



THE
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WORLD
AQUARIUM

Reptiles & Amphibians: A Resource for Teachers

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REPTILES

Reptiles are vertebrate animals, terrestrial or aquatic; most have the following features:

1. cold-blooded (poikilothermic)
2. breathe air by means of lungs
3. develop direct (no larval forms)
4. dry skin with scales
5. internal fertilization
6. paired short limbs, when present, usually with five clawed fingers or toes
7. three- or four-chambered heart
8. an amniote egg (has an amnion and allantois in its fluid-filled sac)
(Amnion is the inner wall of the fluid-filled sack in which the embryo is suspended. The allantois is another sac that projects from the embryo's digestive tract. It serves as a bladder to receive and store waste and allows oxygen and carbon dioxide in and out of the slightly porous shell.)
9. A complete or incomplete partition (secondary palate) along the roof of the mouth that separates the food and air so that breathing can continue while eating.

There are four orders of reptiles:

- **TESTUDINATA** (turtles, terrapins, tortoises and side-necked turtle)
- **SQUAMATA** (lizards and snake)
- **RHYNCHOCEPHALIA** (tuatara)
- **CROCODILIA** (alligators, crocodiles, caimans and gavials)

TESTUDINATA (Turtles)

Testudinata was the first order of reptiles to evolve more than 200 million years ago. There are about 245 species in this order with a great range in size. Even though all living shelled reptiles are known as turtles, the terms tortoise and terrapin are applied in different parts of the world.

“Tortoise” usually refers to terrestrial or land turtles and “terrapin” to aquatic, edible, hard-shelled turtles. The tiny Spectacled tortoise (*Homopus signatus*) is the smallest member of this order, measuring only 3¾ inches (9.5 cm) in length and weighing 5 ounces (142 gr). The Leatherback turtle (*Dermochelys coriacea*) is the largest member of this order with a shell length up to 95 inches (241 cm) and weighing up to 1,890 pounds (857 kg). Turtles are found on every continent except Antarctica and have adapted to many types of habitats — mountains, plains, deserts, savannas, grasslands and woodlands.

Turtles are the only reptiles that have a shell built into their skeleton. The turtle’s shell consists of two parts: the carapace (upper) and the plastron (lower). The upper and lower parts are joined on each side by a bridge. The protective shell is made up of bony segments covered by large horny plates. Openings for the head, legs and tail are where the carapace and plastron meet. The arrangement and number of scutes differ and are helpful for identification of species. Three families of turtles lack the protective horny plates: softshell turtles, leathery turtles and Papuan softshell turtles. All modern turtles lack teeth on their jaws, although small teeth are evident on the palate of the oldest known fossils. The horny ridges which occur on the upper and lower jaws of modern turtles are razor sharp in carnivores and serrated in herbivores.

Two main suborders can be found today -- the hidden-necked and side-necked turtles. Hidden-necked turtles can at least partially draw the head directly into the shell by vertically bending the vertebral column of the neck. Side-necked turtles fold the head under the front edge of the shell by moving the head either to the left or the right.

All turtles possess strong limbs, but the toes and fingers differ, depending on the turtle’s habitat. The digits of land turtles have grown together while aquatic turtles have webbing between each digit. Sea turtles are the only turtles which must drag their body across the ground when they come ashore to lay eggs.

Turtles lay their eggs in a nest chamber and the young develop at the temperature of their surrounding environment. Parents display no further interest in their offspring after the eggs are laid or covered. All babies fend for themselves from the moment they hatch.

There are twelve families in the Order Testudines. These include the Carettochelyidae, Chelidae, Cheloniidae, Chelydridae, Dermochelyidae, Dermatemydidae, Emydidae, Kinosternidae, Pelomedusidae, Testudinidae and Trionychidae families.

Chelidae

Matamata (*Chelus fimbriatus*)

The Matamata (*Chelus fimbriatus*) is the only member of its genus. It has a brownish-black carapace which is oblong in shape and usually covered with algae. The large, unusual, flat head has a narrow snout which, along with coloration, allows this carnivore to ambush its prey. Loose flaps of skin around the head and neck sway in the water like aquatic vegetation. Males have a concave area on the plastron and longer, thicker tails than females. The Matamata can hold its breath for long periods of time, allowing it to wait for its prey which is sucked into the mouth as the head is thrust forward.



Chewing is difficult as the jaws are not attached. Another hunting technique used by the Matamata (usually juveniles) is herding small fish into shallow pools where they are devoured. The Matamata rarely swims but creeps along the river bottom and seldom basks. The mating ritual includes the male thrusting his head towards the female and opening and closing his gaping mouth. Nesting occurs from October to December when 12-28 eggs are deposited in each clutch. Hatchlings are more colorful than adults and are poor swimmers.

The Matamata is found in rivers in parts of Bolivia, Peru, Colombia, Ecuador, Venezuela and Brazil. The Matamata has been observed in Trinidad, apparently by mainland floods. It is most often observed in muddy rivers and shallow swamps.

Cheloniidae (sea turtles)

Hawksbill sea turtle (*Eretmochelys imbricata*)

Sea turtles occur worldwide in all tropical oceans and are truly marine, with females coming ashore only when nesting. There are seven species of sea turtles; six are found in the Cheloniidae family; the Leatherback sea turtle is found in the Dermochelyidae family. All sea turtles are threatened or endangered.

The Hawksbill sea turtle is brown in color, with numerous splashes of yellow, orange or reddish-brown on the carapace. The plastron is yellowish with black spots. It is the only sea turtle with a combination of two pairs of prefrontal scales on the head and four pairs of costal scutes on the carapace. Juveniles are black or very dark brown with light brown or yellow coloration on the edge of the shell, limbs and raised ridges of the carapace. While young, their carapace, or upper shell, is heart-shaped, and as they mature becomes elongated. Males have longer claws, thicker tails, and somewhat brighter coloring than females. It has a tapered head that ends in a sharp point resembling a bird's beak.



The Hawksbill is small to medium-sized, with adults being 2.5-3 feet (0.76-0.9 m) in carapace length and weighing between 100-150 pounds (45-68 kg). Hatchlings weigh about 0.5 ounce (14 gr).

Typically diurnal (except during mating season), solitary Hawksbill turtles comb the reefs and continental shelves searching for food. Like other sea turtles, Hawksbills make incredible migrations in order to move from feeding sites to nesting grounds, normally on tropical beaches. However, in contrast to all other sea turtle species, they nest in low densities. When Hawksbill turtles are young, they are unable to dive into deep water; therefore, they are forced to live in floating sea plants, such as sargassum. Hawksbill sea turtles, like other sea turtles, can hear well and have a strong sense of smell. They feed primarily on sponges but will also eat mollusks, marine algae, crustaceans, sea urchins, fish and jellyfish.

The nesting season varies with locality, but in most locations nesting occurs sometime between April and November and occurs every two to three years at night. The nesting procedure begins when the turtles leave the sea to choose an area to lay their eggs, usually high up on the beach, under or in the beach/dune vegetation. A pit is dug in the sand, filled with approximately 140 eggs and then covered. At this stage, the turtles retreat to the sea, leaving the eggs, which will hatch in about 60 days. After the eggs hatch, the newborn turtles make a dash for the water where they will mature. The most significant nesting within the U.S. occurs in Puerto Rico and

the U.S. Virgin Islands, specifically on Mona Island and Buck Island. They are found in tropical and subtropical regions of the Atlantic, Pacific and Indian Oceans; widely distributed in the Caribbean Sea and western Atlantic Ocean. Hawksbills frequent rocky areas, coral reefs, shallow coastal areas, lagoons or oceanic islands, narrow creeks and passes. They are seldom seen in water deeper than 65 feet (20 m).

Emydidae

Red-eared slider (*Trachemys scripta*)



Red-eared sliders can be distinguished by the presence of a prominent red patch behind each eye. The oval carapace is olive to brown with yellow markings. Skin is green to olive brown with yellow stripes. There are many stripes on the neck and a central chin stripe runs backward and splits to form a Y-shaped design.

Males are usually smaller than females; typically growing to approximately eight inches (20.3 cm) with a maximum recorded size of 11½ inches (29 cm). Nests are excavated along the banks well above water to a depth of 4 to 4½ feet (1.2-1.4 m) with clutch size typically being between 7 and 13 eggs. Eggs hatch in approximately 68-70 days; up to three clutches may be laid per season.

Trachemys scripta is the most variable of all turtles, with 14 or more identified subspecies. They are found in the U.S., through Mexico and Central America to Brazil. They prefer quiet waters with soft bottoms, plenty of aquatic vegetation and suitable basking sites. Juveniles are highly carnivorous but adults are omnivorous and will eat almost any food item available (algae, assorted emergent herbaceous plants, tadpoles, small fish, insects, crayfish, shrimp, amphipods and various mollusks).

Kinosternidae

Mexican musk turtle (*Staurotypus triporcatus*)



All members of this family produce a pungent musk from glands located in front of and behind the bridge area between the plastron and the carapace. Throughout its life, the Mexican musk turtle will have three well developed longitudinal keels on its elongated carapace. The brown carapace has yellow seams, dark spots and radiations. The large head is yellowish to olive with dark reticulations that extend on the jaws; two sensory barbels are found on the chin. Limbs and tail are grayish brown. The toes are webbed.

The Mexican giant musk turtle is the largest species of the Kinosternidae, reaching a shell length of 15 inches (38 cm). It is believed that nesting occurs in September with a normal clutch consisting of three to six eggs. It is found in Belize, Guatemala, Honduras, and Mexico where it prefers slow-moving waterways, such as lakes, marshes and lagoons. It eats small invertebrates (aquatic insects, worms, snails, clams, crustaceans), fishes, and amphibians, as well as other smaller mud turtles.

Pelomedusidae

Arrau side-necked turtles (*Podocnemis expansa*)

These turtles, also known as Giant South American river turtles, are most obvious because of their size. They are the largest living Podocnemis (side-necked). The adult carapace is rather flat and broadest behind the center. It is olive/dark gray to brown and may have dark spots with a light border in juveniles. The plastron is large but does not completely cover the carapacial opening. The plastron, bridge and outer edge of the underside are yellow. The head is gray/brown with yellow markings and has a broad protruding snout and square upper jaw. The jaws are usually tan, chin is yellow and the neck is yellow and gray. Males have longer, thicker tails and more undiscerning rounded heads, than do females. The name side-necked refers to how the neck is not pulled straight back into the shell like most turtles but instead it is folded to the side.



Arrau turtles live in the rivers and drainage areas of many rivers in South America. They are sometimes found on the island of Trinidad, after floods of the mainland Orinoco river. Arrau turtles live in the main rivers of the Orinoco and Amazon basins during the dry season and move into the flood plains during the rainy season where they find fruits, flowers, roots and aquatic plants for food. They tend to fast during the dry season.

The night-time nesting congregations of the Arrau turtle are most fascinating to observe. The nesting beaches often become so crowded that several females use the same nest. The carapace of the female may reach an approximate length of three feet (0.9 m) and weigh close to 200 pounds (91 kg). Nesting takes place during the dry season between February and April in Venezuela when the sandy river banks and bars are exposed (but also vulnerable to flooding). Mating occurs in the water after which the female begins basking daily for six hours or more, possibly to speed up the development of the eggs. After several weeks of basking, the turtles start retreating from the water after sunset for a few hours to explore the nesting areas. Actual laying of the eggs takes place a few nights later. The flask-shaped nest is approximately 30 inches (76 cm) deep. Females bury up to 130 spherical-shaped and leathery-shelled eggs in each nest. Hatching occurs in 45-50 days after which the brightly marked hatchlings (carapace length of 1½ to 2 inches or 3.8 - 5.1 cm) race for the water.

Juveniles are in demand for pet shops, turtles die in fish nets, laws are not enforced and their natural habitats are threatened and destroyed by pollution, irrigation, etc.

Pelomedusidae



Llanos or Savannah side-necked turtle (*Podocnemis vogli*)

The Savannah side-necked turtle is one of the smaller species of *Podocnemis*, with a recorded carapace length of 14 inches (36 cm). In adults, the oval carapace is olive to brown; the broad head is gray to brown and has a protruding snout; jaws are yellow; and the neck and limbs are gray.

This species is endemic to small streams, swamps and rivers of Venezuela and Colombia. They inhabit smaller water bodies than its larger relatives and often the smaller ponds evaporate in the dry season, forcing them to aestivate in the mud. They are omnivorous, mainly feeding on vegetation, fruits, insects, worms and amphibians. The Savannah side-necked turtle is predominantly diurnal and basks on sunny days. Egg clutches usually consist of 12-15 eggs and are often laid far from water in dry savannah clay soils three times per year.

Pelomedusidae

Yellow-spotted Amazon river turtle (*Podocnemis unifilis*)

Yellow-spotted Amazon river turtles are smaller than Arraus, with shell lengths of females reaching 27 inches (68 cm) and males 14 inches (35 cm). Their carapace is brown to greenish-gray with a narrow yellow border which darkens to olive-gray with age. The head is large and the upper jaw has a distinct notch. One barbel is present on the chin in the Orinoco population and two in the



Amazon population. The gray-brown head has yellow spots on the sides of the snout and on either side of the head. Males maintain the juvenile head markings and have longer and thicker tails than females.

The Yellow-spotted turtle is found in lakes, ponds, floodplains, oxbows and lagoons along the Orinoco and Amazon rivers. This turtle is primarily a vegetarian.

Nesting season varies upon geographical location but is generally in June-July or September-October. Females dig their solitary nests away from the water and lay at least two clutches of 15-25 eggs each breeding season.

The ellipse-shaped shells have calcareous shells. Shell length of hatchlings is about 1.7 inches (4.3 cm).

Testudinidae

Yellow-footed tortoise (*Chelonoidis denticulata*)

The Yellow-footed tortoise has a thick, heavy shell that is dark brown with patches of yellow and/or orange. The limbs and head are brown with orange scales and markings. The skin is black with yellow markings on the head and lower jaw. Some scales on the tail and forelegs are bright yellow.



They usually reach a length of 16-20 inches (41 - 51 cm), however, there are reports of adults reaching lengths of 22-28 inches (56 - 71 cm). This species is a true “rainforest” species and is found in tropical evergreen and deciduous rainforest where it feeds on grasses, succulent plants, fallen fruit and carrion.

Breeding and nesting occurs throughout the year, with clutch size normally being comprised of four to eight eggs. Incubation takes four to five months.

Worldwide turtle populations have been declining at an alarming rate. Factors for this decline are many, including:

- adults are used for food
- decrease in numbers due to herbicides and insecticides
- disappearance and destruction of natural habitat
- eggs used as a major source of protein
- used for turtle oil
- used in the pet industry

SQUAMATA

(Snakes & lizards)

The largest order of reptiles is Squamata (meaning “scale reptiles”). Lizards and snakes make up this order and are found on every continent except Antarctica.

There are over 4,500 species of lizards in this order. The smallest lizard is the Monitor gecko (*Spaherodactylus parthenonpion*) measuring 1a inches (3.4 cm) in length and weighing 0.004 ounce (0.12 gr). The largest lizard is the Komodo monitor which can reach lengths of 5½ to 10 feet (1.7 to 3.0 m). Few lizards exceed one foot (0.3 m) and it is the small size which enables a large, diverse population to exist in a small area. In a forest, many different habitats exist, from the leaf litter to the tree tops. The small size of the animals also limits their geographical range. Mountain ranges and bodies of water create substantial boundaries for small species, but promote speciation (evolution of new species).

Most lizards have eyelids and external openings and cannot regulate their body temperature. Average body temperature for lizards is 107° F (42° C). Temperatures above or below this can effect ability and mobility.

Most lizard species exhibit external fertilization. Oviparity (egg-laying) is the most common mode of reproduction, but some species do demonstrate viviparity (live-bearing). Except when mating, most lizards keep a solitary existence.

Some of the lizard species include chameleons (family Chamaeleonidae), iguanas (family Iguanidae), geckos (family Gekkonidae), Gila monsters (family Helodermatidae), casque-headed lizards (family Corytophanidae), horned lizards and relatives (family Phrynosomatidae), monitors (families Varanidae and Lanthanotidae), skinks (family Scincidae) and racerunners, whiptails, and tegus (family Teiidae).

Corytophanidae

Helmeted basilisk (*Corytophanes cristatus*)

The casque or helmet of the Helmeted basilisk is triangular and supported at the back by a projection of the parietal bone (located at the back of the head). The canthus (corner or angle at either side of the eye) raises into a sharp ridge, extending as an arch over the eyes and then back. The casque continues as a vertical crest onto the shoulders. A gular (situated on the throat) flap extends from below the chin. Coloration varies from tan,



brown, to green with irregular spots and bands. The limbs and tail are long and slender. Adult Helmeted basilisks reach four to five inches (10.2-12.7 cm) in SVL (snout-vent length) and a total length of 14-15 inches (35.6-38.1 cm). There is little or no sexual dimorphism in size but the crest may be somewhat larger in males.

Helmeted basilisks use their cryptic color pattern as a defense, usually remaining motionless on a vertical limb. When threatened, they increase their apparent size by stiffening their legs to raise their body, depressing the head in order to raise the crest and expanding the throat fan. Head-bobbing, forward lunging and biting are also used if necessary. Helmeted basilisks sit and wait for their prey, feeding mostly on large insects. They are not particularly agile but can move quickly for short distances by using an awkward-appearing bipedal hop.

Helmeted basilisks inhabit dry, moist and wet forests and subtropical wet forests. They are common in the Yucatan and range from Veracruz to Panama. Five to eight eggs are laid in a shallow nest on the forest floor. The leathery eggs are 0.8 - 1 inch (2-2.5 cm) in length and weigh 0.07 - 0.1 ounce (2-2.8 gr). The eggs more than triple in weight before hatching.

Helodermatidae

Mexican beaded lizard (*Heloderma horridum alvarezii*)



Mexican beaded lizards are as long as 35 inches (90 cm). The tail makes up most of the length. The *Heloderma horridum alvarezii* is completely black and its tongue is pink. The skin or armor is composed of beaded scales containing bits of bone called osteoderms (many dinosaurs had this kind of skin). It protects the lizards from the sharp teeth and claws of their enemies. Mexican beaded lizards are relatives of monitor lizards, descending from mosasaurs, huge seagoing lizards that lived in the age of dinosaurs. Mexican beaded lizards are closely related to the Gila monsters.

The Gila monster and Mexican beaded lizard are the only two poisonous lizards. Mexican beaded lizards dribble their poison along grooves located outside of their teeth. The poison glands lie under the lower teeth. Because the poison moves slowly, these lizards must keep biting and not let go. With their strong jaws, they chew the venom into the prey. Although the poison of the Mexican beaded lizard is extremely painful and recovery may take several weeks, it is not lethal. The Mexican beaded lizard is immune to the venom of other poisonous lizards and rattlesnakes, which is deadly to most desert creatures. The long claws are used for digging. In the winter, Mexican beaded lizards stay in safe hiding places. They enter a quiet state similar to hibernation. Their burrows, called hibernacula, often attract other reptiles. Rattlesnakes, tortoises and other Mexican beaded lizards are often found in the same hibernacula. They spend more than half of their lives resting in these hibernacula. Mexican beaded lizards can eat up to half their weight at one time and store extra fat in their tail for a long sleepy winter.

After leaving the hibernacula for the season, male Mexican beaded lizards compete for the chance to mate. These savage fights may last for hours, with the larger lizard usually winning. Mexican beaded lizards mate in the spring and lay their eggs 45 days later. They lay an average clutch of 10 eggs. After an incubation period of about 10 months, the young hatch the following spring. The babies have sharp teeth and poisonous venom from the time they hatch.

Mexican beaded lizards are found in woodland areas, in the western coastal areas of Mexico and in Guatemala.

Phrynosomatidae

Blue spiny lizard (*Sceloporus serrifer*)

Spiny lizards are so-called because their scales are large, strongly keeled (ridged) and pointed or “spiny.” The Blue spiny lizard (*Sceloporus serrifer*) is the largest of all native Spiny lizards, growing up to 14 inches (35.6 cm) or more, including the tail. They are native from Southern Texas to Mexico and are found in rocky hillsides and shrublands.



Some Blue spiny lizards are bluer than others; all have blue shoulders. Females are usually quite drab in colors. Males have a metallic blue-green sheen on the back and their chin, throat and belly are also blue. Both males and females have a very distinct black-and-white collar around the neck.

Blue spiny lizards are diurnal. When they are not foraging, they spend a lot of time sheltering underground or in rocky crevices, avoiding temperature extremes or hiding from predators. They eat a variety of invertebrates but they seem to favor flying insects. They are preyed upon by birds of prey, snakes, mammals and larger lizards. Blue spiny lizards give birth to 6-20 young in February-June.

Teiidae

Caiman lizard (*Dracaena guianensis*)

Caiman lizards get their common name from the enlarged dorsal scales on their backs that resemble crocodile scutes. They have a green body, a red-orange head, short powerful limbs and a heavily muscular jaw with strong, modified molar teeth, necessary for cracking the snail's shell and removing its soft parts. Their tail is powerful, long and flattened and is used for swimming and self-defense. They also have a clear third eyelid which protects their eyes while underwater. Both sexes are similar in appearance, except the male's head is redder and broader. They are aquatic, spending most of their time in or near water. They are also excellent climbers, basking on branches overhanging the waterways. At night, they hide in trees and bushes.



Caiman lizards are large, reaching lengths of two to four feet (0.6-1.2 m) and weights up to 10 pounds (4.5 kg). They are carnivorous predators. Large freshwater snails are their primary food source, however they will digest other insects, crabs, fish, rodents and amphibians.

After mating, female Caiman lizards lay their eggs in a hole in the riverbank and then cover them up for protection. Clutch size is 8 to 10 eggs and eggs stay underground for five or six months. Once the baby lizards hatch, they are completely independent and there is no parental care given.

Caiman lizards inhabit the rainforest and swampland areas of South America in Brazil, Colombia, Ecuador, Guyana and Peru.

Snakes

Snakes are represented in the Squamata order by approximately 2,700 species. Snakes range in size from about six inches (15 cm) in length (threadsnakes and wormsnakes) to Anacondas that can reach 33 feet (10 m). They have been successful in the evolutionary tendency to lengthen the body and reduce limb size. All snakes are carnivores, lack external eardrums and have a fixed transparent scale over each eye instead of an eyelid. They generally have short tails. Snakes possess more vertebrae (some have up to 400 vertebrae, humans have only 33) which give their backbone more flexibility and facilitates their movements.

Snakes use different strategies to move: lateral undulation, rectilinear locomotion (caterpillar crawl), concertina locomotion, slide-pushing and side-winding. Rectilinear locomotion is a sneaky way of getting around allowing snakes to move close to prey without being noticed. The snake “walks” on its own skin by moving the broad scales on the belly forward and pulling the rest of the body along. The snake pushes against irregular features in the surface to move by means of lateral undulation. Concertina locomotion is the pushing of the head forward and allowing the rest of the body to coil up and so on. Slide-pushing results when the snake pushes its body forcefully in vigorous undulations in a sliding sideways motion over a smooth surface; generally when the snake is startled and tried to escape quickly. Sidewinding is used to move across smooth or soft surfaces. The snake skips across the surface, only touching the ground in two spots, moving sideways in an “s” like shape.

The mouth of a snake is small, relative to the size of its body, which can pose a problem when feeding. However, several strategies have been developed to combat this problem. Some eat large numbers of small prey, others kill large prey and eat them in small bites and others radically adjust the shape of their skull to enable them to eat prey much larger than their own size. The skull of the snake has several points where adjacent bones can move relative to one another. The two halves of the lower jaw are not fused but are joined by an elastic ligament which allows it to stretch far apart. Their skin can also stretch to accommodate large meals. Snakes consume large amounts of food so it may not be necessary for them to eat on a daily or even weekly basis; some only eat several times a year.

Snakes rely on their sense organs to hunt for prey. The forked tongue of the snake, which is thought to be evil by several religions, is actually a great source of information for the snake. The tongue is used to gather chemicals from the environment which are deposited in the Jacobson’s organ in the mouth. Here the samples are analyzed through the senses of taste and smell to give the snake information about its surroundings.

Vision is another tool used by snakes. Snakes do not have eyelids, but have a fixed transparent scale over each eye for protection. The ability for snakes to hear is questionable, since they have no external ear openings. However, some scientists believe snakes do possess the ability to hear or at least detect vibrations in the ground or the water. Some snakes (pythons and boas) have pit organs which allow them to sense a temperature increase when warm-blooded prey is nearby.

Boidae

Anaconda (Eunectes murinus)

The Anaconda, a venomless boa constrictor, is easy to distinguish from all other large constrictors by their dorsal color and pattern. The dorsal ground color is typically olive green, but may vary from greenish-brown to grayish-brown to nearly black in some specimens. Large black or brownish-black spots can be round, oval or in the shape of a crossbar.



Anacondas are very large with girths up to 3.5 feet (1.1 m), especially in snakes 15 feet (4.5 m) and longer. The head of a large Anaconda is disproportionately small when compared to the size of its body. The eyes and nose are positioned on the top of the head, which is an adaptation to the aquatic environment. In the water, the Anaconda is extremely agile and flicks its tongue constantly, using its sense of taste to find information about its environment. Longevity in the wild is unknown, but Anacondas have lived up to 32 years in captivity.

They are found in every South American country except Argentina, Chile and Uruguay. Anacondas are often found resting among vegetation or tree roots at the water's edge or lying submerged in the water. They can also be found basking on a log or branch, especially in the morning hours. After they have warmed, they find relief from the heat by resting in the shade, hiding under a large object or entering the water. During the dry season, characterized by hot temperatures, Anacondas will bury themselves in mud and become inactive, which is basically a form of aestivation. Young Anacondas fall prey to various carnivores which occur in their range.

Anacondas are known to feed upon a variety of animals including fish, amphibians, mammals and other reptiles. They use a sit-and-wait ambush strategy. An Anaconda will lie partially or totally submerged at the water's edge and wait for an animal to come and drink. The unsuspecting animal is bitten, coiled around and dragged into the water, where it is submerged and ingested. They unhinge their jaw to swallow animals that are bigger than themselves.

Reproduction can take place in or out of the water. Litter size can be from 4 to 77 young with the record being 82. Gestation period can last between five and eight months. At birth, the neonates are rather aggressive, but become more docile after a few months. The Anaconda is the world's largest or heaviest snake. The most significant threat to Anacondas is habitat destruction.

Boidae

Boa constrictor (*Boa constrictor imperator*)

The Mexican or Central American boa constrictor (*imperator*) is the northernmost subspecies. It is found from Mexico to northwestern South America. Boa constrictors are usually about ten feet (3 m) in length, although much longer ones have been recorded. Coloration is often sandy brown with a pinkish tint and dark brown marks on the back. They may forage in trees but



are mainly terrestrial, particularly the larger snakes. The diet consists mainly of birds, iguanas and small mammals. Their keen sense of smell aids in detecting the presence of other animals. As with other constrictors, they coil around and suffocate their prey, rather than crushing. The loosely hinged jaws can be stretched, enabling it to swallow animals with bodies much larger than the boa's head. The female boa constrictor bears her young alive (ovoviviparous).

There can be several dozen offspring at each birth. The offspring are 12-24 inches (30-60 cm) in length.

Viperidae

Eyelash palm viper (*Bothriechis schlegelii*)



The Eyelash palm viper gets its common name from a patch of bristly scales or “eyelashes” above each eye. The head of the slender snake is distinct from the neck. They have very long fangs and heat sensitive pits between the eyes and nostrils. Color and pattern varies greatly, depending on the geographical origin of the snake. Its venom is somewhat mild and is not considered lethal. They are arboreal snakes, equipped with a prehensile tail that allows them to climb up tree trunks, over slender branches and lianas or palm leaves. The Eyelash palm viper is fairly aggressive and primarily inhabits mid to low elevations.

Eyelash palm vipers use chemical substances called pheromones to communicate. They have been observed as high as 59½ feet (18 m) in trees, but may also be found just above the leaf litter, perched on a root. The Eyelash palm viper ranges from southern Mexico to Venezuela and Ecuador. These “sit-and-wait” predators are thought to be primarily nocturnal but are sometimes found sunning on leaves or branches. They specialize in taking a variety of prey, including small mammals, birds, bats, lizards and frogs. Eyelash palm vipers reach lengths of 22 - 36 inches (56-91cm).

One litter may contain 12-20 snakes of several different color ranges. A gestation period of 166 days was reported in Honduras. They are born live, aggressive and ready to defend themselves. Young snakes prey mainly on tree frogs. *Bothriechis schlegelii* are threatened by large mammals, other snakes, humans and disturbance of natural habitat.

Viperidae

Neotropical rattlesnake (*Crotalus durissus durissus*)

The Neotropical rattlesnake is the second longest venomous snake in Mexico.

They can reach lengths of 72 inches (183 cm), females are slightly smaller.

The head of this species is stout and broad. The brown-black diamonds on the back of the Neotropical rattlesnake, contrast to the lighter colored sides.

The back quarter of the snake turns to a solid black or brown. The underside is a solid cream to brown color. Stripes on the head and neck distinguish

Neotropical rattlesnakes from other rattlesnakes. Their venom attacks not

only the circulatory system, but also the nervous system, causing paralysis. The venom contains both hemotoxic and neurotoxic components, making it the most potent in this genus and highly dangerous. It damages the kidneys and death can occur after only a few days by kidney failure.

Nearly 75 percent of humans die, if they do not receive large quantities of serum soon after a bite.



They are crepuscular and feed on rodents, lizards and small birds. Two small pits located between their eyes sense the heat of their prey. Neotropical rattlesnakes are not extremely aggressive, but are known for their size, calmness and “arrogant” disposition. The *Crotalus durissus durissus* is found from central Mexico to Costa Rica in open, grass-rich areas and areas with low thorn bushes. They are able to climb trees and swim to catch prey.

Crotalus durissus durissus are live-bearing. The young develop in an egg capsule but break free of it at birth. Twenty to fifty babies are born (usually in August) and leave their mother in less than a day. Within seven to ten days, they shed skin for the first time, displaying their full rattle.

Viperidae

Fer-de-lance (*Bothrops atrox*)

The Fer-de-lance is the largest, most dangerous venomous snake in the Yucatán Peninsula. A dorsal view shows the head to be triangular in shape and quite distinct from the neck. Eyes are moderately large, pupils are vertically elliptical and a deep pit can be seen between each eye and nostril. Their color and pattern varies, with dorsal ground color usually being tan, brown, gray; sometimes a pinkish cast can be seen. The head is generally dark gray or brown above the chin and the sides of the head are lighter in color, often with a distinct yellowish tint. Fer-de-lances are between 43-72 inches (109-183 cm) in length.



Fer-de-lances are found in low and moderate elevations on the Atlantic slope from Tamaulipas southward through Central America to Ecuador, Colombia and Venezuela. Scattered populations are found on the Pacific slope of Chiapas and Guatemala. They are widespread in the Yucatán Peninsula but apparently are absent in the arid northwest corner. They are terrestrial, except the youthful specimens that sometimes can be found on vegetation. Adults feed predominantly on birds, small mammals, whereas juveniles consume small frogs, lizards and centipedes.

The *Bothrops asper* is live bearing (brood size is between 5-86) with newborns appearing in the summer rainy season. The mating takes place usually from October to November.

CROCODILIA

(Crocodiles, Alligators, Caimans, Gavials)

Crocodylians are aquatic reptiles that range in size from four feet (1.2 m) to a reported 30 feet (9 m). Little data is available on the life span of crocodiles in the wild. Signs of aging, such as lack of teeth, are evident in animals more than 50 years of age. One crocodylian in Australia lived 66 years in captivity. It has been speculated that some of the largest crocodylians could be close to 100 years old. There are 23 species of crocodylians (more than half considered endangered). Included in the Crocodylidae families are the crocodile, alligator, caiman and gavial subfamilies. Crocodylians date back to the dinosaur age, ranking them among the oldest surviving vertebrate life forms. They have been of major importance to the ancient cultures of Africa, Asia, Australia, China, Egypt, North America and South America. Due to their longevity, predatory nature, appearance and large size, crocodylians have always played an integral part in the folklore of many countries.

The feature that most distinguishes crocodiles from alligators, caimans and gavials is the arrangement of the fourth tooth in their narrow lower jaw. All of the crocodile's other teeth fit into pits, however, this long exposed tooth fits into a groove on the upper jaw, giving the crocodile a typical expression. In alligators, the teeth of the lower jaw are overlapped by the upper teeth, hiding them from view.

Crocodylians have no lips, therefore cannot exclude water from their mouth. They do have a secondary palate in the roof of their mouth. Air goes over this bone, down to the back of the mouth and into the pharynx and trachea. This separates the food and air so that the crocodylians can breathe while eating. When the animal submerges, muscles seal the external nostrils in the nasal plate. Crocodylians can snap their jaws together with tremendous force, crunching turtle shells and human bones. However, the muscles that open the jaws are quite weak, making it easy to keep the mouth of large crocodiles closed. The sharp-pointed, conical-shaped teeth are kept in their sockets by means of connective tissue. Their teeth are continuously replaced through life (slower with age). New teeth develop in a separate pocket on the inner side of the existing teeth. Each tooth moves into place as the old tooth breaks down or is lost. Some crocodylians may have as many as fifty sets of teeth. The tongue is wide and attached to the bottom of the mouth and does not aid in capturing its prey. The interlocking teeth at the end of the snout are better suited for grabbing and inflicting injury on prey than for chewing. Small prey, such as fish, are carefully passed from the front of the mouth

to the back and then swallowed into the cheek cavities by a quick upward movement of the head. Crocodilians tend to roll their larger prey in the water in such a way that chunks of meat are torn off and swallowed whole. The neck of the crocodilian is given extra support by the overlapping processes of its neck vertebrae. This enables them to successfully resist the fighting response of much larger creatures, thus dragging them into deep water, where they are drowned.

Crocodilians rely on their environment for body warmth. Body size influences the rate of heat loss, with larger animals having more control over thermo-regulation than juveniles. Water temperatures have less extreme variation than air temperatures, therefore, crocodilians remain close to water. They bask on land in the sunshine during the mornings and afternoons in order to raise their body temperature, but usually return to the water midday when the sun becomes stronger. Gaping of the mouth is often seen while they are basking. This may allow the crocodilian to cool its head while the remainder of its body stays heated. In extreme heat, crocodilians may bury into mud to avoid the scorching heat during the dry season. In those areas where the temperature falls below freezing, dens are dug that usually allow for some water, yet have air holes overhead. Other crocodilians burrow in order to survive during droughts. These burrows may house as many as 10 - 15 animals. Salt glands are present in all crocodiles, but not in alligators and caimans. It is thought these glands may be carried over from marine ancestors. Their prime function is probably to counter the build-up of salt following extended dehydration.

The body casing of crocodilians is made up of scales that vary in shape and strength. Crocodilians do not shed their skin like snakes, instead, they lose and replace individual scutes. Not only do these scutes provide increased protection, they also enable the transference of heat when basking. Located along the back are osteoderms (bony deposits within each scale). The osteoderms are rough in texture and are often different in color. Crocodiles with bellies free of osteoderms are much preferred for commercial purposes. The tail has no osteoderms, but it does have a double row of thick scutes that aid in swimming.

Crocodilians mainly swim by the thrust from their powerful tails. The webbed feet may help a little, but they are normally kept close to the body when in the water. The legs are used in their "high-walking" gait, when moving quickly overland to catch prey. Some crocodilians can move at speeds of more than ten miles (16 km) per hour, but only for a very short distance.

Crocodylians are normally quite sluggish, except when feeding, when they often switch to anaerobic (absence of oxygen) metabolism. The concentration of lactic acid in the blood rises during an attack and falls after the catch is complete. Oxygen lowers the lactic acid level, however, an extended struggle may result in over-exertion and death from acidosis (an abnormal acidity of the blood).

Smaller-snouted crocodylians have more mobility in water, but less variety in prey. Crocodylians are excellent opportunistic hunters. With only the eyes and sometimes the tip of the snout showing, they can look for unsuspecting prey. The eyes are close together, allowing for binocular vision. When hunting at night, their eyes have a slit-like pupil that allows more light to enter and register on the retina than would be possible if the pupil was round. A layer of cells at the back of the retina directs light going through the eye, back to the retina. This improves the images that are seen and explains the glow of their eyes at night when light shines on them. Both cones and rods form the retina, giving crocodylian color vision. As previously mentioned, a protective membrane over their eyes, allows crocodiles to see underwater. A large portion of their small brain is allotted to olfactory stimuli, resulting in a keen sense of smell. Hearing is also sharp. Flaps of tissue cover the ear opening when submerged.

Crocodylians are sensitive to a wide frequency range. The use of communication by vocalization is unique among crocodylians. "Bellowing" is somewhat like the roar of a lion, with males having a lower pitch than females. Hatchlings grunt or bark, a sound that is often mimicked by hunters to lure adult crocodiles. Headslapping is also used for communication. The lower jaw rests on top of the water and the upper jaw slaps closed, causing a loud pop, followed by a splash. Headslapping is also used as a sign of dominance. Some species communicate by head slapping underwater and blowing bubbles. Tail thrashing is another means of communicating. An "infra-sound" that is barely audible occurs when the crocodile nears the water's surface and twitches its body, causing reverberating waves.

All crocodylians reproduce by means of eggs. Sexual maturity is indicated by size, around six feet (1.8 m) in length, a length attained at about 10-12 years of age.

The Order Crocodylia contains three families. These include the Alligatoridae, Crocodylidae and Gavialidae Families.

Alligatoridae

Dwarf caimans (*Paleosuchus palpebrosus*)

Dwarf caimans (*Paleosuchus palpebrosus*) are dark reddish-brown. They are heavily armored on their back and stomach, this provides protection from predators. Their head is short and smooth with a high skull and an upturned long snout. The head is void of bony ridges between the eyes. The dorsal surface is mostly plain, while the upper and bottom jaws are covered with several dark and light spots. The tail is marked with encircling bands to the tip. The eyes are brown. Their fourth tooth on each side of the bottom jaw fits into a socket within the upper jaw and is not visible when the jaws are closed.



They are a nocturnal hunter, preferring to spend the daylight hours basking in the sun. When in pairs or small groups, they are known to migrate long distances due to competition. This species is the smallest living crocodylian. Males grow to about 4.3 - 4.9 feet (1.3-1.5 m) and the females grow to about 4 feet (1.2 m). The diet differs for the young and adults. The young feed on insects, crabs, frogs, tadpoles, shrimp, snails and small fish. Adults feed on fish, frogs, tadpoles, snails, small mammals and a wide variety of insects. Their prey is usually swallowed whole or in large pieces.

They communicate through sounds, postures, movements, smells, and touch. Non-verbal communication is done by head-slapping or jaw-clapping at the water's surface. During courtship males emit a grunt-like "chumph" sound. They have small sensory organs on the head.

Female caimans build mound nests using soil mixed with rotten and green leaves, grasses and twigs. The nest contains an egg chamber at the center, where anywhere from 10 to 25 white, oblong, shaped eggs are laid. The eggs are incubated for about 2.5 - 3 months and during this time the mother guards the nest. The nest is opened by the female in response to vocalizations of the young. After the young hatch from their eggs, they stay beneath the debris of the nest for several days before venturing out on their own

Dwarf caimans prefer clean, clear, fast-moving streams or rivers in forested areas containing waterfalls and rapids. They are widespread throughout the Orinoco and Amazon basins, inhabiting areas extending from Colombia, Venezuela and the Guianas, south to Sao Paulo and the upper Rio Paraguay in southern Brazil and west to the Rio Pastaza in Ecuador.

Crocodylidae

Morelet's crocodile (*Crocodylus moreletii*)

The Morelet's is a small Central American crocodile, usually reaching lengths of 10-14 feet (3-4.3 m). Until the 1920s, it was confused with both the American and Cuban crocodiles. The main distinction is its unusually broad snout. The iris is silvery-brown in color. Morelet's crocodiles have 66-68 teeth. The teeth in the upper and lower jaws are in perfect alignment, which distinguishes all crocodiles from alligators. The fourth tooth, on either side of the bottom jaw, is slightly larger than the other teeth and is visible when the mouth is closed.



Morelet's crocodiles are similar in color to the American crocodile, but are somewhat darker. They are a dark grayish-brown in color, with even darker bands and spots on the body and tail. The dorsal is irregular and the neck scales are heavy. The body lacks ventral osteoderms and is highly valuable for tanning. The legs are powerful and end in clawed, webbed feet. The tail is also very powerful and allows Morelet's crocodiles to swim with powerful thrusts. Juveniles are bright yellow in color with black bands. There are no subspecies of Morelet's crocodiles.

The nostrils are situated at the end of the snout; behind the snout are the eyes and behind the eyes are the ears. These three sensory receptors are all located on the same plane on the top of the head, allowing it to stay almost completely submerged underwater, while still being able to see, hear and smell. The eyes have a special eyelid called a nictitating membrane, which is a clear eyelid that covers and protects the eye while underwater.

Appetites of Morelet's crocodiles vary according to age and size. Juveniles eat small invertebrates and fish. Adolescents feed on aquatic snails, fish, small birds and mammals. Older and larger crocodiles feed on larger prey, including domestic animals such as dogs, birds, fish, lizards and Kinosternon mud turtles. They can also be cannibalistic, eating young juveniles. Morelet's crocodiles are generally shy around humans, but 14 feet (4.3 m) specimens may attack.

Morelet's crocodiles are found in northern and central coastal Belize, as well as areas in Mexico and Guatemala. They seem to prefer freshwater and are found mainly in swamps, marshes, rivers and lakes in forested areas. They will also live in brackish waters (areas where salt and freshwater meet). They can also be found in lowland rivers and ponds. Their range overlaps that of the American crocodile.

Morelet's crocodiles have the distinction of being the only North American crocodile to build only mound nests (not mound and hole nests). The breeding season starts before the rainy season. Approximately 20-45 eggs are laid in a mound nest near the water or on floating vegetation. Nests may contain eggs from more than one female. Females guard the nest for 80 days, after which the eggs hatch. Both parents protect the juveniles from enemies. Captive Morelet's crocodiles have also escaped from farms to form feral populations in Mexico outside of their regular breeding area.

Crocodylidae

Orinoco crocodile (*Crocodylus intermedius*)



The Orinoco crocodile is a relatively large species with a long, slightly upward-curving snout. They have symmetrical dorsal armor with six prominent scutes (strong scales) on the back of the neck. There are three color phases which occur in the Orinoco crocodile (mariposo (Spanish for butterfly)-grayish green body and dark dorsal patches; amarillo Spanish for yellow)-the most common coloration with a light, tan body and scattered dark areas; and negro (Spanish for black)-uniformly dark gray). Changes in color have been observed in captivity over long periods of time.

Orinoco crocodiles have a total of 68 teeth. If they lose a tooth, it is replaced, although this process slows with age. They have up to 50 sets of teeth. The largest males today seldom exceed 16 feet (5 m).

The Orinoco crocodile is found in the quiet waters and lagoons of the Orinoco River basin in eastern Colombia and Venezuela. Juveniles eat small fish and invertebrates. Larger animals take many aquatic vertebrates, including fish. They also take terrestrial mammals or birds which are approaching or entering the water.

A hole nest is excavated from sandbars which are exposed during the annual dry season (January to February). Clutch size is from 15 to 70 eggs. The eggs hatch two months later with the onset of the wet season and a rise in the water level. Females protect the young pod for one to three years. The Orinoco crocodile aestivates in holes dug in the river banks during the annual dry season when water levels become very low.

RADICAL REPTILE FACTS

- Some snakes have 400 vertebrae - humans only have 33
- Female snakes are almost always larger than males
- When a 120 pound (54 kg) person closes its mouth, the jaw pressure is about 60 pounds (27 kg), when a 120 pound (54 kg) crocodile closes its mouth the pressure rises to 1500 pounds (680 kg).
- Snakes do not have to open their mouth to flick their tongues. They have a notch in the upper lip to put it through.
- Legend has it that rattlesnakes coil clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere.

USEFUL VOCABULARY

acidosis	abnormal acidity in the blood
adaptation	adjustment to environmental conditions
aestivate	to spend the summer
agile	quick and easy of movement
allantois	an embryonic sac from the digestive tract that stores waste and allows oxygen and carbon dioxide in and out of the egg
amarillo	yellow (Spanish)
ambush	lying in wait to attack
amnion	sac in which the embryo is suspended
amniote	any vertebrae characterized by having an egg with an amnion
anaerobic	caused by absence of oxygen
analyze	to separate into parts to determine the nature, proportion or function
ancestors	an animal from which later generations have evolved
annuli	series of rings or folds that may aid in locomotion
aperture	an opening, hole or gap
aquatic	relating to water
arboreal	adapted for living in trees
armor	a protective coating
barbel	an organ of touch found on the lips or jaw of certain animals
basin	all the land drained by a river and its branches
bask	to be exposed to a pleasant warmth, lie in the sun
bellow	to utter loudly or powerfully
binocular	involving two eyes
bipedal	two feet
bladder	a sac in the abdomen which receives urin from the kidneys and stores it for excretion
brackish	a mixture of seawater and fresh water
burrows	tunnels or holes; digs tunnels or holes
calcareous	containing calcium carbonate, calcium or lime
camouflage	a disguise or concealment
canopy	the largest and most active layer of the rainforest (ranging from 60-100 feet (18 - 31 m))
canthus	corner or angle at either side of the eye
captivity	being confined; imprisoned; constrained
carapace	the horny, protective covering over all or part of the back of certain animals
carbon dioxide	a heavy, colorless gas; absorbed from the air by plants in photosynthesis (CO ₂)

carnivore	flesh-eating
casque	helmetlike structure or protuberance
caudal autonomy	ability to regenerate the tail
chamber	an enclosed space or compartment
clutch	a hatch, the number of eggs laid at one time
cold-blooded	body temperature varies with environment
coloration	the way something is colored
cone	flask-shaped cells found in the retina of most vertebrates, sensitive to bright light and color
confiscated	taken or seized by authorities
congregation	a gathering
conical-shaped	cone shaped, narrow pointed top
coniferous	a tree bearing cones and evergreen needle-like or scale-like leaves
conservation	a careful preservation and protection of something
constriction	making smaller or narrower by binding, squeezing or shrinking continent one of the usual seven divisions of land on the globe
costal	of or relating to or near a rib
crepuscular	becoming active at twilight or before sunrise
deciduous	tree or shrub that sheds its leaves annually
dehydration	the act of losing water
destruction	the action or process of destroying something
dewlap	a loose fold of skin hanging from the throat of an animal
digit	a finger or toe
dimorphism	existence among animals of the same species of two distinct forms that differ in one or more characteristics, such as coloration, size, or shape
display	showy exhibition, ostentation
diverse	differing from one another
docile	easy to manage or discipline
dorsal	of, on or near the back
drought	dry weather, lack of rain
egg	a reproductive cell produced by the female
egg-tooth	a sharp projection of skin at the tip of the upper jaw used to break the eggshell
elastic	able to spring back to its original shape or position after being squeezed or stretched
elongate	to make longer or stretch
embryo	an animal in the earliest stages of development in the uterus or egg
endangered	threatened, in imminent peril
environment	surroundings or external conditions

evolution	process of gradual, progressive development from a simple to an advanced form
excavated	to make a hole or cavity in
external	outside the body
extinct	not existing now, died out
exuvia	castoff coverings of animals
fertilization	to make a female's egg fertile by pollinating or impregnating with the male gamete
flask-shaped	pear-shaped
floodplain	a flat region or valley floor surrounding a stream channel into which the stream overflows during flooding
forage	search for food
fossil	hardened remains or imprints of plant or animal life of a previous geologic period
fuse	to unite as if by melting together; blend
gait	manner of moving on foot; rate of moving
gaping	open, with mouth open
gastroliths	a calculous mass or stone in the stomach
gelatinous	viscous; having a relatively high resistance to flow
gestation	pregnancy
gill	the organ for breathing for most aquatic animals
gland	any organ or specialized group of cells that produces secretions
granular	containing or consisting of grains
gular	of or pertaining to the throat
habitat	the place where a plant or animal naturally lives or grows
hatchling	a recently hatched bird, turtle, fish, etc.
headslapping	the sudden closing of the mouth that makes a loud noise and splash
helmeted	equipped with or wearing a helmet; helmet-like appendage
hemotoxic	causing blood poisoning
herbicide	any chemical substance used to destroy plants, especially weeds
herbivore	a plant-eating animal
hibernacule	winter quarters for a hibernating animal
hibernation	spend the winter in a dormant state
horny	toughened or calloused
immune	resistance to an infection
incubation	to keep eggs in a favorable environment for hatching or developing
infrared	invisible rays just beyond the red end of the visible spectrum
insecticide	any substance used to kill insects
insectivore	any animal or plant that feeds mainly on insects

internal	inside the body
interval	a period of time between two points of time
invertebrate	having no backbone or spinal column
irrigation	to refresh by watering
juvenile	a young plant or animal
keel	a longitudinal ridge
lagoon	a shallow lake or pond
larvae	the early, immature form of an animal which becomes an adult through metamorphosis
ligament	a band of tough tissue connecting bones or holding organs in place
limb	an arm, leg or wing
locomotion	motion or the power of moving
longevity	the length or duration of life
longitudinal	running lengthwise
lubricant	a substance for reducing friction
lung	either of two respiratory organs in vertebrates that oxygenate the blood and remove carbon dioxide from it
malnourished	improperly nourished
mangrove	a group of tropical woody plants that are highly tolerant of immersion in saltwater
marine	of or relating to the sea
maternal	derived, received or inherited from a mother
membrane	a thin layer of tissue
metabolism	process by which energy is made available
metamorphosis	to change form, shape or structure
mosasaurs	huge seagoing lizards that live in the age of dinosaurs
mucous	of, containing or secreting mucus
murky	dirty or cloudy
musk	a strong-smelling substance secreted by animals
neonate	a newly born individual
neurotoxic	poisonous to nerves or nerve tissues
nictating membrane	a transparent inner eyelid in some animals that closes to protect and moisten the eye
nocturnal	active at night
odor	a smell, fragrance or stench
offspring	a child or animal as related to its parent
olfactory	smell

omnivore	eating both plants and animals
opportunistic	adapting one's actions to circumstances in order to further one's immediate interests
order	rank in a community
organ	in plants and animals, a part of specialized tissues adapted for a specific function
osteoderm	bony deposits in the scutes
oviparous	eggs that mature and hatch after being expelled from the body
ovoviviparous	eggs develop within the female (unlike oviparous), and the embryo gains no nutritional substances from the female (unlike viviparous); also known as oviviparous
oxbow	the bend of a river shaped like the U-part of an ox yoke
oxygen	colorless, tasteless gas found in our atmosphere (O ₂)
palate	roof of the mouth
parotoid gland	is an external skin gland on the back, neck and shoulder
parietal	located at the back of the head
partition	divider; separator
permeable	open to passage or penetration, usually by fluids
pharynx	tube that connects the mouth and nasal passages with the esophagus
pheromones	chemical substances
pigment	any coloring matter in the cells and tissues of plants and animals
placenta	the lining of the uterus which bears the eggs
plastron	the lower part of the shell of a turtle or tortoise
plates	a thin layer or scale usually of bone or horny tissue
poikilothermic	having a body temperature that varies with the environment
pollution	a substance which contaminates or corrupts an area
population	the whole number of people or inhabitants in a country or region
porous	with minute openings
potential	capable of development
predator	living by capturing and feeding on other animals
prehensile	adapted for seizing or grasping
prey	an animal hunted or killed for food by another animal
pungent	having a sharply strong taste or smell
pupil	the circular (usually black) opening in the iris of an eye
radiation	the process of sending out waves or rays
range	to live or occur in or be native to a specific region
regenerate	to grow anew

regulate	to control or maintain
resistant	to withstand, oppose or fend off
reticulation	mark with lines resembling a network
retina	the innermost lining of the eyeball
rod	rod-shaped cells in the retina of a vertebrate that are sensitive to dim light
sargassum	a brown seaweed with berry-like air bladders, typically floating in large masses
scale	horny plates that form the covering
scute	strong scales
secrete	to release
serrated	having marginal teeth pointing forward
shell	a hard outer covering
side-winding	a form of locomotion (used by snakes) by looping its body sideways
skeleton	rigid support or protective framework of an organism
slough	the skin of a snake, periodically cast off
snout	the projecting nose and jaws, or muzzle of an animal
socket	a bony hollow in which a structure fits
soil	loose surface material of the earth in which plants grow
solitary	living or being alone
speciation	the process of developing new species through evolution
species	a class of organisms having common attributes and designated by common names
submerge	to place under or cover with water
subtropical	the regions bordering the tropical zone
symmetrical	regular in form, arranged correspondingly
temperature	degree of heat
terrestrial	relating to land
territory	area that an animal defends against intruders
threatened	likely in the near future to become endangered
trachea	windpipe, tube that conveys the air to and from the lungs
transparent	so clear that objects on the other side may be seen
tropical	located in the tropics
vegetation	plant life
vent	an external opening in birds, reptiles, amphibians and fish
vertebrate	having a backbone or spinal column
vulnerable	can be wounded or physically injured
warm-blooded	having a body temperature that remains relatively constant
webbing	a membrane joining the digits

AMPHIBIANS

Amphibians are vertebrate animals, terrestrial or aquatic, with most having the following features:

- cold-blooded (poikilothermic)
- some breathe air by means of lungs, others have gills either during larval stage or throughout life
- metamorphosis is usually present in development
- skin is smooth, moist and permeable with many glands (some of which may be poison glands), pigment cells common and no scales
- mostly internal fertilization in salamanders and caecilians; mostly external in frogs and toads
- usually have four limbs although some are legless
- have a three-chambered heart
- have moderately yolky eggs with jelly-like membrane coverings
- are predominantly oviparous
- feed on insects or other small invertebrates
- skeleton is mostly bony with varying number of vertebrae

There are three orders of amphibians:

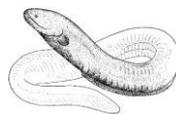
1) ANURA - Frogs and Toads



2) CAUDATA - Salamanders and Newts



3) GYMNOPTIONA - Caecilians



ANURANS (Frogs & Toads)

The order Anura has more than 4,000 species. Salamanders are often mistaken as lizards, Caecilians are thought of as worms, but there is no mistaking frogs and toads. There are some differences between frogs and toads -- frogs are sometimes believed to be smooth and slimy, while toads are dry and bumpy; frogs are generally closer to (or in) water. While these differences are relatively true, toads have shorter legs and they tend to walk instead of hop. Frogs' legs are longer and stronger and are built for jumping. The bones and muscles in their legs are elongated to improve their ability to leap. When specific species of frogs and toads are studied, other adaptations to their environment may be observed.

Vision and hearing are important to frogs and toads. Their eyes are generally large and set high on their head to provide a large field of vision. The eyeballs can be retracted into sockets to help the frog swallow by pushing against the roof of the mouth. Hearing is important in breeding and establishing territory.

In the mid-1990s, the decline of amphibian populations (usually that of frogs) created a concern. Frogs are now considered an "indicator species", meaning they are letting us know that our environment may be in big trouble. The declining population and drastic deformities are seen by many scientists as a warning to humans. Although deformed frogs have been observed in 35 states since 1986, the gravity of the problem was not identified until 1995. Scientists are still trying to determine whether the abnormalities are caused by natural or man-made sources and if they are terrestrial or airborne. Abnormalities range from frogs with missing eyes or limbs to those with three or more hind limbs. Reproductive organs are also often missing or deformed.

Some of the 25 families in the Order Anura are: Bufonidae, Centrolenidae, Dendrobatidae, Discoglossidae, Hylidae, Hyperolidae, Leptodactylidae, Microhylidae, Myobatrachidae, Pelobatidae, Pipidae, Pseudidae, Ranidae and Rhinophrynidae. The Dallas World Aquarium has many interesting species of frogs and toads (orders underlined) both on display and off-exhibit, with a few of those more frequently displayed, described below.

ANURANS

Dendrobatidae

Yellow and black poison dart frog (*Dendrobates leucomelas*)



Blue poison dart frog (*Dendrobates azureus*)



Dyeing poison dart frog (*Dendrobates tinctorius*)



Green and black poison dart frog (*Dendrobates auratus*)



These are brightly colored frogs that grow to about one inch (2.5 cm) in length. The skin gland secretes a poison. The most colorful frogs are the most poisonous and the least shy. They have adhesive pads on their toes to agilely climb trees in search of insects. They must keep their skin moist. Males are generally slightly smaller than females, but stockier. They are found on the forest floor and among the trees in rainforests in Central and South America.

They eat small insects such as ants and spiders. Their skin secretions become poisonous when they eat a specific combination of ants and plants. Without this certain mixture, the frogs are not poisonous.

Breeding occurs during the humid or rainy season. Females lay small batches of eggs about every three weeks during the wet season. The female carries her tadpoles from the floor of the forest, up into the canopy and puts them in a small puddle inside a bromeliad. They emerge as frogs. This is safer than the river where they would likely be eaten.

Their bright colors send messages to potential predators that they are deadly. The call of the poison dart frog varies from species to species, but all are difficult for humans to distinguish. The males are fairly territorial. They will stay in one place for days or weeks using their low calls to designate it as their territory. Males of the same species will space themselves 10 - 13 ft (3-4 m) apart. Their lack of predators allows these frogs to be diurnal.

South American Indians kill them and use their powerful poison to coat the tips of their arrows and blow darts. One frog produces enough poison for 40-50 darts. The strength of the poison varies with the species. It is reported that a single Golden poison frog, contains enough poison to kill 10 people.

Pipidae

Surinam toad (*Pipa pipa*)



The average length of the Surinam toad is four to five inches (10-13 cm) but can reach eight inches (20 cm). Females are normally larger and fleshier. They have a flattened body with a triangular shaped head; hind legs are powerful with webbed feet. In contrast, the forelimbs are short with star-shaped fingers and no webs. These fingertips have tiny “feelers” on the end, used when searching for food. These aquatic omnivores eat worms, insects, crustaceans and small fish.

Native to northern South America, they are found in murky ponds and swamps and spend most of their time resting underwater. They can stay submerged for more than one hour, but usually come to the surface every thirty minutes.

Mating begins when males use a series of clicking sounds while under water. The female releases eggs which are received by the male who fertilizes them and allows them to roll onto the back of the female. The eggs sink into the skin and form pockets over a period of several days, eventually taking on the appearance of a honey comb structure. The female carries the eggs until they are fully developed and emerge as miniature adults. Approximately 100 eggs are laid and fertilized.

Leptodactylidae

Ornate horned frog (*Ceratophys ornata*)

Ornate horned frogs are round, plump amphibians that grow to six inches (15 cm) in length; females are slightly larger than males. They are green with dark red to black markings along their back. Their mouth appears to extend around the entire body, giving them the nickname of “Pac-man frogs.”

When lunging toward their prey, they appear to be all mouth. They are passive hunters, waiting for food to come to them before attacking. Insects, lizards, mice and other frogs make up their diet. The common name, horned frog, comes from the folds of skin located over their eyes.



Native to South America, Ornate horned frogs burrow in leafy, muddy vegetation of tropical forest floors.

Females deposit 1,000-2,000 eggs in standing water. It takes only two weeks for the eggs to hatch and for the young to develop into small frogs. Average life span is six years.

Bufo

Marine or Cane toad (*Bufo marinus*)

Marine toads are distinguished by deeply pitted parotoid glands extending far down the sides of their bodies. They are usually brown or gray-brown on the top, with cream spots scattered across the back, sides and legs. The underside is creamy yellow, sometimes flecked with black. The back and legs are covered with spiny warts. They have an average length of six to nine inches (15 to 23 cm), but may grow larger.



The Marine toad sits in an upright position; when it moves, it hops in short fast hops. During cold or dry seasons, it will remain inactive in a shallow burrow. Marine toads are omnivorous, eating just about anything, including insects, vegetation, small birds and snakes. Toads do not

cause property damage, but their skin secretions are highly toxic to dogs, cats and other animals and can cause skin irritation in humans. When confronted by a predator, it is able to “shoot” the toxin.

Breeding occurs from early spring to autumn, during or soon after rains. Native habitat is from the Amazon basin in South America, through Central America to extreme southern Texas. *Bufo marinus* were also successfully introduced in Hawaii, Mauritius, Fiji, Philippines, Taiwan, Ryukyu Islands, New Guinea, Australia and many Pacific islands. Marine toads have been described as “the most introduced amphibian in the world.” They have been introduced throughout the world as control agents for insects. In many areas, the population has increased to the point of being declared a public nuisance.

Panamanian golden frog (*Atelopus zeteki*)

Adult males and females have similar coloration, ranging from a deep yellowish gold to light yellow or greenish yellow. Adults may also have black markings, which are absent on sub-adults and juveniles. The undersides of all ages are bright yellow. Females, who are larger than males, measure 1¾ - 2½ inches (4.4 - 6.4 cm) in length and weigh 0.14-0.53 ounces (4 - 15 gr). Found along dry forest and wet forest streams, frogs in dry forest stream areas are two-thirds larger than those in wet forest stream areas.



Panamanian golden frogs are diurnal and active mostly during the morning and early evening when they hop about the forest floor in search of food and mates. Voice calls or chirps are used by males to attract mates and claim territories. Males also wave their hands, literally letting others know the territory is taken. This behavior, known as semaphoring, probably resulted from environments where vocal calls were drowned out by noisy, fast-flowing streams. Their keen eyesight is helpful in locating a variety of small invertebrates (beetles, flies, wasps, ants, spiders, caterpillars, etc.) included in their diet.

Males are known to be very persistent, clinging to a female for days, just “waiting” on her back (amplexus) until the moment she is finally fertile. Eggs are laid at the onset of the dry season when the streams are slower and lower. An average clutch size is 370 and metamorphosis takes from four to eight months, depending on water conditions.

The *Atelopus zeteki* inhabits areas along streams in western-central Panama. They are found in two habitat types – wet forest streams and dry forest streams. The population density of Panamanian golden frogs is higher in dry forests than in wet forests. Listed as Critically Endangered on the 2007 IUCN Red List of Threatened Species and CITES Appendix I, the Panamanian golden frog is believed to be extinct in its natural habitat. In addition to deforestation, water pollution and over collection, an infectious disease (chytridiomycosis), contributing to a worldwide amphibian decline, has had a dramatic effect on the *Atelopus zeteki*. Amphibians breathe and drink through their papery-thin skins, resulting in suffocation of the frogs as the disease swept across their habitats.

Hylidae

Hourglass tree frog (*Hyla ebraccata*)

Hourglass tree frogs are highly variable in shape, but often take the form of an “hourglass.” The back is yellow or yellowish tan and uniformly covered with brown dorsal markings. The side of the head is mostly brown, with a distinct cream upper stripe which runs from the lip to the eye and usually is expanded to a pale spot below the eye. Thighs are uniformly pale orange or yellow; the upper arms, flanks, hands and feet are pale yellow. The underside is cream and the iris is reddish bronze.



Males are 0.94 -1.06 inches (2.4 - 2.7 cm) long and females are 1.18 - 1.34 inches (3.0 - 3.4 cm). Hourglass tree frogs are nocturnal, arboreal frogs. They presumably spend most of their non-breeding time in forest trees and in bromeliads. During the rainy season, they call from low emergent vegetation at the edge of a pond, from dusk throughout most of the night.

Hourglass tree frogs live high in the rainforest canopy for most of the year. During the rainy season, they descend to swamps and ponds in the rainforest for breeding. Males sing from exposed perches, hoping to lure a female, but trying at the same time to avoid being eaten. Their small size puts them at great risk of predation when breeding. Cat-eyed snakes and Frog-eating spiders are among the most common threats, but Bulldog fishing bats and other winged predators are also threats. If breeding is successful, the female lays eggs in clumps (24 - 76 eggs)

in a single layer on the upper surfaces of leaves above water. The leaf eventually falls into the water where, the eggs hatch into beautiful gold and black-striped tadpoles. Tadpoles quickly grow and metamorphose into frogs. The young frogs head for the trees until the next breeding season.

Red-eyed tree frog (*Agalychnis callidryas*)

The Red-eyed tree frog has bright red, bulging eyes to startle its predators. The body is bright green and the sides are blue with pale yellow stripes. The feet are reddish orange and the upper legs are blue. They have long, powerful jumping legs. The suction cups on the toes are important for mating, sleeping and eating. Even though Red-eyed tree frogs spend a large portion of their time in trees, they are good swimmers.



The average size of *Agalychnis callidryas* is no more than three inches (7.6 cm). They are nocturnal and rest on the undersides of large leaves during the day.

Some bats, snakes and birds eat the Red-eyed tree frog. The carnivorous amphibian feeds on crickets, moths, flies, grasshoppers and sometimes even smaller frogs. Basically, they will eat any insect or food item that they can fit into their mouth.

Red-eyed tree frogs have a very musical mating ritual. When one male starts croaking, the rest of the males in the area chime in as well. This "song" is sung to attract the females. The croaking continues as the males jump from leaf to leaf to establish a territory. The males inflate their vocal sacs and rise on all fours to deter males from their territory and to attract females. Red-eyed tree frogs spend their lives near water because they must return to the water to lay their eggs. Female Red-eyed tree frogs lay eggs on the undersides of leaves, above the water and the male fertilizes the eggs as they are deposited. When the eggs hatch into tiny brown tadpoles, they fall into the water below. As they mature, they lose their tail, develop lungs and become brightly colored.

Mexican tree frog (*Smilisca baudinii*)

The Mexican tree frog is generally a gray-brown in color, with darker brown irregular blotching. Their underside is typically a lighter gray or white. Their legs have distinctive dark banding. A dark band runs from the snout to above the forelimbs. Females tend to be larger and have more truncated snouts and a rounder body shape. The females of this species often have a snout-to-vent length of up to three inches (8 cm); males usually slightly smaller reach two inches (5.5 cm). These nocturnal, arboreal amphibians find shelter under loose tree bark, in damp soil or in fallen logs during the dry season. They are generally found in the lower levels of forest where they eat such invertebrates as grasshoppers, roaches and spiders. Frog-eating snakes are their main predators.



A few nights after strong rains of the wet season, males can be heard giving deep “bonks”, repeated up to six times. Mexican tree frogs typically call in duets, and the initial calls of a duet cause other duets to respond.

Following rains, Mexican tree frogs move to and from wetlands to breed. Breeding sites are small, temporary pools where eggs are initially deposited as clusters and then disperse into a surface film.

CAUDATA

The order Caudata (meaning “provided with a tail”) has more than 500 recognized species of salamanders, newts, sirens, amphiuma, waterdogs and mudpuppies. They range in size from the Lungless salamander (*Thorius*) which only reaches one inch (2.5 cm) in length to the Chinese giant salamander (*Andrias davidianus*) which grows to six feet (1.8 m).

Salamanders can be mistaken for lizards because of their many similarities, however they lack scales. Like lizards, salamanders are able to regenerate their tails after they have been lost, usually to escape danger. Salamanders and newts periodically shed their skin because they continue to grow after reaching adulthood. Once they shed the top layer of skin, called the slough or exuvia, they typically eat it. This provides a rich source of nutrients for the animal.

Salamanders have mucous, granular and mixed glands distributed over their body. The mucous gland helps to keep the animal moist, even when out of the water, and acts as a lubricant when swimming. The granular gland may secrete toxins or odors for self-defense. The third gland produces a mixture of both substances. There are ten families in the Order Caudata. The Ambystomatidae family is of interest to The Dallas World Aquarium.

CAUDATA

Ambystomatidae

Axolotl (Ambystoma mexicanum)



Axolotls are also known as Mexican walking fish. Their name stems from an Aztec word meaning “water dog” or “water monster.”

Axolotls have cylindrical bodies, short legs, a relatively long tail and feathery external gills. They have four toes on the front feet, five toes on the back feet and moveable eyelids. They are known for their blunt snouts and large mouths. Adult Axolotls can reach

approximately 12 inches (30 cm) in length from nose to tip of the tail and can weigh as much as 10½ ounces (300 gr). Aggressive toward one another, the Axolotl will bite off each others gills, feet and tails.

Body parts of the *Ambystoma mexicanum* will regenerate. Axolotls are amphibians, their body and gills must remain moist so they can breathe. The Axolotl differs from other amphibians in that it spends its entire life in the water, in larval stage. Should the Axolotl undergo metamorphosis, it is transformed into the Mexican salamander. It is one of the amphibian species exhibiting neoteny (can live out its life and successfully breed as a larva). The Axolotl has the ability to remain as a larva and this is its normal state. Some sources say Axolotls can be induced to complete metamorphosis under a variety of conditions, including certain environmental stresses and treatment with thyroid hormone. Once they have gone through metamorphosis, regeneration is no longer possible, or greatly reduced and life span is shortened. Axolotls are nocturnal animals that avoid light.

The Axolotl was originally native to Xochimilco and Chalco, two freshwater lakes south of Mexico City. Chalco is now gone and Xochimilco survives only as a network of canals and lagoons. These bodies of water are muddy bottomed and rich in plant and animal life.

Axolotls become sexually mature at about 18 months, while still in their aquatic larval form. After the courtship dance, the female Axolotl takes up the sperm capsule deposited by the male. Eggs are laid individually, usually on plants. There may be between one hundred and over a thousand eggs laid in one spawning, depending on the size of the female. Eggs hatch after 14 days at 75°F (24°C), and after a few hours, the larvae will begin to eat anything small enough to fit in their mouths.

GYMNOPHIONA

(Caecilians)

The order Gymnophiona is made up of burrowing amphibians which closely resemble worms – Caecilians. They are found in tropical and subtropical zones. Although the name Caecilians means blind, they do have small eyes. This little known order of amphibians contains 154 species. These legless amphibians range in size from the 4a inches (11 cm), *Grandisonia brevis*, to the *Caecilia thomsoni* of South America, which may reach lengths up to 5 feet (1.5 m).

The shape of their head allows Caecilians to burrow through the soil and build tunnels. Their small eyes are an adaptation because of the lack of light they encounter. They are equipped with tentacles on either side of their snout which are thought to be organs of taste and smell. The body of the Caecilian is made up of a series of rings or folds called annuli which are thought to aid in locomotion. Some Caecilians are oviparous (egg-layers), some viviparous (livebearers) and a few are ovoviviparous (eggs hatch inside the mother and the young live in her until maturity).

Caecilians are carnivorous (mainly insectivores, but occasionally eat earthworms, small frogs and lizards). The main predators of the Caecilians are snakes. There are five or six recognized families in the Order Gymnophiona.

Typhlonectidae

Aquatic Caecilian (*Typhlonectes natans*)



Typhlonectes is the genus of fully aquatic Caecilians found only in South America. Although the *Typhlonectes natans* spends its entire life in water, you can observe it coming to the surface to fill its lungs with air. It resembles a smooth, rubbery tube that is dark grayish-lavender in color. They can reach lengths of 18 to 22 inches (46-56 cm). Their eyesight is very poor and they search for their food (fish and aquatic invertebrates) mainly by smell. The *Typhlonectes natans* is viviparous, giving birth to fully formed young. Due to the long gestation period (six to nine months), females breed no more than every second year and seem to have a low number of offspring.

Amazing Amphibian Facts

- When confronted by a predator, toads gulp lots of air so they appear bigger.
- The frog with the greatest leap is the *Rana fasciata* - it hops 14 feet (4.2 m).
- Most newts and salamanders are found in North America, with a few found in Europe and Asia. No species are known to exist in the Southern Hemisphere!
- Caecilians may look like earthworms, but are much faster and more energetic; can be very difficult to catch.
- When the terms frog and toad were coined there were only two species of anurans, the frog (now known as *Rana temporaria*) and the toad (now known as *Bufo bufo*).

USEFUL VOCABULARY

adhesive	sticking and not coming loose
blotching	covering with irregular patches or unsightly marks
blunt	having a flat or rounded end; not sharp
bromeliad	an epiphytic plant
concave	having an outline or surface that curves inward
cryptic	helping to camouflage an animal in its natural environment
diurnal	of or during the daytime
duet	performance by two
flank	the side of the body between the ribs and the hip
flecked	marked or dotted with small patches of color or light
introduced	bring in and establish in a new place or environment, such as plants or animals
oxygen	colorless, tasteless gas found in our atmosphere (O ₂)
retract	to draw back
semaphore	send messages by holding or waving the arms
spawning	release or deposit eggs
spherical	any round body or figure having the surface equally distant from the center
stockier	stouter and stronger
suffocation	die from lack of air or inability to breathe
tentacle	long, slender, flexible growths used for grasping, moving or feeling
toxin	a substance that is harmful to a living organism
truncated	terminated abruptly by having or as if having an end or point cut off;
blunt uniformly	not varying in form or character, the same in all cases and at all times
venom	poison
viviparity	bearing or bringing forth live young
waste	matter which is not used
webbing	a membrane joining the digits
yolk	the protein and fat stored in the ovum which serves as nourishment for the growing embryo