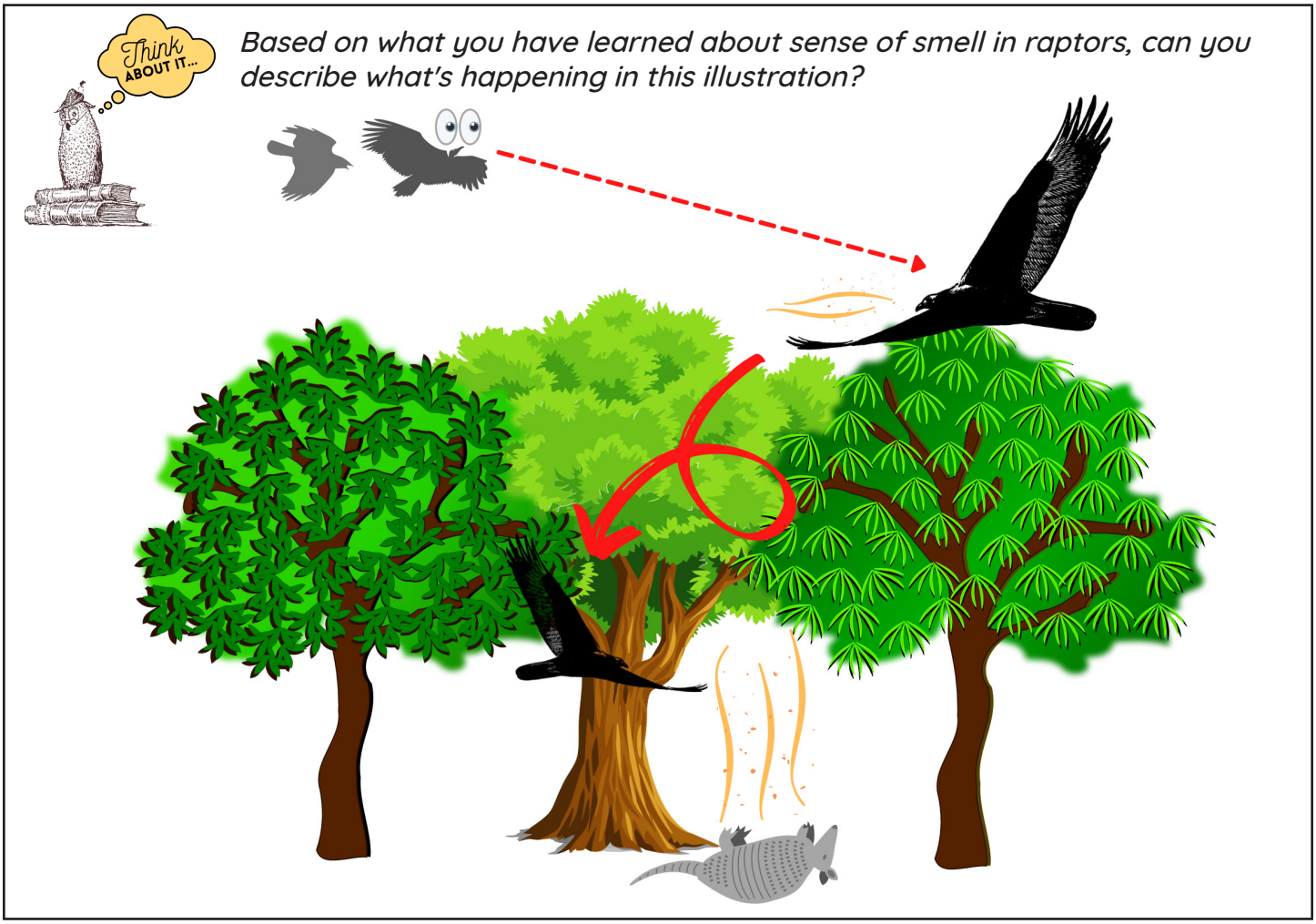
Though, as far as we know, most raptors don't have a good sense of smell, there is one very notable exception. New World vultures, and in particular **turkey vultures**, actually have an incredible sense of smell. They are able to detect rotting meat from kilometers away.

The keen nostrils of the turkey vulture, actually help other species of vultures, as well! How does this work? Well, as you can imagine, since most raptors don't have a sense of smell, they must use other senses to detect food. In the case of scavenging birds, they will key in on the behavior of other scavengers.

For example, in the Americas, **black vultures** and **king vultures**, which don't have a good sense of smell, follow turkey vultures - which do! When the other vultures notice turkey vultures congregating on the forest floor, they know there is probably something good to eat nearby. Without taking cues from the turkey vultures, they probably wouldn't know the food was there! This is especially true in a thick forest, where dead animals would be difficult to spot among all the vegetation.

But turkey vultures don't only help other scavengers. The olfactory prowess of turkey vultures has also helped humans! To detect leaks in oiil pipelines, people who worked at the pipeline had a clever idea. They pumped a chemical inside the pipes that smelled like rotting meat. If the pipes were in good shape, the chemical would remain in the pipes. Howver, if there was a crack or a leak, the chemical would seep out, and the area around the leak would begin to smell quite bad to humans, but quite good to a vulture!

With kilometers and kilometers of pipeline to take care of, employees no longer had to walk or drive for long hours checking to see if there were leaks. They simply had to look to the sky. If they saw turkey vultures soaring somewhere over the pipeline, it was a good bet that it had sprung a leak in just that area.



Sexual Dimorphism

Sexual dimorphism is defined as the clear difference in size or other outward appearance between the sexes of the same species. Imagine a male lion with a bushy mane versus a female lion that lacks one, or a vividly colored male wood duck compared to the muted colors of a female. These are both examples of **sexual dimorphism.**

Most males and females of the same raptor species share identical plumage characteristics - meaning the colors and patterns of their feathers are the same. Perhaps because many raptors mate for life, the males don't need to have flashy colors to attract a new female each breeding season. Of course, there are some exceptions. For example, it is easy to spot the clear differences in coloration between male and female **American kestrels.**

However, the majority of raptors do exhibit a difference in size between the sexes. Would you be surprised to learn that the female raptor is larger than the male of the same species? This is called reverse sexual dimorphism and female raptors can be as much as 50% larger than their male counterparts. Scientists do not really know why there is a size difference in raptors though there are several theories. One suggests that because the female is responsible for laying and caring for the young she must be bigger in order to ward off predators and protect the young from weather. Another theory is that smaller, more agile males are better hunters and providers for their family. This is important during incubation, the females rely on the males to do most of the hunting.

Both sexes must hunt once the young birds reach a certain size and require more food. Some believe that having a small male and a larger female enables the birds to hunt different sized food, thus preventing them from directly competing with each other for prey. There is another theory that suggests that the female chooses a smaller male because she will be able to dominate him, thus avoiding potential threats from the male. These are examples of a few theories. Can you think of any others?

Types of Raptors

Currently there are around 559 different species of birds of prey around the world., including eagles, osprey, hawks, falcons, owls, vultures, secretarybirds, and seriemas. But what is the difference between all of these birds and how can we go about distinguishing one from the other?

One of the easiest ways to begin identifying raptor groups is to study their silhouettes. Vultures are large birds with wide, almost rectangular-shaped wings. They spend a lot of time soaring. When perched, they often hold their neck close to their bodies, which gives them a sort of hunched appearance. Falcons, on the other hand, have sharp, pointed wings, which they often flap in quick, shallow beats. However, even within these raptor groups, there is quite a bit of variation. Read on to learn more about this fascinating group of birds!

Osprey

Osprey are sometimes called "fishing eagles." While they do bear some resemblence to the true fishing eagles such as the **Madagascar fish-eagle** or the **African fish-eagle**, the osprey isn't really an eagle at all. This large bird of prey is in its own family, Pandionidae. The osprey is usually found near both freshwater and saltwater.

The osprey is a highly specialized, **piscivorous** raptor, which means that it feeds mainly on fish. However, it will occasionally catch snakes, crabs, frogs or even small mammals. Ospreys are large with long, narrow wings and long, powerful legs.

These raptors have unique adaptations that help them catch slippery fish. First, their talons are incredibly curved, like a fish hook. Their footpads are rough and covered with small barbs called **spicules**, which helps them to grip fish well. They can also rotate their outer toes forwards or backwards. This helps increase the surface area of their feet, giving them more grabbing power.

Unlike true fishing eagles, which snatch fish from near the surface of the water, osprey plunge feet first and are able to fully submerge themselves. But if you have ever dived underwater, you might have experienced the uncomfortable sensation of water up your nose! Ospreys can close their nostrils completely when underwater to prevent this from happening. They also have extra dense, oily feathers, which helps keep them dry.

Ospreys build large stick nests, often on man-made structures such as utility poles. They often use the same nest over and over, adding natural materials as well as some man-made touches such as plastic bottles. After years of use and "remodeling" these nests can grow quite large, measuring up to 3-4 meters deep, and 1-2 meters in diameter!

Some osprey populations are migratory and can travel nearly 10,000 km each year. Like the **bald eagle** and **peregrine falcon**, osprey were heavily affected by DDT in past decades, but have since made a successful comeback and are listed as Least Concern by the International Union for Conservation of Nature (IUCN).

Eagles

Eagles, perhaps, are the birds of prey that most capture our imaginations. And for good reason. They are among the largest, most powerful raptors in the world. They soar the skies on broad wings, construct large nests, are powerful hunters, and have a piercing stare! Like hawks, they are members of the Accipitridae family. They too are diverse and found in a wide variety of habitats.

If you ever look to the sky in search of eagles, keep your eyes out for a large bird, with long, broad wings soaring in wide circles above the earth. In silhouette, they are distinguished from hawks and vultures by their size and wing shape.

Eagles are generally classified into different ecological groups based on their habits and habitats. Fish eagles and sea eagles, which include the well-known **bald eagle** and enormous **Steller's sea-eagle**, specialize in hunting fish, yet frequently also scavenge. They can be solitary or highly social when fish are abundant.

Booted eagles, named for the feathers that cover their entire legs as if they were wearing boots, are hawk-like in appearance and behavior. Snake-eagles are compact eagles found in Africa and Asia, and specialize in hunting snakes. Forest eagles, such as the mighty **harpy eagle**, **crested eagle**, and **Philippine eagle**, are built for life in the rainforest canopy. They are equipped with long tails and relatively shorter wings for maneuvering through dense tropical forests.

In general, eagles tend to build large stick nests either in the tops of tall trees, on power poles, or even on cliff ledges.

The largest eagles in the world include the Philippine and the harpy eagles. The smallest eagle in the world is the Pygmy Eagle, which is only 48 centimeters long, and weighs around 450 grams. Compare this to the Philippine Eagle which measures 100 centimeters and weighs over 8,000 grams. There are around 60 species of eagles worldwide.

Hawks

Hawks are the quintessential raptor, comprising all the main characteristics of birds of prey and utilizing them well. Hawks are diverse around the globe and, depending on their preferred prey, have additional adaptations for hunting. Hawks are divided into two main groups: the Accipiters and the Buteos. In general, Buteos are larger and more broad-winged, while Accipiters have longer tails and are more agile.

Hawks, as a group, are extremely varied and include harriers, bazas, honey buzzards, harrier-hawks, chanting-goshawks, and more. As a group, they feed on everything from insects to fish, to mammals and birds. Hawks that specialize in feeding primarily on birds, such as ***Accipiters***, tend to be sleek, and thin-bodied. They often have long legs and tails, and short, rounded wings. They tend to have small heads and beaks. They are typically found in forested areas and their compact bodies allow them to maneuver through the trees. Long legs and thin toes help them to grab birds.

The ***Buteos*** take to the skies by soaring. They are heavier-built and have long, broad wings and fan-shaped tails. They are typically found in open areas, perching or soaring while scanning the ground below for mammalian prey.

No matter where you find yourself, from the open grasslands of Africa to the tropical rainforests of the Neotropics, from the frigid Arctic tundra to the hot, arid deserts, there is a good chance you will encounter hawks. All hawks are members of the family Accipitridae, which also includes eagles and kites.

While some hawk species are common and abundant, others are quite limited in range and some are even Critically Endangered. For example, in the Americas, the **red-tailed hawk** is quite abundant and widespread, while the **Ridgway's hawk** is found only on the island of Hispaniola, in the Caribbean.

Just as hawk diets and **habitats** vary, so do their nesting habits. However, most species build their own nests, usually typical stick structures, but on occasion places in weird places. For example, **Harris' hawks** nest on top of cacti!

Kites

Kites are highly aerial raptors. They are closely related to hawks, but tend to spend more time in the air. They are generally small to medium in size. Many kites have pointed wings and they get their name from their light and buoyant flight style.

Kites are found all over the globe except for Antarctica. They are highly variable in form and plumage characteristics. While some kites are equipped with pointed wings, others have paddle-shaped wings like hawks. Kites are named for their signature flight style, but they also soar and dive with ease. Some kites are also experts at hovering - flapping their wings quickly, as they float in place, usually low to the ground.

These raptors tend to feed on aerial prey such as insects and birds, but they will also eat a wide variety of other animals. For example, the **snail kite** is highly specialized for feeding on apple snails which it plucks from the surface of large, calm bodies of water, such as lakes or wetlands.

The most widespread of all the kites is probably the **black kite**. It is found throughout Asia, Africa, Australia, and Europe and lives in deserts, grasslands, coastlines, savannas, shrublands, woodlands and in the heart of major cities. It sometimes congregates in large flocks, especially at night to roost.

Many kite species are migratory, including the black kite, the **swallow-tailed kite**, and **Mississippi kite**. Though in general, kites are relatively common, there are some exceptions. The **Cuban hook-billed kite** is one of the most Critically Endangered raptors in the world. There haven't been confirmed sightings of this kite in man years. Some biologists fear that it might be extinct.

The smallest kites in the world include the Pearl Kite (pictured above) which measures only 23 centimeters long.

Just as kite diets and habitats vary, so do their nesting habits. However, most species build their own nests, usually typical stick structures. Some, such as the **scissor-tailed kite**, of Africa, sometimes nest in colonies.

Falcons

Falcons are aerial predators. They feed primarily on birds and insects, although some hunt rodents and other prey. In order to catch fast-moving animals in flight, falcons are built for speed. They are highly streamlined raptors, with long, pointed wings and long tails for maneuvering.

Watching a falcon in a dive is an unforgettable sight. Picture a small, pointy-winged bird high up in the clouds. When it spots an animal flying below, the falcon will tuck its wings close to its body, point its head toward the earth, and dive. It looks like a torpedo shooting through the sky. In fact, the **peregrine falcon** is the fastest animal on Earth. It can reach speeds of 400 km/h in a stoop dive.

Falcons are equipped with long toes perfect for snatching flying prey out of the air. And, while they are fully capable of killing their prey with their feet, falcons are equipped with another powerful weapon. They have an extra notch on their beak which is designed to bite the neck of their prey to kill it quickly.

Falcons generally prefer to hunt in open areas, but some, such as the forest-falcons of the Neotropics, live in dense rainforests.

Many falcons have a distinctive stripe under the eye, called a **malar stripe**. This characteristic is thought to reduce the reflection of the sun into their eyes. Perhaps American football players, who put black lines under their eyes, learned this trick from falcons.

Within the falcon family are the caracaras. Caracaras do not share the typical physical characteristics of falcons and are rather generally built like a hawk, but are primarily scavengers, like vultures. Interestingly, falcons are not closely related to other birds of prey, and they are actually more closely related to parrots! However, they have developed the same predatory bird characteristics that are shared with hawks, eagles and other raptors.

Most falcons don't build their own nests, but rather use natural cavities. cliff ledges, or old nests abandoned by other bird species.

Secretarybird

The secretarybird is a unique raptor found in the open plains of sub-Saharan Africa. It is the only member of its own family, Sagittaridae. Among the most distinctive birds on our planet, the secretarybird is somewhat crane-like in appearance, with long legs for walking in grasslands. It gets its name from the long feathers that extend off the back of its head, resembling pen quills tucked behind a secretary's ears.

Secretarybirds are the tallest birds of prey on Earth, standing 1.3 meters tall. They also have the longest legs of any raptor, which they put to good use. These lovely birds spend quite a bit of time walking. They prefer to hunt on the ground, and feed mainly on lizards, snakes, small mammals, and insects. When they catch something, they will then stomp it to death with their powerful legs and feet. When killing difficult prey, such as snakes, they might toss it up into the air or drop it from mid-air to kill it more quickly.

Secretarybirds are denizens of grasslands, dotted with scattered trees. They sometimes perch in these trees, and also use them for nesting. Secretarybirds can lay one to three eggs per clutch. As long as enough food is available, all three nestlings can survive to fledging.

Secretarybirds are generally solitary, although they may be seen congregating at watering holes.

The Secretarybird is considered Endangered by the IUCN due to significant recent declines in its population because of extensive habitat loss.

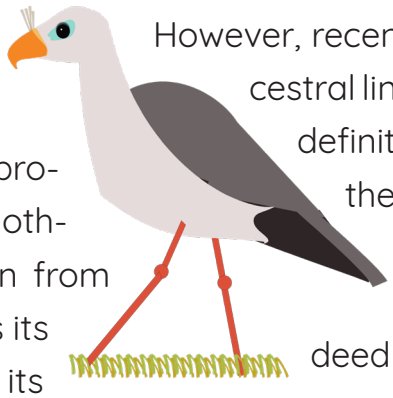
Like many birds of prey, the secretarybird has been depicted on national symbols of several countries. It is on the South African coat of arms and Sudan's emblem. Its image also appears on a number of postage stamps of several different African nations.

Seriemas

Seriemas are land-dwelling raptorial birds of the South American plains that superficially resemble the secretarybird. They have long legs adapted for life in savannas. They are fast runners and have been clocked at speeds of up to 70 km/h. While they can fly, they prefer only to do so when absolutely necessary.

There are only two species of seriemas in the world: the **black-legged seriema** and the **red-legged seriema**. Second only to the rheas, they are some of the largest ground-dwelling birds of the Neotropics.

Seriemas are terrestrial predators and find food by walking on the ground. They will consume insects, reptiles, frogs, rodents, and even some plant matter. They are often seen hanging around cattle in open fields. These cattle act as a living buffet table for the seriemas, providing food in the form of ticks and other insects, which the seriemas glean from their backs. Once a seriema captures its prey, it doesn't stomp it to death with its feet as a secretarybird might. Instead, a seriema will pick its prey up with its beak and slam it on a rock or other hard surface to kill it. It will often use the very curved, sharp talon on its second toe to help tear apart its prey when eating.



Though seriemas do spend a lot of time on the ground, they will often roost in trees or shrubs, and of course, they also build their nests in trees.

Until very recently, the two living species of seriemas were not considered raptors at all. However, recent investigations into their ancestral lineages, a recent refining of the definition of 'raptor,' and of course their raptorial adaptations and behaviors, now give solid evidence that seriemas are indeed birds of prey.

Seriemas are believed to be the only living relative of the extinct "terror birds" - extremely large, meat-eating, flightless birds that could measure up to 3 meters tall.

Vultures

Vultures are the scavengers of the bird world. While often thought of as being ugly, dirty, and disgusting to most because of their featherless heads and because of what they eat, they are actually very beautiful birds and among the most graceful fliers. Furthermore, vultures have a very important role in the environment. They are known as nature's clean up crew. They clean up dead carcasses and stop the spread of disease. We owe a huge thanks to vultures!

Vultures are found throughout most of the world, though they are notably absent from Australia and Antarctica. While some vultures, such as the **palm-nut vulture**, feast quite readily on palm-nut fruits, and others are known to kill some small prey animals, most vultures feast primarliy on dead animals. Because of this, they have some additional physical features that help them succeed in their niche.

Vultures spend a lot of time preening their feathers and bathing to keep themselves clean and in good condition. While their bald heads might seem strange to us, they serve a very important purpose. Since vultures get into some pretty messy situations, such as a feeding on dead cow, chunks of meat and blood stick to and dry on their heads and bodies. If they had feathers on their heads, it would be difficult to clean because it is impossible for a bird to preen its own head. Having a bald head means the blood will wash off more easily. Imagine dunking your head in a bowl of pasta. It would be much easier cleaning the sauce off of a bald head than getting it out of your hair! Researchers also believe that the exposed skin on their heads helps vultures cool off on hot days.

And speaking of keeping cool - vultures also have an odd habit of defecating down their legs to help them keep cool. When the **uric acid** evaporates, it cools the legs by taking heat out of the skin. This also helps stop bugs from crawling up their legs and can kill bacteria.

Vultures are grouped with birds of prey, as they share several of the defining characteristics of raptors. However, through recent studies, we know that New World vultures are more closely related to storks than to other raptors.

Owls

Owls are hunters of the night. A vast majority of owls are nocturnal and have specialized adaptations, such as large eyes and excellent hearing, in order to catch and kill prey in low-light conditions. Owls generally have a stout body with a large round head. The feathers on their face form a facial disc designed for directing sounds into their ears.

Owls are found on every continent, except Antarctica. They make their home in a myriad of habitats from arid deserts, to thorny scrub, high mountains, tundras, and rainforests. While most of them are **nocturnal**, others are **diurnal** or **crepuscular**. Some species, such as the **barn owl**, are incredibly cosmopolitan, and are found in nearly every country in the world. Others, such as the **Pernambuco pygmy-owl**, are found within a very limited geographical range.

In general, owls are masters of camouflage, and tend to have cryptically colored plumage ideal for blending into their surroundings. Many owls also have feather tufts on the top of their heads, which help break up their round-headed profile. These tufts, which resemble some mammal ears but aren't ears at all, are also used for non-verbal communication and species recognition. Apart from their ability to be almost "invisible" by blending so well into their surroundings, they are also capable of silent flight thanks to their specialized feathers.

Owls range in size from the sparrow-sized **elf owl** to the huge **Blakiston's eagle-owl**, which has a 2-meter long wingspan and weighs up to 11 lbs!

No matter their size, owls are opportunistic, formidable predators, capable of taking prey from small insects up to medium-sized mammals, slippery fish, speedy birds, venomous snakes, and everything in between.

Most owls don't build their own nests, but lay eggs in natural cavities, on the ground, on cliff ledges, or in old stick nests built by other birds. Cavity-nesting owls can even be enticed to nest in man-made structures.

A CLOSER LOOK

Raptors at a Glance

	 Shape & Flight	 Diet	 Habits
Osprey	Long, tapered wings often bent into a "w" shape	Mainly fish, but takes other aquatic and terrestrial prey	Often nests on man-made structures; dives head and feet first into water, fully submerging itself
Eagles	Generally large raptors with wide wings, often soar	Varied: fish, small to large mammals, snakes, lizards, and birds	Generally build large stick nests; some, like fish-eagles, are gregarious, and will gather in large groups.
Hawks	Accipiters - short wings, longer tails; Buteos- broad wings, shorter tails. Often soar	Varied: small to medium mammals, reptiles, amphibians, insects, and birds	Build stick nests in trees; some are highly migratory; inhabit a wide variety of habitats
Falcons	Pointed, narrow wings, can hover, swift fliers, some stoop dive	Varied, but often birds and other aerial prey (bats, winged insects)	Don't build nests, use tree cavities, cliff ledges, abandoned bird nests; many are migratory
Vultures	Wide, rectangular-shaped wings, soars often on thermals	Mostly carrion, sometimes bones, fruit, feces, small animals	Nature's clean-up crew; often travel long distances to find carcasses; very few have a good sense of smell
Owls	Long rounded wings; short tails; silent flight	Varied: insects, fish, birds, mammals, reptiles & amphibians	Majority are nocturnal; swallow prey whole; don't build their own nests, use abandoned stick nests or in cavities
Seriemas	Long legs; rarely flies, except when avoiding danger	Varied. Will kill its prey by smashing it against the ground with its beak	Inhabits open areas of South America; catches prey on foot; builds stick nests lined with leaves and dung
Secretarybird	Very long legs with distinctive crest on head; does soar	Insects, mammals, snakes, and more, which it often kick to death with its feet	Inhabits open areas of Sub-Saharan Africa; catches prey on foot; found alone or in pairs; roosts in acacia trees

Fun RAPTOR FACTS

A group of owls is called a parliament

The wedge-tailed eagle is believed to have the keenest vision of all the world's raptors!

The stomach acid of vultures has a pH of slightly above zero, stronger than battery acid!

There are 559 species of raptors in the world

The Gyrfalcon is the largest falcon in the world!

Hawks are the most common of all the raptors

When an osprey catches a fish, it turns it so it is upright and facing forward. This helps with aerodynamics!

A raptor's eyes are very big compared to the size of their heads. If our eyes were the same size proportionately, we would have eyes the size of tennis balls!

The Importance of Raptors

Now that you have learned about the amazing adaptations that raptors have, it is important to recognize that birds of prey have much value in the ecosystems where they live. There are many ways in which raptors influence and promote the health of the environment, and help us, as well. This is called **ecosystem services.** Let's explore some of the ways in which raptors are vitally important members of our communities.

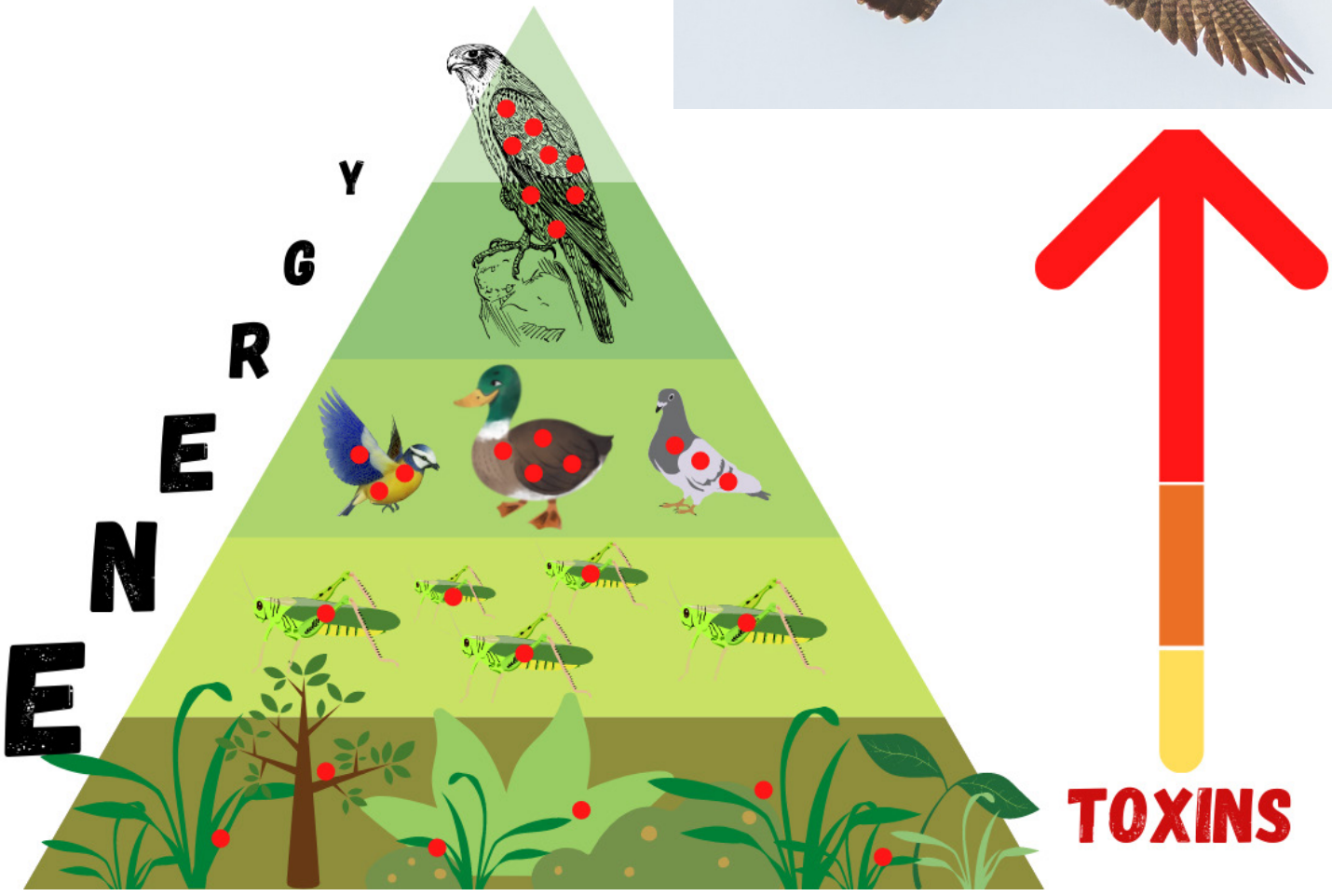
Bioindicators

Raptors, being apex predators, are very important indicators of the health of the environment. They sit on the top of the food chain in almost every ecosystem on Earth. Certain sensitive species of raptors can quickly alert us to the health of an ecosystem. Since toxins will accumulate and magnify as you go up the food chain, it is the top predators that will often show signs of being affected. When we observe that raptors are becoming sick, or populations are declining, it tells us that something is wrong, not just with the particular species themselves, but also that something bigger or more serious might be affecting the environment as a whole. Let's investigate this further.

A classic example of this is with DDT and the Peregrine Falcon. For many decades, DDT, a noxious pesticide, had been used widely throughout the Americas to kill crop pests. Furthermore, it was also sprayed in huge quantities near people as a misguided attempt to prevent polio. But how did we realize it was something more dangerous than initially thought? It wasn't until the mid-1900s, when people started noticing that Peregrine Falcon populations were declining rapidly. With some investigation, it was discovered that DDT was accumulating (through bioaccumulation) in the tissues of Peregrine Falcons. However, the DDT didn't kill the falcons directly. Instead, it affected the Peregrine

Falcon's ability to absorb calcium. It made the eggshells very thin and weak, to the point where they would break open when the adults incubated the eggs. Peregrine Falcon populations plummeted to near extinction by the 1970s. DDT was banned in 1972, and an intensive captive breeding and release program for Peregrine Falcons was carried out by The Peregrine Fund in hopes to save this sensitive species. Over the following decades, nearly 7000 peregrines were hatched in captivity and released, and its populations slowly started to increase little by little. The Peregrine Falcon was finally removed from the endangered species list in the USA in 1999.

But we can learn a valuable lesson from this. The loss of the Peregrine Falcon, as well as Bald Eagles and Ospreys, two other species significantly affected by DDT, as bioindicators, can give us clues to the dangers that DDT and other pesticides present to humans. Thus, raptors are excellent bio-indicators not only for ecosystem health, but our own as well.



Umbrella Species

Imagine it is raining and you are the only one with an umbrella. To protect your friends from getting wet, you could all get under the same umbrella to stay dry. Likewise, by protecting an **umbrella species**, this protection extends to its entire ecosystem. By protecting an umbrella species, many other species that associate or interact with the species in its habitat are indirectly protected as well. These species are chosen for making conservation-minded decisions.

But why are raptors often selected as umbrella species? Birds of prey are generally large, detectable, and relatively easy to observe and study. They typically have large home ranges that provide homes for many other organisms. For example, the **spotted owl** of the old growth forests of western North America is considered an umbrella species. For decades, **northern spotted owl** populations have been declining due to rapid deforestation of their old growth forest habitats, as well as being outcompeted by other closely related species, such as the **barred owl**. By protecting the northern spotted owl and its sensitive habitat, many other species, including salamanders, molluscs, and endangered plants, are thus protected as well.

Furthermore, umbrella species also are often considered flagship species, in which they are easily recognized by the public and are used to raise money for conservation initiatives. It is much easier to put effort into conserving a large, beautiful bird of prey, than a small, nondescript salamander or a rare moss that goes unnoticed by many.

Top Predators

Top or apex predators are essential in any healthy ecosystem. While there are many predators in an ecosystem, a **top predator** is a species that hunts other animals, but has no habitual natural predators as adults. Many species of raptors, especially larger eagles, are the top predators in their ecosystems. Raptors as top predators maintain a balance of the complex food webs they are a part of. Their role is to keep the populations of their prey species, whether that be a rabbit, pigeon, or fish, in check. The **harpy eagle**, a top predator in the lowland rainforests of central and south America, feeds on monkeys and other medium-sized animals in the rainforest canopy. If harpy eagles are removed from their ecosystem, the populations of monkeys could increase. More monkeys may result in overgrazing of leaves (in the case of foliage-eating howler monkeys) or consumption of other plants and animals. The ecosystem would become out of balance. The **Philippine eagle** of the Philippines, the **martial eagle** of Africa, and the **osprey** are all examples of top predators in their environment. Can you think of any others?

Keystone Species

Many raptors can be considered “keystone species.” A **keystone species** is one that has a disproportionately large impact on its environment. There are no other species in the ecosystem that can serve their same function. Without its keystone species, the ecosystem would be dramatically different or cease to exist. Vultures, as obligate scavengers, are keystone species in their ecosystems. As we have learned, vultures have an important role to clean up the environment and stop the spread of disease.

While other scavengers live side by side with vultures, vultures have the capacity to remove dead carcasses at a much greater rate. In the case of vultures in India and ohter parts of Asia, where populations have decreased to critical levels due to poisoning, dead cow carcasses are not being cleaned up. Feral dog populations have increased, along with rabies cases among humans as a result of feral dog bites, resulting in 47,000 human deaths per year. Overall, the loss of vultures throughout Africa and Asia has changed the environment dramatically.

Balancing Ecosystems

Naturally, raptors are important at controlling prey populations and maintaining a balance in their ecosystem. They can be particularly useful to humans in this respect. Birds of prey are friends of farmers, and farmers are beginning to understand how impoartant having these raptors around can be. A **barn owl** can consume 1000 mice in one year! Having birds of prey around farm fields significantly helps keep rodent populations down.

Rodents, such as rats and mice, are also important to the food chain and play key roles in the habitats in which they live. However, when the ecosystem is off balance, for example, when people kill predators, litter (which provdes great homes and food for rodents), destroy habitats, rodents often increase greatly in numbers. When there are a lot, they can sometimes damage crops and even destroy homes and vehicles. Having raptors, as well as other rodent predators, such as snakes, helps keep these populations in check.

In Culture

Birds of prey are celebrated in cultures around the world - both past and present. In ancient Egypt, an eagle symbolized the goddess Nekhbet, the protector of the Pharaoh. Horus, the Egyptian god of the sun, was often depicted with a falcon's head on a man's body. The "Egyptian Eagle" is a national symbol, adorning the flag of Egypt today.

Greek and Roman mythology associated Zeus or Jupiter with an eagle and Athena or Minerva with an owl. Mexico City is where it is thanks to a bird of prey. The story begins when the Aztecs were told by their god, Huitzilopochtli, that they would find an eagle eating a serperent while perched on a nopal cactus. When they saw this, they were to settle down in that place. Upon seeing this, they founded Tenochtitlan, which today we know as Mexico City.

Mongol tribes depicted falcons in their artwork, and to this day, the Kazakhs use eagles in traditional hunting practices and ceremonies. Today, as in the past, in some Native American cultures, eagles are considered sacred. Their feathers adorn traditional headdresses and dress, and are used in smudging ceremonies and other religious traditions.

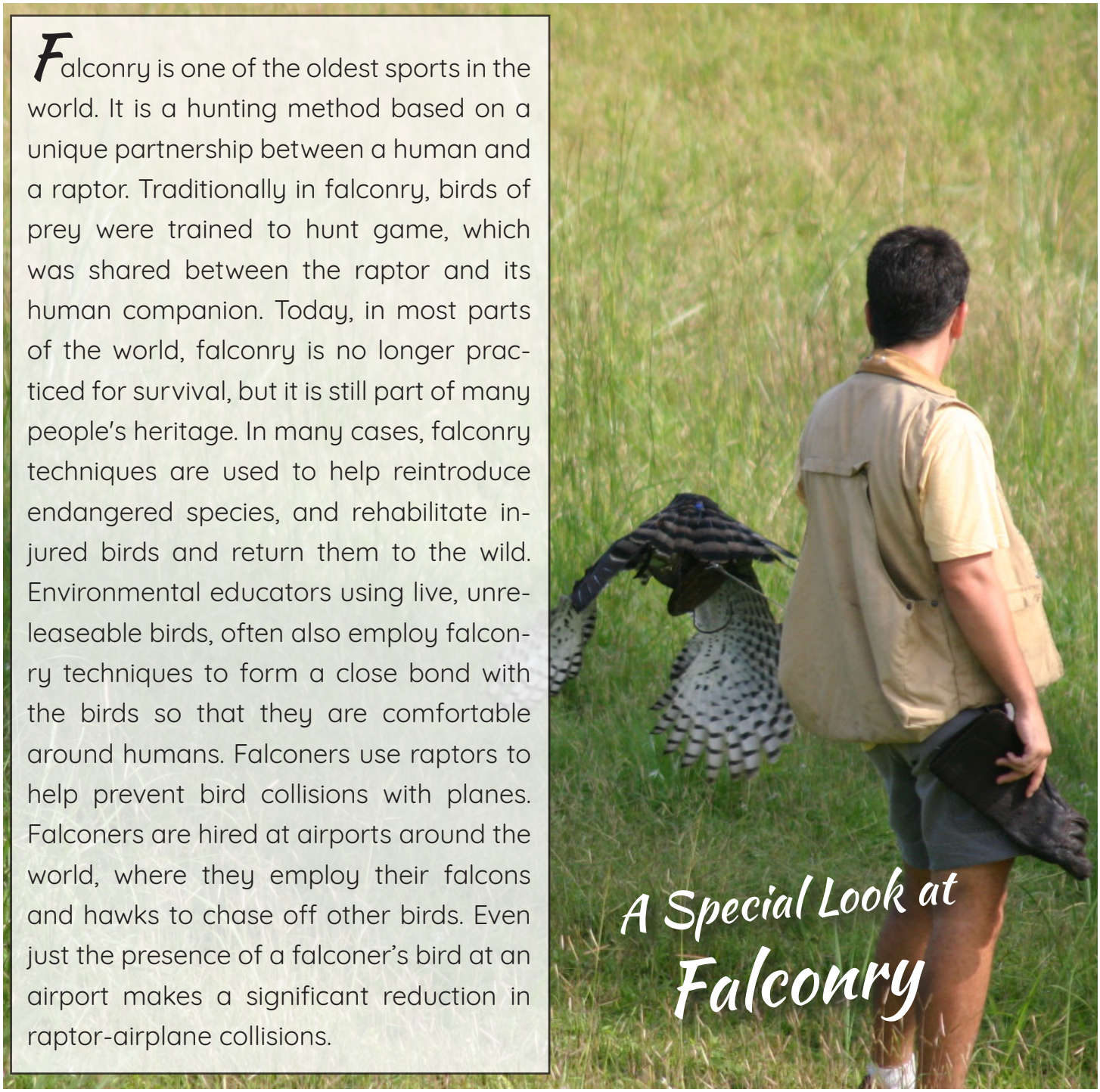
Birds of prey are represented as national symbols all over the world and at least 22 countries have officially selected a raptor species as their national bird. The **bald eagle** was designated the national bird of the United States of America in 1782. In Canada, some provinces have adopted birds of prey as their provincial birds, such as the **snowy owl** of Quebec. The **Andean condor** is the national bird of Colombia, Ecuador, Chile, and Bolivia, while also being represented as national symbols in Argentina, Peru and the Venezuelan Andean states. The critically endangered **Philippine eagle** is the national bird of the Philippines. Furthermore, birds of prey are depicted on the flags and/or are national birds of Mexico, Ecuador, Egypt, Albania, Zambia, and some European countries.

In parts of Asia, vultures are used in traditional burial practices, called **sky burials**. Instead of burying the dead, they are left in an open area to be devoured by wild vultures and other scavengers. This is part of the Buddhist tradition that promotes compassion and kindness for all living things. One's death can help feed a number of animals and nourish the Earth.

Some major sports teams are named after birds of preyand raptors are also found as countless characters in fictional books, comics, movies and TV programs. Have you heard of Hedwig, Harry Potter's pet **snowy owl**? Are you familiar with any other memorable raptor characters?

A Special Look at Falconry

Falconry is one of the oldest sports in the world. It is a hunting method based on a unique partnership between a human and a raptor. Traditionally in falconry, birds of prey were trained to hunt game, which was shared between the raptor and its human companion. Today, in most parts of the world, falconry is no longer practiced for survival, but it is still part of many people's heritage. In many cases, falconry techniques are used to help reintroduce endangered species, and rehabilitate injured birds and return them to the wild. Environmental educators using live, unreleaseable birds, often also employ falconry techniques to form a close bond with the birds so that they are comfortable around humans. Falconers use raptors to help prevent bird collisions with planes. Falconers are hired at airports around the world, where they employ their falcons and hawks to chase off other birds. Even just the presence of a falconer's bird at an airport makes a significant reduction in raptor-airplane collisions.



Creative Corner

You just learned a little bit about how raptors have influenced cultures throughout time. Now, think about how raptors might inspire you. Will you be able to create an original piece of art, poetry, prose, music, dance, or even a play inspired by a bird of prey? Brainstorm some ideas and share them with your classmates or family.

Read and reflect...

Wow! Give yourself a pat on the back! You just learned a lot about some of the amazing birds of prey that live right alongside us in cities, forests, deserts, mountains, and mangroves. These avian neighbors provide a myriad of ecosystem services that directly benefit us!

In this chapter, we started learning about some of the over 550 different birds of prey on Earth. But we only touched the surface of all the fascinating characteristics of what makes a raptor a raptor, and the incredible diversity among this group of birds. There is still so much to learn. Whether studying the breeding habits of a little-known owl species, understanding how raptors may use their sense of smell, or seeking to understand all the ways in which raptors communicate, one could certainly spend a lifetime studying these avian wonders .

While we hope this chapter helped answer some questions you might have had about raptors, we also hope it left you with a curiosity to learn more.

If so, we invite you to make a list of questions you would like the answers to in a journal or other place you can easily access your questions and make notes. Now, work on your own, with family members, friends, or your teacher to discover the answers to some of these questions. Using scientific resources, talking with an expert, and making your own observations are just some of the ways you can go about this.

Finally, take a moment to think about the quote at the beginning of this chapter. *"But what I love is the gray stubbon hawk who floats alone beyond the frozen vines"* What does this quote mean to you? Does it mean something different now that you have learned a little more about raptors? This quote is part of a longer poem, by Mary Oliver. Would you like to try your hand at writing a poem, or song, or choreographing a dance inspired by a bird of prey? If so, which bird of prey do you think would inspire you the most?

explorer's corner

my backyard

Even though raptors are found on every continent of the world except Antarctica, and in almost every habitat type, they can still be hard to find and might not be common in your area. If they are, terrific! Spend some time observing raptors, noting their behavior, activity, diet, or anything else you can observe.

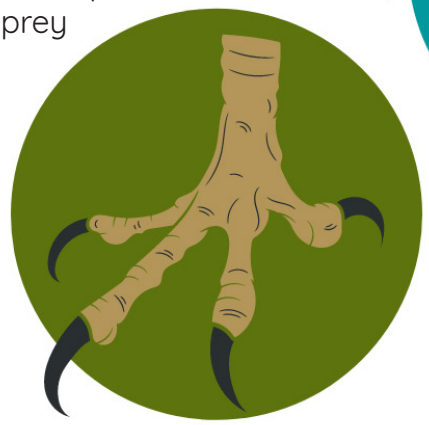
If raptors aren't very easy to see where you live, spend some time observing those birds that are easy to see. Pay attention to what they eat, the size and shape of their feet and beaks, the patters of their flight. Do these birds share any traits with raptors? How are they the same? How are they different?

Also pay attention to the different habitats in your area. What factors might influence why raptors might be more or less abundant?

Record all your observations in a notebook

Before you go, be sure to review the main characteristcs of a bird of prey.

Strong feet
to catch, stomp, or otherwise kill prey



Sharp, hooked beak
for tearing meat

Large eyes
for keen vision

Glossary

Adaptation - A change in structure, function or behavior of an organism which improves its chances of survival in a specific environment or condition.

Asymmetrical - having parts that are offset or not equal

Binocular vision - vision in which there is extensive overlap of the field of view, providing excellent depth perception

Bioindicator - Sensitive species that alerts us to ecosystem health

Carrion - decaying flesh of an animal

Cones - photoreceptor cells found in the retina of the eye, responsible for color vision

Crepuscular - active in low-light conditions, ie. dawn and dusk

Depth perception - the ability to see in three dimensions and judge the distance of objects

Diurnal - active during the day

Ecosystem services - benefits provided to humans by ecosystems and their components / the benefits wildlife and ecosystems bring to humans

Endemic - An organism (plant or animal) native and restricted to a specific geographical place.

Facial disc - flattened or concave feathers around the eyes of an owl (and some other birds) forming a forward-facing circle or semicircle; helps direct sounds into the ears

Falconry - the art or sport of hunting with birds of prey

Flagship species - a species selected as an ambassador, it is usually easily recognized by the public and us used to raise money for conservation initiatives and environmental campaigns

Fovea - a small depression in the retina of the eye that provides the sharpest vision (highest visual acuity)

Habitat - A natural home or environment of an animal, plant or other organism.

Keystone species - a species with a disproportionately large impact on its ecosystem

Malar stripe - refers to a stripe on the cheek (malar)

Nictitating membrane - a translucid third eyelid that adds moisture and protection to the eye when flying or feeding

Nocturnal - active during the night

Obligate scavenger - an animal that feeds exclusively on dead animals (carrion)

Organism - An individual form of life composed of a single cell or a complex of cells in which organelles or organs work together to carry out the various processes of life. An organism is capable of growing, metabolizing nutrients and (normally) reproducing.

Pellet - a small package of indigestible materials, regurgitated by a raptor after eating

Piscivorous - a feeding type in which an animal eats primarily fish

Quarry - they prey animal being hunted by a raptor or other predator

Raptor - a bird of prey that hunts other animals for food, often characterized by having sharp beak and talons, and high visual acuity

Resident - an organism that stays in one place; ie. non-migratory

Rods - photoreceptor cells found in the retina of the eye, responsible for vision in low-light conditions

Scavenger - an animal that feeds primarily on dead animals (carrion)

Sexual dimorphism - a condition in which males and females of the same species have different physical characteristics such as colors, markings, adornments, size and weight

Talon - the claw of an animal, but especially referring to a raptor

Tomial tooth - a special elongated notch on the upper mandible of some birds, particularly falcons, kites and shrikes, designed to help break the neck of their prey

Top predator - a species that hunts other animals but has no habitual natural predators (as adults)

Triangulate - measuring distance by determining the location of a point using the three points of a triangle; in raptors, they calculate the distance to a certain point (prey location, perch, etc.) by moving their head side to side and analyzing the angles needed to determine an accurate distance to that point

Ultraviolet spectrum - a part of the electromagnetic spectrum characterized by short wavelengths of light (called UV light) and is invisible to the human eye

Umbrella species - a species chosen for making conservation-minded decisions

Visual acuity - a measure of the sharpness or clarity of vision

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