

WHAT IS AN ANIMAL?



It is estimated that around nine or 10 million species of animals inhabit the earth, although the exact number is not known and estimates are rough. All members of the animal kingdom are multi-cellular and all are heterotrophs, which means they rely on other organisms for nourishment. They are the eaters of the earth and most animals ingest and digest food in an internal cavity. Most animals reproduce sexually as well, by means of eggs and sperm. Animals range in size from microscopic to many tons (blue whales, the largest animals ever known to have lived on Earth, have hearts that weigh as much as a car.)

The group with the most species by far is the insects, with groups such as mollusks, crustaceans, and nematodes also being especially diverse. Only about one out of a hundred animals is a vertebrate (has a backbone); 99 percent of the earth's animals are invertebrates.

EVOLUTION

Evolution is change in the inherited physical or behavioral traits of biological populations over successive generations. Changes that allow an organism to better adapt to its environment will help it survive and have more offspring. The theory of evolution by natural selection was first formulated in Charles Darwin's book "On the Origin of Species" in 1859.

Evolution by natural selection is one of the best substantiated theories in the history of science, supported by evidence from a wide variety of scientific disciplines including paleontology, geology, genetics and developmental biology. All life on Earth is connected and related to each other and this diversity of life is a product of modifications of populations by natural selection, where some traits were favored in an environment over others.

In evolutionary biology, convergent evolution is the process whereby organisms not closely related independently evolve similar traits as a result of having to adapt to similar environments or ecological niches. For example, several mammal groups have independently evolved spines: echidnas (monotremes), hedgehogs, and some tenrecs (a diverse group of shrew-like Madagascan mammals). The last common ancestor of all of these groups was a contemporary of the

dinosaurs and they all developed spines independently, an example of convergent evolution.

Another example is prehensile tails. A number of diverse and unrelated species have developed tails that can be used as another limb, such as New World monkeys, kinkajous, porcupines, tree-anteaters, marsupial opossums, pangolins, skinks and chameleons.

TAXONOMY

Taxonomy is the science of the classification of organisms. It's been called "the world's oldest profession," and naming and classifying our surroundings has likely been taking place as long as mankind has been able to communicate. It would have been important to know the names of poisonous versus edible plants and medicinal plant illustrations show up in Egyptian wall paintings from c.1500 BCE. Historical records show that informally classifying organisms took place at least back to the days of Aristotle (Greece, 384–322 B.C.), who was the first to begin to classify all living things and to this day we still use some of those definitions (i.e., invertebrate, vertebrate). The Swedish botanist Carolus Linnaeus is regarded as the father of taxonomy; he developed the system known as Linnaean classification for categorization of organisms and "binomial nomenclature" for naming organisms. Binomial nomenclature is the formal system of naming all living things by giving each separate species a name composed of two parts, *Genus* and *species*.

WHY IS CLASSIFICATION IMPORTANT?

Animals are classified based on shared characteristics. This classification starts with broad, general traits (kingdom) and narrows to more specific characteristics (species). These groupings usually show the evolutionary relationship between species. Animal taxonomy ranks are: kingdom, phylum, class, order, family, genus, species. *(There are also sub phylas, super orders, infra orders, sub families, etc., and scientists often debate how different groups should best be organized. Groups can also seem rather fluid, especially with new DNA discoveries and genome mapping. For our purposes, however, the major groupings should be sufficient.)*

For example, let's look at tigers. Most broadly, all tigers are in the phylum Chordata (or vertebrates, which means they have a backbone). They are in the class Mammalia, which means they have hair and nurse their young with mammary glands. Mammals are divided into about 29 orders, and tigers are in the order Carnivora (meat eaters). The carnivores are divided into about 13 families, one of which is the cat family (Felidae). The felines are further divided into about 18 genera, one of which is *Panthera*, aka the big cats. Tigers are classified as *Panthera tigris*, and Potter Park Zoo exhibits Amur tigers (*Panthera tigris altaica*), which are a tiger subspecies.

WHAT IS AN ANIMAL?

When we discuss animals using their scientific name, it might seem like it makes things unnecessarily confusing and difficult. But scientific names serve a distinct purpose: when using a scientific name, one can be sure that we're all talking about the same animal. For example: **which one of these birds is a buzzard?**

The correct answer is *Buteo buteo*, or common buzzard, a bird of prey whose range covers most of Europe and extends into Asia. *Cathartes aura*, or turkey vulture, is commonly referred to as a buzzard in North America, but is distantly related to actual buzzards.



Cathartes aura



Buteo buteo

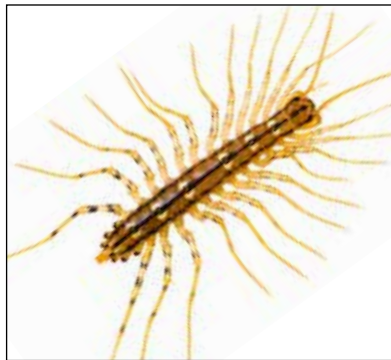
EXAMPLES OF TAXONOMIC CLASSIFICATION

kingdom	Animalia					
phylum	Chordata	Chordata	Chordata	Chordata	Arthropoda	Arthropoda
class	Mammalia	Mammalia	Aves	Reptilia	Arachnida	Insecta
order	Carnivora	Artiodactyla	Falconiformes	Testudines	Araneae	Blattodea
family	Mustelidae	Suidae	Cathartidae	Emydidae	Theraphosidae	Blaberidae
genus	Lontra	Sus	Sarcoramphus	Chrysemys	Grammostola	Gromphadorhina
species	<i>L. canadensis</i>	<i>S. scrofa</i>	<i>S. papa</i>	<i>C. picta</i>	<i>G. rosea</i>	<i>G. portentosa</i>
common name	North American river otter	Guinea hog	King vulture	Painted turtle	Chilean rose-haired tarantula	Madagascar hissing cockroach

WHAT IS AN ARTHROPOD?



Class Arachnida
spiders, mites, scorpions



Class Chilopoda
centipedes



Class Crustacea
shrimps, crabs, lobsters

An arthropod (from Greek arthro-, joint + podos, foot) is an invertebrate (no backbone) animal having an exoskeleton (external skeleton), a segmented body, and jointed appendages. Arthropods form the phylum Arthropoda and include insects, arachnids, and crustaceans. There are far more species of arthropods than all other animal species combined, and the number of undescribed species in the largest class of arthropods, the insects, probably numbers in the tens of millions. For example, there are 20,000 bee species worldwide, 200 of which are found in Central Park, NYC, an area of just 1.3 square miles. Another example is mosquitoes: there are more than 3,500 species of mosquitoes worldwide, about 175 of which are found in the United States, and about 60 species are found in Michigan.

Arthropods' bodies comprise of segments: the head, thorax and abdomen, which themselves can be fused or segmented even further. Arthropods generally grow by molting their exoskeletons in a process called ecdysis. The exoskeleton is primarily made of chitin. Most arthropods have a pair of compound eyes and one to several simple ("median") eyes; either or both kinds of eyes may be reduced or absent in some groups. Fertilization, with with paired reproductive organs (ovaries, testes), is internal in most but not all groups. Most arthropods lay eggs and development often proceeds with some form of metamorphosis (larval stage, for example).

CLASS INSECTA (insects)

With around one million named species and perhaps several times that number unnamed, insects account for a great majority of the species of animals on earth. They are a tremendously successful group and are found in almost all terrestrial and freshwater habitats, from the driest deserts to freshwater ponds, from the canopy of a tropical rainforest (where their diversity is unbelievably great) to the arctic wastes. Their feeding habits are similarly varied; almost any substance that has nutritive value is eaten by some group of insects.

Insects also show huge variety in shape and form. Almost the only condition their group does not attain is very large body size. A number of features, however, are shared by most kinds of living insects, including a body composed of three segments (head, thorax, and abdomen); a pair of relatively large compound eyes; a pair of antennae; two pairs of wings; and three pairs of legs.

The manner in which growth is accomplished is an especially important characteristic of insects. In almost 90 percent of insect species, newly hatched young are completely different in appearance from adults. These larval forms usually live in different habitats, eat different foods, and assume a body form completely different from that of their parents. The larva feeds and grows, molting its skin periodically. At some point



Order Diplopoda
millipedes



Class Insecta
insects



Class Merostomata
horseshoe crabs

WHAT IS AN ARTHROPOD?

The coconut crab is the largest land-living arthropod in the world with a weight of up to 9 pounds (4 kg) and a length from leg to leg of up to 3 feet (1 m).

A spider eats about 2,000 insects a year.

The most dangerous animal in the world? Probably the blood-sucking female mosquito, responsible for more than one million human deaths every year.

larval growth is completed, the larva stops feeding and builds a case or cocoon around itself. This nonfeeding condition is called a pupa or chrysalis. While encased, the larva undergoes a complete transformation, or “metamorphosis,” of its body form and a fully formed adult emerges. Other species undergo a more gradual process, in which the newly hatched young are more similar to the adult but are small in size, lack wings, are sexually immature, and may differ in other, relatively minor ways as well. The young in these insects are called nymphs.

CLASS ARACHNIDA (spiders, mites, ticks, scorpions, harvestmen)

There are over 60,000 described species of arachnids, nearly all of which are terrestrial. All arachnids have four pairs of walking legs, a pair of chelicerae (mouthparts), and pair of pedipalps (“arms”). Most have two body segments (cephalothorax and abdomen), although some only have one. Arachnids also lack wings and antennae (also unlike insects). Most arachnids have 6–10 eyes, although some have no eyes and others have as many as 12 eyes. The eyes are usually arranged in the center of the head, but many species have rows of eyes along the side of the head as well.

Arachnids usually lay eggs, which hatch into immatures that resemble adults. Scorpions, however, are either ovoviviparous or viviparous, and bear live young.

CLASS CRUSTACEA (crabs, lobsters, shrimp, krill, barnacles)

There are approximately 30,000 species of crustaceans, the majority of which are marine. All have two pairs of antennae, a pair of mandibles (jaws), and a pair of compound eyes (usually on stalks). Their bodies have three segments: head, thorax, abdomen, although the head and thorax may be fused together to form a cephalothorax, which may be covered by a single large carapace.

In many groups of crustaceans, the fertilised eggs are simply released into the water column, while others have developed a number of mechanisms for holding on to the eggs until they are ready to hatch.

CLASS CHILOPODA (centipedes)

Centipedes are a diverse group of over 2,500 species. Most are small, but a few can reach up to 10 inches in length. Despite their name, centipedes can have a varying number of legs, ranging from 30 to 354. Each segment of a centipede’s body (and there can be up to 177) has a single pair of legs. All centipedes are predatory, feeding on soil invertebrates such as earthworms and terrestrial insects. The legs of the first body segment have been modified to form large, poisonous fangs that are used to capture prey. The bite of a large centipede can even be painful to an adult and dangerous to a small child. All centipedes are terrestrial, but they require moisture. Fertilization is internal, with spermatophore transferred in ways similar to many arachnids. Centipedes lay eggs, which in some species are carefully brooded by the female. When they hatch, the young resemble miniature adults.

ORDER DIPLOPODA (millipedes)

Most of the approximately 8,000 species of millipedes are herbivores or scavengers, living primarily on decaying plant and animal matter in moist habitats. Millipedes have bodies that are made up of numerous segments that each have two pairs of legs. Millipedes lack poisonous fangs and do not bite; rather, to discourage predators they roll into a defensive ball and many emit poisonous or foul-smelling substances. Like centipedes, female millipedes lay eggs in nests, which are often carefully guarded. Newly hatched millipedes usually have only three pairs of legs, adding legs and body segments with each molt as they grow.

WHAT IS AN AMPHIBIAN?



Order Anura
frogs, toads



Order Caudata
salamanders, newts



Order Gymnophiona
caecilians

Amphibians are cold-blooded (ectothermic), egg-laying vertebrates with thin, permeable skin. They inhabit a wide variety of habitats with most species living within terrestrial, fossorial, arboreal or freshwater aquatic ecosystems. The young generally undergo metamorphosis from larva with gills to an air-breathing adult with lungs, although some species have developed behavioural adaptations to bypass this (paedomorphosis). Amphibians use their skin as a secondary respiratory surface (cutaneous respiration) and some small terrestrial salamanders and frogs lack lungs and rely entirely on their skin. Amphibians are superficially similar to reptiles but, along with mammals and birds, reptiles are amniotes, which means that they do not require water in which to breed. With their complex reproductive needs and permeable skins, amphibians are often ecological indicators and in recent decades there has been a dramatic decline in amphibian populations for many species around the globe.

Amphibians exhibit the greatest diversity of reproductive modes of any vertebrate group. Fertilization can be internal or external. In some species, the sperm is shed into the water near the eggs (external). In others, sperm is transferred in small packets called spermatophores that are picked up by the female. The sperm can be used immediately or stored until the following season. With few exceptions, frogs fertilize externally, and caecilians fertilize internally. Salamanders do both depending on the species.

Most amphibian species lay eggs in fresh water or on land near water. The jelly-like eggs lack a hard or leathery shell and have no amniotic sac. When eggs hatch, the young have gills to breathe underwater. As the young metamorphose into adults, they lose the gills, develop lungs, grow legs, and undergo other changes, many of them internal.

Most amphibians have a well-developed sense of smell and many have a Jacobson's organ. Nearly all have functional eyes, although caecilians have the poorest eyesight and rely mostly on scent. All can hear, with frogs and toads having the best hearing.

There are approximately 7,000 amphibian species, of which nearly 90% are frogs.

The smallest amphibian (and vertebrate) in the world is a frog from New Guinea (*Paedophryne amauensis*) with an adult length of just 0.30 inches (8 mm).

At 6 feet long, the largest living amphibian is the Chinese giant salamander.

ORDER ANURA (FROGS, TOADS)

The most numerous and diverse of the amphibians, frogs and toads are found in nearly all habitats on all continents except Antarctica. There are some species that are permanently aquatic and others that are completely terrestrial. There are about 3,500 species in the order Anura. The main feature that distinguishes frogs and toads from other amphibians is the absence of a tail in the adult stage.

All frogs and toads have heads with wide mouths, and a tongue that is attached at the front with a sticky tip to snare food. Respiration occurs primarily through the permeable skin (cutaneous respiration), but they also have lungs with which to breathe. However, since frogs and toads do not have a separate channel by which air can enter the lungs, they must swallow it. Legs are extremely well-developed with the hind legs considerably longer and stronger than the front. Most anurans have eyes that are set on opposite sides of the head and look out in different directions, so binocular vision is not possible at close range.

Anurans are the most primitive vertebrates that have a middle ear cavity and a true voice box. In some species, the males have vocal sacs that they inflate to amplify their voices. In addition to mating/territorial call produced by the males, there are also release and distress calls made by both sexes.

WHAT IS AN AMPHIBIAN?

In most species, the males seek water and call to the females when breeding season arrives. The female enters the water and breeding takes place there. Fertilization is almost always external. Most species do not provide maternal care, although there are species that carry the fertilized eggs in their mouths or in pores on their backs. Once the eggs hatch, the tadpoles (larval stage) are on their own while they develop and go through metamorphosis.

There is no scientific distinction between frogs and toads although the family of “true” frogs, Ranidae, does differ from the family of “true” toads, Bufonidae. True frogs are better jumpers, have bulging eyes and teeth, and lay eggs in clusters; true toads lack teeth, have poison glands behind the eyes, and tend to walk instead of jump.

ORDER CAUDATA (salamanders and newts)

Salamanders and newts are one of the least familiar groups of animals due to their secretive nature. They tend to live in cool, shady places, often under rocks, are ordinarily active at night, and few are more than six inches long. They typically have elongated bodies, long tails, and two pairs of legs roughly the same size. The order Caudata contains approximately 420 species. The term “salamander” is applied generally to any tailed amphibian, but more especially to those in terrestrial habitats. “Newt” refers to those animals that return to water to breed each spring.

Salamanders and newts have moist skin that acts as a respiratory surface, thus they are restricted to damp or wet habitats and some species are fully aquatic. For most species, their moist skin is not the only means of respiration. Larvae usually have external gills and adults have lungs, although some species, such as mudpuppies, retain larval features such as gills into adulthood, a condition known as paedomorphism.

Salamanders are not vocal and in most species the sexes look alike, so they use olfactory and tactile cues to identify potential mates. Reproduction methods are quite diverse. In about 90 percent of salamanders, fertilization is internal. The male deposits a spermatophore on the ground or in the water, and the female picks it up with her cloaca. In typical terrestrial species, mating takes place on land and the young pass through the larval stage while still in the egg, so they

hatch as mini adults. In a few species, the eggs hatch inside the mother’s body (ovoviviparous) and are born as either larvae or juveniles.

Many salamander species are protected from predators by poison secreted by glands under the skin. They advertise this to predators through brightly colored patterns on their skin. All salamanders and newts are carnivorous, eating mainly insects and other small animals.

ORDER GYMNOPTERA (caecilians)

The smallest order of amphibians, with nearly 200 species, caecilians are long-bodied, limbless amphibians, often mistaken for large earthworms. They are distributed throughout the warm, tropical areas of Central and South America, Africa, and southern Asia.

Caecilians are burrowing animals and are difficult to observe as they emerge infrequently from their homes in soil or in the floor of a body of water. They use their heads as trowels for digging or to poke in mud for food. Their skulls are heavily boned for this use and the underlying layers of skin are fused to the bones so that the skin does not shear away during digging. Caecilians’ skin is smooth and contains many mucus glands and variable numbers of poison glands, which can be quite toxic to predators.

All caecilians have internal fertilization. Primitive species lay eggs in burrows near streams; gilled larvae hatch, wriggle into water, and become terrestrial after metamorphosis. In some species, the eggs are laid underground and the young pass through metamorphosis while in the egg. In all observed egg-laying species, the mother provides parental care by lying coiled around the eggs.

They have functional but small eyes, relying mostly on smell to locate food. Most are generalized opportunistic feeders preying on earthworms and termites. Some species are also known to eat detritus.

WHAT IS A REPTILE?



Order Crocodylia
crocodiles, alligators, caimans



Order Rhynchocephalia
tuatara



Order Squamata
lizards, snakes



Order Testudines
turtles

Reptiles are cold-blooded (ectothermic), egg-laying (usually) vertebrates with dry skin covered with scales or bony plates. They inhabit every continent with the exception of Antarctica. Most reptiles lay soft, leathery eggs (oviparous) in nests that the females usually dig in the ground, which she may or may not tend to and guard. The sex of the offspring is often determined by the temperature of the eggs as they're developing; warmer eggs develop into females and cooler eggs are male. There are a lot of species, however, that exhibit ovoviviparity (eggs remain in the mother's body until they are ready to hatch), including all boas and most vipers. Recently, it has been confirmed that several species of snake are fully viviparous, such as the boa constrictor and green anaconda, nourishing their young through a placenta as well as a yolk sac. All reptiles have internal fertilization.

Reptiles continue to grow their entire lives, even after sexual maturity has been reached, although they grow the most and the fastest when they're young. Female reptiles are usually larger than males. Reptiles have a huge advantage over birds and mammals; being less dependant on maintaining a constant body temperature, they can survive on fraction of the food that birds and mammals require. They are thus able to exploit environments where food supplies are sparse or sporadic.

ORDER CROCODYLIA (crocodiles, alligators, caimans)

There are only three families of Crocodylia, with 23 species total. All crocodylians have a similar body shape, with a head held horizontally in front of the body, four legs which project from the sides, heavy scales which function as armor, and a heavy muscular tail. All crocodylians have strong jaw muscles for capturing prey and all are entirely carnivorous. Most of crocodylians' adaptations had already evolved by the late Triassic period (about 200 million years ago).

Crocodylians' senses of smell, sight, and hearing are well developed. Their ears are covered by flaps which close to prevent water from entering them. Crocodylians' eyes are covered by three eyelids: the third eyelid, the nictitating membrane, is transparent, but protects the eye from water. The tapetum lucidum at the back of their eyes greatly increases their ability to see at night as well; this also makes their eyes glow in the dark. Most crocodylians live in the tropics. The only exceptions are the American alligator and the Chinese alligator and they still cannot tolerate any place colder than temperate climates.

All crocodylians lay eggs in nests made out of plant material and/or mud. Adults, especially mothers, often guard nests. All eggs in a nest hatch at the same time, and the entire brood leaves the nest at once. Adults will respond aggressively to hatchlings' distress cries, and mothers (and fathers, in some species) may attend hatchlings for several weeks.

ORDER RHYNCHOCEPHALIA (tuatara)

Tuatara, although resembling lizards, are part of a separate distinct lineage, the order Rhynchocephalia. The two species of tuatara are the only surviving members of the order, which flourished around 200 million years ago. Tuataras were once widespread on New Zealand's main North and South Islands, but are now confined to 32 offshore islands.

Tuatara have a third eye on the top of their head, called the parietal eye. This eye has its own lens, cornea, retina with rod-like structures, and nerve connection to the brain, suggesting it evolved from a real eye. The parietal eye is only visible in hatchlings, which have a translucent patch at the top center of the skull. After four to six months, it becomes covered with opaque scales. After that, its purpose is unknown, but it may be useful in absorbing ultraviolet rays to produce vitamin D, as well as to determine light/dark cycles, and help with thermoregulation.

WHAT IS A REPTILE?

It's not uncommon for tuataras to live for over 100 years. Henry, a male tuatara at the Southland Museum in New Zealand, became a father (possibly for the first time) in 2009, at the age of 111. Some experts believe that captive tuataras could live as long as 200 years.

ORDER SQAMATA (lizards, snakes, worm lizards)

With over 9,000 species, the order Squamata is the largest order of reptiles. The order is divided into three suborders: Lacertilia, the lizards; Serpentes, the snakes; and Amphisbaenia, the worm lizards. Two characteristics unite all the squamates: their skin is covered in overlapping scales that are shed periodically, and they have uniquely jointed skulls and jaws, which are both strong and flexible. Male members of the group Squamata also have hemipenes (paired copulatory organs), which come in a variety of shapes and ornamentation, such as spines or hooks. Snakes and worm lizards are strictly carnivorous, and although there are some omnivorous species, most lizard species are also carnivorous.

The vomeronasal organ, or Jacobson's organ, is an olfactory sense organ that is found in many vertebrates, most notably reptiles. When a snake or lizard sticks out its tongue, it's "tasting" the air. The tongue carries odor particles from the outside into the mouth. When the tongue is placed against the Jacobson's organ in the roof of the mouth, an animal has yet another way (in addition to smell) to process chemical messages, such as readiness for sexual activity, tracking prey, and detecting chemical signals related to aggression and territoriality. In addition to reptiles, many animals, including primates, elephants, amphibians, cats and ungulates, also have Jacobson's organs. Instead of using their tongues, however, many animals engage in a distinctive facial movement called the Flehmen response, where an animal will lift its head, wrinkle its nose and lift its lips (like a grimace) when it finds a compelling odor.

With few exceptions, the only venomous land vertebrates are reptiles. In snakes and a handful of lizards, venom is actually highly modified saliva produced by the animal's salivary glands. Venom is any toxin an animal injects into a victim through a bite or sting (which differentiates it from poison, which is absorbed, consumed or inhaled). There are two broad classes of toxins found in snake venom: neurotoxins and hemotoxins. Snake venom is delivered to the victim through tubular or channeled teeth.

Lizards (suborder Lacertilia) typically have feet and external ears, while snakes lack both of these characteristics. Sight is very important for most lizards, both for locating prey and for communication, and, as such, many lizards have highly acute

The smallest reptile is the tiny dwarf gecko, which only reaches 0.7 inches (17 mm) in length.

The largest reptile is the saltwater crocodile which may reach over 19 feet (6 m) in length and weigh over 2,200 pounds (1,000 kg).

At 183 years old, a Seychelles giant tortoise named Jonathan is the oldest known living terrestrial animal in the world.

color vision. Most lizards rely heavily on body language, using specific postures, gestures, and movements to define territory, resolve disputes, and entice mates.

Many lizard species (including geckos, skinks, and others) are capable of detaching part of their tails through a process called autotomy. This allows them to escape when captured by the tail by a predator. The detached tail continues to writhe and wiggle, distracting the predator's attention from the fleeing lizard.

Snakes (suborder Serpentes) can be distinguished from legless lizards by their lack of eyelids and external ears. Snakes also have ventral (belly) scales that are different than their dorsal (back) scales; lizards' scales are uniform over their entire body. Some snake species retain a pelvic girdle with a pair of vestigial "spurs" on either side of the cloaca. Snakes are thought to have evolved from either burrowing or aquatic lizards, perhaps during the Jurassic period, with the earliest known fossils dating to between 143 and 167 million years ago.

Snakes are found on every continent except Antarctica, and on most smaller land masses; exceptions include some large islands, such as Ireland, Iceland, Greenland and the islands of New Zealand, and many small islands of the Atlantic and central Pacific. Additionally, sea snakes are widespread throughout the Indian and Pacific Oceans. Most snakes are nonvenomous and those that have venom use it primarily to kill and subdue prey rather than for self-defense.

Some snakes have extra sets of visual organs (in the loosest sense of the word) in the form of pits sensitive to infrared radiation (heat). Such heat-sensitive pits are particularly well developed in the pit vipers, but are also found in some boas and pythons. These pits allow the snakes to sense the body heat of birds and mammals, enabling them to hunt rodents in the dark.

WHAT IS A REPTILE?

Worm lizards (suborder Amphisbaenia) are a group of usually legless squamates, comprising over 180 species. They are characterized by their long bodies, the reduction or loss of the limbs, and rudimentary eyes. As many species have a pink body and scales arranged in rings, they have a superficial resemblance to earthworms. Amphisbaenians are widely distributed, occurring in North America, Europe, Africa, South America, and the Caribbean. Most species are less than 6 inches (150 mm) long. Amphisbaenians are able to tear chunks out of larger prey with their powerful, interlocking teeth.

ORDER TESTUDINES (terrapins, tortoises, turtles)

Turtles are unmistakable. No other vertebrate has evolved an armor quite like the turtle's shell. Comprised of 59–61 bones, a turtle shell consists of two parts: the "carapace," covering the animal's back, is a modified ribcage, part of the backbone; and the "plastron," covering the belly, is developed primarily from the sternum and clavicle. The shell is covered in scales (scutes) or leathery skin.

Turtles have remained unchanged for almost 200 million years. There are 327 known species placed into one of two suborders: side-necked (found only in the southern hemisphere) and S-necked. In S-necked (or hidden-necked) turtles, the neck vertebrae flex vertically, allowing the head to be drawn straight back within the shell. In side-necked turtles however, the neck vertebrae only flex laterally, so the neck only pulls the head in along the side of the shell.

The upper shell of the turtle is called the carapace and the lower shell that encases the belly is called the plastron. Turtles have rigid beaks and use their jaws to cut and chew food. Instead of having teeth, the upper and lower jaws are covered by horny ridges. Carnivorous turtles usually have knife-sharp ridges for slicing through their prey. Herbivorous turtles have serrated-edged ridges that help them cut through tough plants. They use their tongues to swallow food, but unlike most reptiles, they cannot stick out their tongues to catch food. Turtles are thought to have exceptional night vision due to the unusually large number of rod cells in their retinas. Turtles also have color vision with sensitivities ranging from the near ultraviolet (UV) to red.

Their rigid shell means that turtles cannot breathe as other vertebrates do, by changing the volume of their chest cavities via expansion and contraction of the ribs. Instead, they breathe in two ways: first, pulling air into their mouths and then pushing it into their lungs via oscillations of the throat. Secondly, when the abdominal muscles contract, the internal volume of the shell increases, drawing air into the lungs, allowing these muscles to function in much the same way as the mammalian diaphragm.

The term "turtle" is often used to refer to any shelled reptile, but there are distinctions between the different terms for the various testudines: "terrapin" (the Algonquian word for turtle) refers to fresh water species, with flatter shells and often webbed feet; "turtle" refers to marine species, which usually have a heart-shaped carapace; and "tortoise" refers to land-dwelling species, with high-domed shells and elephant-like limbs.

WHAT ABOUT DINOSAURS?

Snakes, crocodiles and turtles are all member of extant lineages of reptiles; that is, these lineages have living members. Dinosaurs are extinct reptiles, but they are still classified with orders, families, etc. For example, a Tyrannosaurus rex is classified as:

Phylum: Chordata
Class: Reptilia
Order: Saurischia
Family: Tyrannosauridae
Genus: Tyrannosaurus
species: *T. rex*

Looking at this classification, we notice that order Saurischia is not one of the four orders of extant reptiles (Crocodylia, Rhynchocephalia, Squamata and Testudines). This means that all the members within this order are extinct. At all levels of classification, there are usually extinct and extant members, some of which we know only from the fossil record, and some we know from our own destructive history.

WHAT IS A BIRD?



Order Anseriformes
ducks, geese, swans

Order Apodiformes
hummingbirds, swifts

Order Caprimulgiformes
nighthawks, frogmouths

Order Charadriiformes
waders, gulls, auks

Order Ciconiiformes
storks

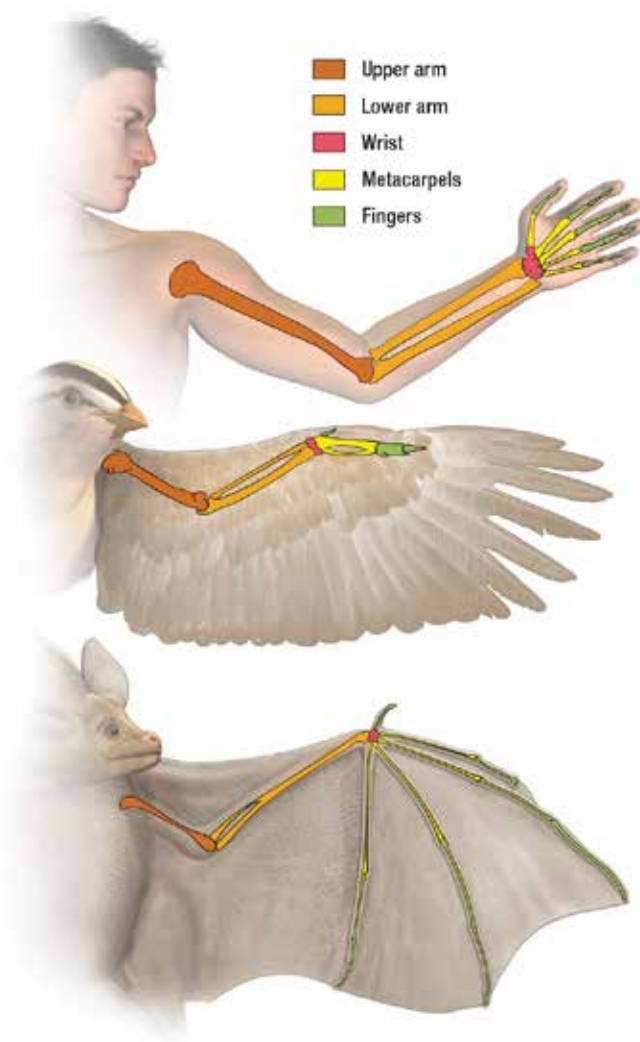
Order Coliiformes
mousebirds

In the class Aves, there are about 30 orders, about 180 families, and about 2,000 genera with 10,000 species (more than half of these are passerines, known as perching birds or songbirds). Despite their diversity of form, birds are an extremely well-defined group of vertebrates. They are all endothermic (warm-blooded), all have feathers and beaks, and they all lay hard shelled eggs. Birds live worldwide and range in size from the tiny hummingbird, which weighs less than an ounce, to the 8-foot-tall (2.4 meters) ostrich, weighing over 285 pounds (130 kg).

FEATHERED FLYING MACHINES

Birds are feathered flying machines and the entire avian body is structured for flight. Fused bones of the pelvis, feet, hands and head contribute to the rigidity and strength of the body. Their skeleton is designed specifically for flight, with the furcula, or “wishbone,” anchoring the flight muscles of the chest and preventing compression during the down stroke of the wings. The wing is a highly modified forelimb that, with a few remarkable exceptions, is nearly incapable of functions other than flight. Birds’ bones are lightweight structures, being spongy, strutted or hollow. Modern birds also lack teeth and the heavy jaw that teeth require. The reduced mass in the front improves balance in flight and allow precision landings.

Feathers, which are unique modifications of the outer skin made of keratin, are probably the most distinctive feature of birds. They are extremely versatile in form and function. Feathers provide insulation for maintenance of a high body temperature, are essential for flight, and serve in visual communication and camouflage. Modified feathers aid in swimming, sound production, protection, cleanliness, water repellance, water transport, tactile sensation, hearing and support of a bird’s body.



Bird and bat wings are analogous – that is, they have separate evolutionary origins, but are superficially similar because they have both evolved for flight. These analogies are the result of convergent evolution.

Order Columbiformes
doves, pigeons

Order Coraciiformes
kingfishers

Order Cuculiformes
cuckoos, roadrunners

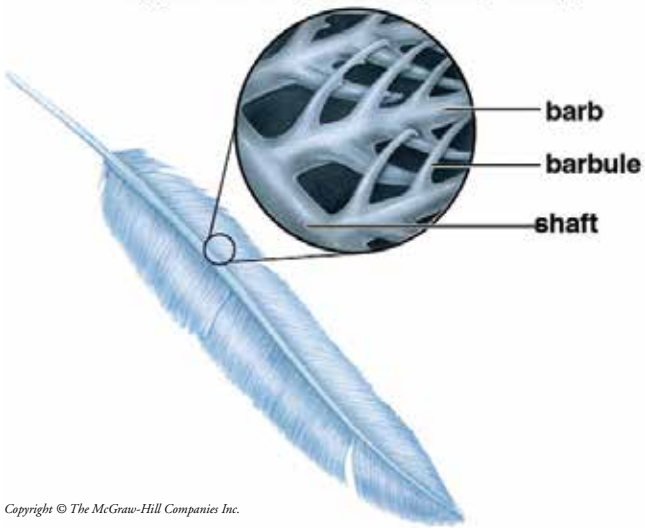
Order Falconiformes
diurnal birds of prey

Order Galliformes
fowl

Order Gaviiformes
loons



WHAT IS A BIRD?



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Most of the feathers that create bird's shape and color are known as vaned feathers. Vaned feathers include the contour feathers covering the body and the larger flight feathers of the wings and tail. The basic structure of a contour feather consists of a stiff central stalk with side branches called barbs and secondary side branches called barbules. The interlocking system of barbs and barbules forms a flexible but cohesive flat surface called the vane. Other major kinds of feathers include the down feathers, semiplumes, filoplumes, bristles and powderdown.

Daily care of the feathers is essential. Birds may preen their feathers as often as once an hour while resting. They systematically rearrange their plumage with their bills, repositioning out-of-place feathers. They also draw each long flight feather firmly through the bill to restore the integrity and alignment of the feather.

The feather coat of most birds consists of thousands of feathers. A tundra swan has roughly 25,000 feathers, of which

20,000, or 80 percent, are on its head and neck. Songbirds typically have 2,000 to 4,000 feathers, of which 30–40 percent are on the head and neck. Although feathers cover the entire body of a bird, they are not attached to the skin evenly or uniformly. Rather, feather attachments are grouped into dense concentrations called feather tracts. There are eight major feather tracts and muscles in the skin under the tracts allow birds to control feather position for courtship displays and regulation of heat loss. The entire feather coat is replaced at least once a year in regular molts.

In general, the feather coats of birds weigh two to three times as much as their bones. For example, the plumage of a bald eagle weighs about 1.5 pounds (700 grams), or 17 percent of its total mass (9 pounds; 4,082 grams) whereas its skeleton weighs only 0.5 pounds (272 grams), or 7 percent of its body mass and less than half of the plumage.

MORE THAN JUST FEATHERS

A bird's bill is its key adaptation for feeding. The broad, flat bill of a duck is not suited to reach carpenter ants in a tree, whereas the chisel-like bill of a woodpecker certainly is. Other bill types are designed to tear flesh, spear fish, crack hard seeds, probe deeply into crevices, or filter tiny creatures from the mud. Some bills are specialized, like the red crossbill's, which extracts seeds from pine cones. Other birds have more generalized bills, like many sparrows that feed on seeds in the winter and insects in the summer.

The anatomy of feet and legs can tell us a lot about a bird's ecology as well. Waterbirds have webbed or lobed toes for swimming; terrestrial birds have toes specialized for running, scratching, or wading. Other land birds have feet designed for climbing, holding prey, or perching. Arboreal, or tree-dwelling species, which constitute the majority of birds, have feet designed for gripping branches tightly. When



WHAT IS A BIRD?

Order Strigiformes
owlsOrder Struthioniformes
emus, ostriches, kiwisOrder Tinamiformes
tinamousOrder Trogoniformes
trogons, quetzalOrder Galliformes
fowlOrder Falconiformes
diurnal birds of prey

the bird bends the foot joint to squat, a tendon automatically flexes, locking the toes around the branch. This also allows birds to sleep while perching without falling out of trees.

A BIRD'S EYE VIEW OF THE WORLD

Birds have a full repertoire of well-developed senses. Large eyes (a European starling's eyes account for 15 percent of its head mass; human eyes account for less than 2 percent) and well-developed optic lobes of the brain enable excellent vision, including the ability to follow small moving objects. Birds may also have the most highly developed color vision of any vertebrate, with some species able to see the infrared, ultraviolet, and polarized light spectrum. The hearing of birds as a group is good but not extraordinary, except for the ability of rock doves to hear extremely low frequencies (infrasound) and the ability of barn owls to pinpoint sounds made by potential prey. Although most birds do not, some birds have an excellent sense of smell. Northern bobwhites, canaries, mallards, chickens, shearwaters, turkey vultures, brown kiwis and Humboldt penguins all pass laboratory olfaction tests. Birds are also sensitive to slight differences in barometric pressure and to magnetism.

The vocal repertoires of birds are among the richest in the animal kingdom. The loud broadcasts of territorial birds, which are among the most familiar to humans, convey information about the identity, location and motivation of the singer, including ownership of territorial space. More varied song repertoires help to attract females and foster superiority in vocal duel between competing males. The acoustical structure of songs are also used for both species and individual recognition. The ability to imitate new sounds is important to the development of a young bird's vocal repertoire. Copying the vocalizations of neighbors also leads naturally to the formation of regional song dialects, much like the local accents of humans.

WHICH CAME FIRST—CHICKEN OR EGG?

All birds have internal fertilization (usually described as a "cloacal kiss") and lay hard shelled eggs. There is distinction between determinate layers, species that lay a fixed number of eggs, and indeterminate layers, species that lay extra eggs if some are removed from the nest early in incubation. Domestic hens and Japanese quail can produce an egg a day all year long, whereas a female emperor penguin will lay one egg and

pass it off to the male for incubation while she forages at sea for over a month.

In general, the development of hatchlings can be classified into one of two main types: altricial and precocial. Altricial birds are naked, blind and virtually immobile when they hatch and are completely dependent on their parents. In contrast, precocial chicks are well-developed miniature birds covered in fluffy down. They can feed themselves, follow a parent and regulate their body temperature. So which is better, precocial or altricial development? It depends a lot on what the bird eats. The food of most precocial birds (insects, worms, seeds) can be procured by young chicks. But other food, such as live prey, must be located and captured by an adult, so altricial young depend on their parents until they are large enough to learn to hunt for themselves (the terms *altricial* and *precocial* refer to other animal groups as well.)

Striking differences in the plumage or size between the sexes is typical of non-monogamous birds. Think of the stunning train of a peacock, the strutting wild turkey tom, or the vivid crimson of a male cardinal. These elaborate sexual differences evolve because of *sexual selection*. Sexual selection usually causes males to become the fancier sex. Males, rather than females, tend to compete for mates and a male's reproductive success varies more than a female's. As potential male reproductive

The heaviest birds capable of regular flight are the trumpeter swan and Dalmatian pelican, both weighing in at 30+ pounds.

At 11.5 feet (3.5 m) the wandering albatross has the largest wingspan of any living bird.

The bee hummingbird is the smallest bird in the world, with a wingspan of just 1.25 inches (3.25 cm).

The kiwi lays the largest egg of any bird relative to its size—up to a quarter of the mass of the female.

WHAT IS A BIRD?

success increases so does the value of the characteristics (such as large size, fancy plumage, intricate songs and striking displays) that are responsible for the success.

FEATHERED DINOSAURS

The first groups of reptiles evolved about 300 million years ago. About 40 million years later, a group of reptiles called therapsids branched off, which eventually became modern mammals. Other groups of reptiles split off over the next 120 million years, and one branch called the dinosaurs were very successful. These dinosaurs were only distantly related to modern snakes, lizards, and turtles, groups that had split off at different times. But 65 million years ago there was a massive extinction event, and all dinosaurs were killed except for a single group of feathered dinosaurs. These evolved over the next 65 million years into modern birds. This is what most people mean when they say that birds are reptiles. But birds are usually classified in a separate class from reptiles. Why?

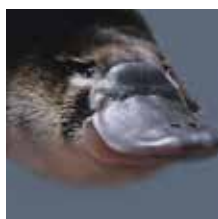
Biologists use two types of classification systems, the Linnaean and the phylogenetic. In the Linnaean system (developed in the 1730s), organisms are grouped by characteristics

regardless of their ancestry. So a reptile is an animal that is ectothermic and has scales, and birds would not be reptiles. In the 1940s, another classification system was developed called phylogenetics. In this system, organisms are grouped *only* by their ancestry, and characteristics are only used to discover the ancestry. So a reptile is any animal descended from the original group called reptiles, and birds (as well as mammals) would be reptiles.

Why do biologists have two systems of classification? One reason, of course, is history, but they are also both useful in their own ways. The phylogenetic system is useful for understanding the relationships between animals, while the Linnaean system is more useful for understanding how animals live. It's sort of like cooking. If you organized all your ingredients phylogenetically, you would put everything that was made from peanuts on the same shelf. Then you could see that peanut butter, peanut oil, and peanut brittle are related to each other. But when you actually want to cook, you would use something like the Linnaean system and put all your oils together, all your dry goods together, etc. So both systems have their uses.

WHAT IS A MAMMAL?

In the class Mammalia, there are about 5,000 species placed in about 26 orders. They are all endothermic (warm-blooded), all have hair at some point in their development, and all female mammals produce milk by way of modified sweat glands called mammary glands. Mammals exhibit a vast diversity of forms, including species that fly, glide, swim, run, climb, burrow and jump. They have evolved to exploit almost every ecological niche on earth and have evolved numerous adaptations to take advantage of a wide variety of lifestyles. Mammals range in size from the tiny bumblebee bat (about the size of a bumblebee) to the largest animal to ever live on the planet, the blue whale, which can weigh 175 tons (160,000 kg). That's a 53 million-fold difference in mass between the largest and smallest mammal.



Monotremes
egg-laying mammals

There are three major groups of mammals: monotremes, marsupials and placentals. Monotremes are mammals that lay eggs instead of giving birth to live young. The only surviving examples of monotremes, the platypus and four species of echidnas, are found in Australia and New Guinea. Monotremes have unusually

low metabolic rates and maintain a body temperature that is lower than that of most other mammals. Male platypuses have poisonous spurs on their ankles that are presumed to be used in fighting and in defense. They are one of only four mammal species to have poison (two species of solenodons and two species of shrews are the others).



Marsupials
pouched mammals

Marsupials are mammals that give birth to undeveloped young that reside in their mother's pouch a certain time after birth. There are about 330 species of marsupials found primarily in Australasia and the Americas (100 species live in the Americas; only 13 in Central America, one in North America). The highly altricial young

are born after a very short gestation period (8 to 43 days). The young then attach to a nipple inside the mother's pouch and spend a great amount of time nursing as they develop.

Placental mammals are the animals we're probably most familiar with. The placentals are primarily distinguished from other mammals in that the fetus is carried in the uterus of its mother where it is nourished via a placenta, until the live birth of an offspring.

Once born, all mammals are dependent upon their mothers for milk, which rich in fats and protein.

HAIR OR FUR?

Is there a difference between hair and fur? Nope. They're the same thing. Scientifically, hair and fur are made of exactly the same material, a protein called keratin. From a developmental standpoint, there is no distinction between the follicles from which hair, fur, eyelashes, whiskers, wool, or porcupine quills grow. The scaly plates that cover most of a pangolin's body—those are actually modified hairs. They all have hair follicles and it's all hair.

Mammalian hair, serves at least four functions: first, it provides insulation from the environment; second, specialized hairs (whiskers or "vibrissae") have a sensory function, letting an animal know when it is in contact with an object in its environment; third, hair provides an animal with color and pattern that can serve to camouflage, to warn predators of a defensive mechanism (for example, the conspicuous color pattern of a skunk is a warning to predators), or to communicate social information (for example, threats, such as the erect hair on the back of a wolf; or the presence of danger, such as the white underside of the tail of a white-tailed deer); and fourth, hair provides some protection, either simply by providing an additional protective layer (against abrasion or sunburn, for example) or in the form of dangerous spines or coverings that deter predators.

OPEN WIDE

Mammals are typically characterized by their highly differentiated teeth (although several groups of mammals have decided to do without teeth altogether: baleen whales, pangolins, and anteaters.) Teeth are the hardest part of any mammal and often fossilized. Since the number, size, organization, and shape are different in every species, teeth are especially useful in the classification of fossils.

The order of carnivores has highly modified premolar and molar teeth are adapted to shear flesh. These teeth, called carnassial teeth, have knife-like edges so that the teeth slice past one another and act like scissors when the jaw is closing. Herbivores, such as horses and deer, often lack canine teeth and have large flat molars for grinding tough plant material. Some even have teeth that continuously grow to make up for erosion due to the grinding.

All rodents share one characteristic: their teeth are highly specialized for gnawing, with a single pair of upper and a single pair of lower incisors that are rootless and grow continuously. During gnawing, as the incisors grind against each other, they wear away the softer dentine, leaving the enamel front edge as the blade of a chisel. This "self sharpening" system is very effective.

WHAT IS A MAMMAL?

ROCK THE CRADLE

Because the cost of reproduction (gestation and lactation take a lot of energy) is so high for female mammals, it is often the case that males can produce many more offspring in a mating season than can females. As a consequence, the most common mating system in mammals is *polygyny*, with relatively few males fertilizing multiple females (only about 3 percent of mammalian species are monogamous). Polygyny sets the stage for intense male-male competition in many species, and also the potential for females to be choosy when it comes to which males will sire her offspring. As a consequence of the choices females make and the effort males put into acquiring matings, many mammals have complex behaviors and morphologies associated with reproduction. Many mammal groups are marked by *sexual dimorphism* as a result of selection for males that can better compete for access to females. A few examples: male elephant seals can weigh 10 times more than females; antlers of male deer are visual indicators to females as to the genetic health of males, as well as being weapons during fights over females; and selection of mates by lionesses favors male lions with dense, dark manes. The rule of thumb is the darker and fuller the mane, the healthier the male, which means healthier offspring.

Depending upon the species and environmental conditions, male mammals may either provide no care, or may invest some or a great deal of care to their offspring. Care by males often involves defending a territory, resources, or the offspring themselves. Mammalian young are often born in an altricial state, needing extensive care and protection for a period after birth. Most mammals make use of a den or nest for the protection of their young. Some mammals, however, are born well-developed and are able to locomote on their own soon after birth. Most notable in this regard are wildebeest or giraffes. Cetacean young (aquatic mammals such as dolphins and whales) must also swim on their own shortly after birth.

WHAT KIND OF MAMMAL IS THAT?



Tenrecs

Order *Afrosericida*

- Golden moles of southern Africa and the tenrecs of Madagascar and Africa
- Previously included with the insectivores (Soricomorpha)
- Most species are nocturnal and have poor eyesight.



Hoofed animals

Order *Artiodactyla*

- **Even-toed ungulates:** pigs, hippos, camels, llamas, deer, giraffes, antelopes, sheep, goats, and cattle
- Most are herbivores; although plants provide an abundant and diverse food

source, mammals do not possess the enzymes necessary to break down cellulose. Artiodactyls rely on microorganisms to

break down plant compounds and they all have at least one additional stomach chamber in which this occurs.

- Many artiodactyls have horns or antlers. Antlers are branched extensions of the skull grown by members of the deer family that are shed and regrown each year. Only males have antlers; the exception is both male and female caribou (reindeer) have antlers. True horns are a single projection of live bone surrounded a covering of keratin grown by cattle, goats, and antelopes. Both males and females have horns, although males generally have larger, heavier horns. Horns also grow throughout an animal's life and never shed like antlers. The exception is pronghorn antelopes, which have branched horns that shed the outer keratin layer annually, but retain the bony core.
- All artiodactyls give birth to precocial young that are capable of walking within a few hours after birth.
- The cetaceans (aquatic mammals) evolved from even-toed ungulate ancestors and modern taxonomic classification combines Artiodactyla and Cetacea into the superorder Cetiartiodactyla.



Order *Perissodactyla*

- **Odd-toed ungulates:** horses, rhinos, and tapirs
- Have one or three toes
- Perissodactyls have a simple stomach, in contrast to the chambered structure of artiodactyls.

- Lack horns and antlers; rhinos do have horns, but the horns are made of keratin (hair) instead of having a bony core.



Carnivores

Order *Carnivora*

- Carnivores have teeth and claws adapted for catching and eating other animals.
- With exception of walruses, seals and sea lions, all carnivores give birth to

altricial young that require a lot of care and protection until they're weaned, at which point the young need to learn how to hunt and find food from their parents.

- Some carnivores, such as cats and seals, depend entirely on meat for their nutrition. Others, such as raccoons and bears, are more omnivorous: the giant panda is almost exclusively a herbivore.



Whales, dolphins

Order *Cetacea*

- Exclusively aquatic with modified limbs for swimming and external nostrils (blowhole) on the top of their head. They also lack of sweat glands and hair (except whiskers).

- Cetaceans inhabit all of the world's oceans, as well as some freshwater lakes and rivers

WHAT IS A MAMMAL?

**Bats****Order Chiroptera**

- Bats are the only mammals that have true wings and flight.
- Bats are the second-most speciose group of mammals (after rodents.) Bats make up around 20% of all known

living mammal species.

- Divided into two major groups: Megachiroptera (fruit bats) and Microchiroptera (insect-eating bats)

**Armadillos****Order Cingulata**

- All armadillos have dorsal armor that is formed by osteoderms, plates of dermal bone covered in relatively small, overlapping keratinized epidermal scales called “scutes.”

- Only found in the Americas

**“Flying” lemurs****Order Dermoptera**

- Not true lemurs (not primates)
- Only two species, both found in Asia
- They are the most capable of all gliding mammals, using flaps of extra skin between their legs to glide from

higher to lower locations.

**Hedgehogs****Order Erinaceomorpha**

- Hedgehogs and gymnures (moonrats) of Eurasia and Africa
- Hedgehogs are covered with sharp spines.
- Usually nocturnal

- Share distant ancestry with shrews

**Hyraxes****Order Hyracoidea**

- Furry, rotund mammals with short tails, often mistaken for pikas or rodents, but are more closely related to elephants and manatees.
- Hyrax hind feet have hoof-like nails

on two of the toes and specialized muscles in the soles of the feet that help them to work almost like a suction cup.

- Eat mostly leaves, bark and grasses

**Rabbits, hares, pikas****Order Lagomorpha**

- Resemble large rodents
- Have a rudimentary or short tail.
- Lagomorphs have two pairs of incisors in the upper jaw: one large and rodent-like; and the other small pegs

located immediately behind the larger teeth.

**Elephant shrews****Order Macroscelidea**

- They are adapted for leaping, with hind limbs much longer than forelimbs.
- Elephant shrews have elongated snouts and large eyes and ears. They range from mouse-sized to the size of a

squirrel or large rat. Some species are brightly colored.

- Insectivorous and nocturnal
- About 20 species, only found in Africa

**Pangolins****Order Pholidota**

- Backs are covered with large, overlapping scales made up of “agglutinated” hairs that make them look like giant walking pine cones.
- Small group (eight species) of

mammals that feed mostly on ants.

- Found in the tropical regions of Africa and Asia
- Pangolins lack teeth; instead they have extraordinarily long and muscular tongues.

**Sloths, anteaters****Order Pilosa**

- There are four species of anteaters and five species of sloths.
- The name Pilosa comes from the Latin word for “hairy.” Sloths’ fur is home to many insects, as well as a type

of algae that helps camouflage the sloths.

- Anteaters feed lightly and for a short time at any one ant nest, allowing the colony to regrow easily.

**Primates****Order Primates**

- Primates typically have grasping hands and feet. They have flatter faces than most other mammals, lacking the muzzle of dogs, bears, deer, etc. They have good vision but a more limited

sense of smell than most other mammals. Most are highly social.

- Primates in general have larger brains relative to body size than most other mammals.

WHAT IS A MAMMAL?

- Unlike most other mammals, primates have nails on their fingers and toes instead of claws.
- Primates have relatively unspecialized (generalized) teeth. Most primates have four types of teeth: incisors, canine, premolars, and molars.
- Primates are divided into two groups, the Strepsirrhini (prosimians) and the Haplorrhini (anthropoids). Strepsirrhines have naked noses and lower incisors forming a “toothcomb”; Haplorrhines have furry noses and lack a toothcomb. Haplorrhines are further divided into two major groups, the Platyrrhini and the Catarrhini. Platyrrhines have flat noses and are found only in the New World. Catarrhines have nostrils that face downward and are found only in the Old World (except humans).



Elephants *Order Proboscidea*

- Two species living today; mammoths were in the same family; mastadons were in the same order.
- Elephants have a long, muscular trunk that functions almost as a fifth limb,

- and males have a pair of huge tusks derived from upper incisors.
- They have complex social system that involves groups of related individuals led by mature females.
 - Elephants have an excellent sense of smell but relatively poor sight and hearing. They communicate by means of a variety of sounds, some produced vocally and others by tapping or stamping on the ground.



Rodents *Order Rodentia*

- With over 2,000 species, rodents are by far the largest order of mammals (over 40 percent of all mammal species are rodents.)
- All rodents share one characteristic:

- their dentition is highly specialized for gnawing.
- Rodents are incredibly diverse. Some species spend their entire lives in the canopy of rainforests; others seldom emerge from beneath the ground. Some species are highly aquatic, while others are equally specialized for life in deserts. Many are omnivorous; others are highly specialized, eating, for example, only a few species of invertebrates or fungi.



Tree shrews *Order Scandentia*

- 19 species found in the tropical forests of Southeast Asia
- Although they are more closely related to primates, tree shrews are remarkably squirrel-like in external

- shape and size.
- Omnivorous



Manatees, dugongs *Order Sirenia*

- Large, slow-moving, aquatic mammals
- 4 species found in shallow waters along coastlines and inlets
- Herbivorous, eating mainly

- seagrasses, water weeds, and other aquatic vegetation
- Evolved from four-legged land mammals over 60 million years ago, with their closest living relatives being the elephants.



Shrews, moles *Order Soricomorpha*

- Originally called insectivores
- Teeth are small and sharp to pierce and crunch exoskeletons of their prey.
- Many species are fossorial (digging, burrowing) and have poor eyesight

- or are completely blind. To make up for their lack of vision, these species often have a long, slender, nearly naked snout, with an extraordinary sensory system: tens of thousands of touch receptors on their snout help them forage along their tunnel systems. Some species even use echolocation to perceive their environment.

- Shrews must remain near wet areas due to their small body size and the resulting high rate of desiccation.



Armadillos *Order Tubulidentata*

- One species found in Africa
- Pig-sized mammal that specializes in insectivory, especially in capturing and consuming termites
- Their limbs and claws are modified

- for digging into the very hard termite mounds.
- Have teeth (unlike other anteaters), but lack incisors and canines
 - Rely primarily on their sense of smell for locating prey. Their nostrils have fleshy tentacles and dense hairs that seal the nostrils when the animal is digging.

ANIMALS OF POTTER PARK ZOO

as of 03/2017

Class	Species	IUCN status	Gender	DOB/established
Amphibians	American toad	Least concern	1 female, 1 male	March 17, 2014
	Blue poison dart frog	Threatened	4 undetermined	January 1, 2016
	Common gray tree frog	Least concern	1 undetermined	April 23, 2016
	Green-and-black poison dart frog	Least concern	3 undetermined	May 31, 2011, January 1 2016
	Mudpuppy	Least concern	2 undetermined	January 1, 2006
	Northern leopard frog	Least concern	1 undetermined	May 31, 2015
	Puerto rican crested toad	Critically endangered	Several males and females	Varying ages
	Yellow-banded poison dart frog	Least concern	5 undetermined	January 1, 2014, September 1, 2009
Aves (Birds)	American kestrel	Least concern	No record	No record
	Bald eagle	Least concern	2 males, 1 female	February 11, 2005 January 1 2006 December 13, 1986
	Barred owl	Least concern	1 male	August 1, 2012
	Blue jay	Least concern	No record	No record
	Blue-bellied roller	Least concern	1 male, 1 female	April 13, 2010 August 2, 2013
	Blue-crowned hanging parrot	Least concern	5 female	May 3, 2010 May 4, 2010 (2) June 8, 2014 June 29, 2012
	Blue-naped mousebird	Not listed	1 female, 3 males	September 3, 2009 August 25, 2008 June 1, 2008 August 16, 2008
	Canada goose	Least concern	Wild on zoo grounds	
	Common raven	Least concern	1 female, 1 male	January 1, 2006 January 1, 2009
	Domestic chicken	Not listed	6 females	May of 2011 (3) May of 2014 (2) April 29, 2014
	Eastern screech-owl	Least concern	1 male, 1 female	June 10, 2000 January 1, 2004
	Green heron	Not listed	1 male	July 1, 2010
	Guam Microneasian kingfisher	Extinct in the wild	1 male	May 28, 2012
	Indian blue peafowl	Not listed	Several males/females	Varying ages
	King vulture	Least concern	2 males	July 23, 1967 April 23, 2006
	Magellanic penguin	Near threatened	4 females, 5 males	May of 1999–2015
	Mallard duck	Not listed	Wild on zoo grounds	
Green aracari (toucan)	Least concern	3 females	March 25, 2015 June 1, 2015 February 5, 2005	

ANIMALS OF POTTER PARK ZOO

as of 03/2017

Class	Species	IUCN status	Gender	DOB/established
Aves (Birds)	Red-tailed hawk	Least concern	1 female?	?
	Silkie bantam chicken	Not listed	No current record	No current record
	Southern ground hornbill	Vulnerable	2 females	January 17, 2006 December 29, 2006
Education animals	Australian blue-tonged skink	Not listed	1 female	January 1, 1998
	Bearded dragon	Least concern	1 undetermined	
	Chilean rose-haired tarantula	Not listed	1 female	August 1, 2014
	Domestic rabbit	Not listed	2 males	February 1, 2013 January 1, 2007
	European ferret	Not listed	2 females	January 12, 2011 September 7, 2012
	Red-tailed boa constrictor	Threatened	1 male	January 1, 2008
	Eastern box turtle	Vulnerable (special concern in Mich.)	1 female	January 1, 1990
	Eurasian eagle owl	Least concern	1 male	April 15, 1994
	Lesser hedgehog tenrec	Least concern	4 females, 2 males	2007–2014
	Madagascar hissing cockroach	Not listed	Varies	Varying ages
	Mediterranean spur-thighed tortoise	Vulnerable	1 male, 1 female	January 1, 2003 January 1, 2005
	North American porcupine	Least concern	1 male	April 15, 2015
	Ring-necked turtle dove	Not listed	2 females	April 21, 2012 March 13, 2012
	Sinaloan milk snake	Not listed	Undetermined	January 1, 2004
	Sheltopusik	Not listed	Undetermined	June 15, 2001
	Southern three-banded armadillo	Near threatened	1 male	May 2, 1994
Yellow-naped Amazon parrot	Vulnerable	1 female	January 10, 1994	
Mammals	African crested porcupine	Least concern	1 male	March 28, 2007
	African pygmy goat	Not listed	6 males, 1 female	March–May 2012
	Amur tiger	Endangered	1 male, 1 female	March 26, 2005 September 13, 2011
	Bactrian camel	Critically endangered	1 female, 1 male	March 12, 1998 May 23, 2010
	Banded mongoose	Least concern	3 males, 4 females	2009–2010
	Arctic fox	Least concern	1 male, 1 female	April 1, 2014 May 24, 2015
	Bat-eared fox	Least concern	1 male, 1 female	January 23, 2010 April 27, 2007
	Binturong	Vulnerable	1 female	
	Black-headed spider monkey	Critically endangered	4 males, 1 female	1981–1999

ANIMALS OF POTTER PARK ZOO

as of 03/2017

Class	Species	IUCN status	Gender	DOB/established
Mammals	Bongo	Near threatened	1 male, 1 female	March 13, 2003 October 12, 2008
	Cotton-top tamarin	Critically endangered	1 female	April 26, 2006
	Domestic pony	Not listed	4 males	1990–1994
	Golden lion tamarin	Endangered	1 male, 1 female	March 31, 2006
	Guinea hog	Not listed	2 males, 2 females	2006–2010
	African lion	Vulnerable	1 male, 2 females	October 23, 2006 March 26, 2004
	Llama	Not listed	1 male, 2 females	September 9, 1996 March, June 1999
	Mandrill	Vulnerable	1 male, 1 female	November 4, 1992 August 28, 1996
	Meerkat	Least concern	1 male, 1 female	October 24, 2005 December 16, 2004
	Moose	Least concern	1 male, 1 female	June 1, 2014 May 1, 2013
	North American river otter	Least concern	1 male, 1 female	February 19, 2013 February 25, 2014
	Northern tree shrew	Least concern	1 male, 1 female	January 25, 2010 May 25, 2013
	Pallas cat	Near threatened	1 male	2014
	Patagonian mara	Near threatened	3 males	September 8, 2012 October 16, 2013 January 13, 2014
	Red kangaroo	Least concern	1 female	
	Red panda	Endangered	2 males, 2 females	July 3, 2011 June 9, 2014 July 2, 2016 (2)
	Red-ruffed lemur	Critically endangered	1 male, 1 female	May 21, 2007 April 19, 1991
	Reeves' muntjac	Least concern	2 males	July 10, 2005 April 23, 2006
	Eastern black rhinoceros	Critically endangered	1 female	July 6, 2007
	Ring-tailed lemur	Endangered	4 females	1988–1995
	Seba's short-tailed fruit bat	Least concern	26 males?	
	Sicilian burro	Not listed	2 females	January 1, 1995
	Snow leopard	Endangered	1 female	April 22, 1998
	Western grey kangaroo	Least concern	1 male	August 23, 1994
Western tufted deer	Near threatened	1 male, 1 female	January 2, 2014 September 21, 1999	
Gray wolf	Least concern (endangered in Mich.)	2 males, 1 female	April 18, 2014 (2) May 3, 2009	

general

ANIMALS OF POTTER PARK ZOO

as of 03/2017

Class	Species	IUCN status	Gender	DOB/established
Reptiles	African spurred tortoise	Vulnerable	2 males	July 10, 1999 January 1, 2005
	Blanding's turtle	Endangered	1 male	January 1, 2000
	Blue tree monitor	Not listed	1 female	January 1, 2015
	Brazilian rainbow boa	Not listed	1 male, 1 female	January 1, 2004
	Chuckwalla	Least concern	1 male, 1 female	April/May 2005
	Common musk turtle	Least concern	1 male, 2 females	January 1, 2006 January 1, 2004
	Emerald tree boa	Least concern	1 female	September 2, 2005
	Gila monster	Near threatened	1 male, 1 female	October, 1992
	Henkel's leaf-tailed gecko	Vulnerable	4 males	
	Madagascar giant day gecko	Least concern	3 females, 1 male	2012–2013
	Madagascar hognosed snake	Least concern	1 female	Sept. 9, 2012
	Massasauga rattlesnake	Least concern (special concern Mich.)	1 female	August 27, 2016
	Painted turtle	Least concern	1 male, 1 female	January 1, 2006
	Rat snake	Least concern (special concern in Mich.)	No current record	No current record
	Spiny hill turtle	Endangered	1 female	January 1, 2005
Western terrestrial garter snake	Least concern	1 male, 1 female	Feb. 2, 2016	