

## AMPHIBIAN FACT SHEET

This educational resource was created by the New Jersey Academy for Aquatic Sciences, Adventure Aquarium's education partner. The fact sheet may be used by teachers and students to glean more information about amphibians in preparation for a field or to learn more about the amphibians you encountered at Adventure Aquarium.

### What are amphibians?

Today, 5,000 species of amphibians may be found worldwide including frogs and toads, newts and salamanders, and the worm-like caecilians. They arose about 370 million years ago from water-dwelling vertebrates and began to colonize the land. Early amphibians evolved from lobe-finned fishes, and they initially resembled their ancestors a great deal. However, early amphibians developed several adaptations that would be crucial for survival on land.

### What makes amphibians special?

Amphibians are special animals for several reasons. Like the ancient line of fish from which they descended, early amphibians were able to breathe air with rudimentary lungs. However, amphibian lungs adapted to become larger and more efficient. Most amphibians also developed the ability to respire through their scale-free skin. In fact, a few species of salamanders do not have lungs at all; they rely solely on respiration through their skin. The skin of amphibians is very thin and packed with blood vessels. As long as it remains moist, gases can easily transfer through the skin. This allows amphibians to breathe. Amphibians keep their skin moist by producing mucus secretions and by living in a humid environment. There are no marine amphibians because salt water would cause the animals to lose all their moisture through their skin. Amphibians evolved two pairs of jointed limbs, making them Earth's first

quadrupeds. Although a few species are completely legless, most of today's amphibians have four legs. This adaptation enables them to lift their bodies off the ground. Amphibians were also the first to develop eyelids and a muscular tongue.

### What is a tadpole?

Tadpole is the name for the juvenile or larval form of frogs and toads. Although able to exist out of the water, amphibians still require clean fresh water to reproduce. While there are exceptions, most adult amphibians must lay and fertilize their eggs in water. Amphibian eggs are delicate and lack any protective covering. These gelatinous eggs quickly dry out, and the embryos will die if not kept completely wet. Upon hatching, young amphibians enter their larval stage. Often called tadpoles, amphibians at this stage look and act very differently from adults. As larvae, the young amphibians normally have a round body, respire through external gills, lack legs of any kind and have a large fin-like tail. After a few weeks, the external gills are reabsorbed and replaced by internal gills. Eventually the tadpole develops back limbs, followed by front limbs. Gradually the body becomes more elongated and streamlined. Finally, the internal gills are replaced with lungs, and the tail is totally reabsorbed. In the case of salamanders, the tail shape is altered and becomes less fin-like. This transformation is called metamorphosis. Depending on the species, the process of metamorphosis can range from a few days to several years.

### Why are scientists worried about amphibians?

Scientists are concerned that amphibian populations are declining. Amphibians are cold-blooded or ectothermic. This means that they rely on the temperature of the environment to heat their bodies. Due to their cold-blooded metabolism and reproductive needs, amphibians

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must live near a reliable freshwater source with a constant, warm temperature. Because amphibians are sensitive to changes in their environment, they are considered a bio-indicator species. A bio-indicator species signals the health of an ecosystem. When populations of the bio-indicator species are in decline, the ecosystem is unhealthy. When populations of the bio-indicator species are thriving, the ecosystem is healthy. Scientists are alarmed that frog and toad populations are steadily declining in many areas.

### **Are frogs and toads the same kind of animal?**

Frogs and toads are the most familiar of amphibians. The 4,380 living species of frogs and toads represent 85 percent of the total amphibian population. Besides having diverse speciation, frogs are very familiar because they are often seen out and about during the day. The largest species of frog is the Goliath frog (*Conraua goliath*) of West Africa which can measure in excess of 16 inches. In contrast, several species of frogs, such as the Brazilian Gold frog (*Brachycephalus didactylus*), are less than half of an inch in length.

There is no scientific difference between frogs and toads. "Toads" usually refer to those terrestrial amphibians that have dry, bumpy skin and hop slowly rather than with impressive leaps. However, many species of wet, smooth-skinned amphibians are commonly called toads, while some dry, slow-moving ones are known as frogs. Common names rarely hold any scientific distinction. All frogs and toads are strict carnivores.

### **How do frogs move?**

Frogs and toads leap and hop to move from place to place. A typical frog uses its powerful hind legs to make a quick bounding leap from land to the safety of a quiet pond. It then relies on its webbed feet to swim safely from danger. However, many frogs and toads are not "typical." Some species prefer to swim, climb, float, dig

and even fly to get to where they are going. Tree frogs have replaced webbed swimming feet for finger-like gripping toes. Adhesive disks on the ends of their digits allow them to hold onto small branches as well as to walk on perfectly flat vertical surfaces. The most peculiar mode of transportation employed by a frog is flying. Several species of flying frogs use the partial webbing between their toes as a parachute to glide from tree to tree. This is a very effective defense in order to avoid being eaten by a tree snake.

### **How do frogs reproduce?**

The breeding season for many species of frogs coincides with seasonal rain patterns. For this reason, many frogs, often of different species, utilize the same breeding pond at the same time. In order to attract the female of the right species as well as to repel other over-active males, male frogs have developed distinctive vocalizations that can be heard over a mile away. The effectiveness of the call is enhanced by one or more vocal sacs. By inflating himself with air, the frog emits a unique call, moving the air back and forth between the lungs and vocal sacs, which swell to form large bubble-like bulges near the throat. Male frogs and toads externally fertilize the female's eggs from which the embryo develops into a tadpole. That process is generally standard with frogs and toads; however, there is great diversity, if not peculiarity, in how and where the fertilized eggs are kept before they hatch.

In our area, frog eggs generally stick together in a large mass floating at the edge of a quiet pond. Local toad eggs resemble a long string wrapped around underwater plant stems. It is not uncommon to find a string of toad eggs in large puddles after heavy rains. Unfortunately, our local species have not adapted any unique methods of protecting their eggs from predation.

The male Midwife toad (*Alytes sp.*) wraps the string of eggs around his legs and carries them with him until he deposits the eggs in a local pond just before the eggs hatch. The Gray

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foam-nest frog (*Chiromantis xerampelina*) deposits eggs in a nest of protective foam. The nest overhangs a shallow pool, which the tadpoles fall into after they dig their way out of the nest. The female Gastric-brooding frog (*Rheobatrachus sp.*) swallows her eggs to allow them to develop inside her stomach; others lay their eggs in tiny puddles with a bromeliad plant. Frogs have found a variety of ways to carry eggs, tadpoles or froglets with them for added safety, the most peculiar of which may be the Surinam toad (*Pipa pipa*). Fertilized eggs are absorbed into the mother's broad back where they develop in capsules under the skin. The eggs hatch, and the tadpoles develop and burst through the mother's skin and emerge as miniature frogs.

### **How do frogs protect themselves?**

Frogs and toads are not equipped with typical defensive tools like claws or teeth to defend themselves. Instead, many species use a combination of coloration and toxins to ward off potential predators.

Many species are toxic. This poison ranges from a sticky, foul-tasting secretion that irritates a predator's mouth, to a strong toxin that can kill a predator if ingested. Poison-dart frogs of Central and South America rank among the most toxic of amphibians. The dart frog's diet of insects is the source of the toxin, which is secreted from the skin. Simply licking a dart frog may be enough to kill a predator. As its name suggests, indigenous peoples rub their hunting tools on the skin of these frogs to make their weapons more effective. Being so small and toxic, dart frogs are often very gaudily colored to warn predators of the frog's poisonous nature. Marine toads (*Bufo marinus*) on the other hand are much larger and drabber in color. Their large parietal glands, located just behind their eyes, can secrete a strong milky toxin which can kill in as little as 15 minutes if ingested. Marine toads, also called cane toads, have been inadvisably introduced to many other parts of the

world, where they have devastated natural predator populations.

### **What are salamanders and newts?**

Salamanders and newts most closely resemble the first amphibians to colonize the land. With few exceptions, they have a long tail, four short legs and a relatively small head. At first glance, salamanders and newts are often confused with small lizards; however, these animals lack the reptile's scales and claws.

There is no scientific difference between salamanders and newts. In general, the animals within this group that have rough skin are called newts while the animals that have smooth, slimy skin are called salamanders. The order Caudata also contains some unusual giant species such as mudpuppies, amphiumas, sirens and hellbenders. All of these species are aquatic and relatively large. Amphiumas and sirens have long bodies and resemble large eels. Although sirens have one pair of legs and amphiumas have two pairs of legs, their legs are very small. Mudpuppies are large and robust, resembling an enormous larval salamander; they have large external gills and a powerful tail. Hellbenders are the largest of all the salamander species, and one species in Japan measures more than four feet in length. Hellbenders lack external gills and have large flattened bodies and noticeably wrinkled skin.

Newts and salamanders are found in damp places and they are largely confined to the northern hemisphere. In fact, North America boasts more species of salamanders, newts and their kin than the rest of the world combined.

### **Do all salamanders change from a tadpole to an adult?**

Neoteny describes the phenomenon where an animal becomes sexually mature while maintaining some larval characteristics. Amphibian metamorphosis is stimulated by an

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increased level of the hormone thyroxine. In neotenic amphibians, the body produces enough thyroxine to stimulate growth and the development of mature sexual organs. However, it does not produce enough thyroxine to create a complete transformation to the adult form. Neotenic salamanders look like very large juvenile salamanders. They retain their large, feathery, external gills and fin-like tail throughout adulthood. Neotenic salamanders are totally aquatic.

Although there are several neotenic salamanders, the best known species is the axolotl. They are found only in a few remote lakes in Mexico and are on the endangered species list. However, they are bred extensively in research laboratories for study of their amazing regenerative properties. Axolotls are able to regenerate lost limbs. Although neotenic by nature, when injected with thyroxine, axolotls are induced to metamorphosize completely like any other salamander.

### **How do salamanders reproduce?**

Most amphibians engage in external fertilization, a process in which sperm and eggs are directly released into the water. Salamanders are an exception because they utilize internal fertilization, a process in which eggs are inseminated while inside the female's body. However, male salamanders do not have a way of depositing sperm directly into the female's body. Consequently, salamanders have developed a unique method of internal fertilization.

Following an elaborate courtship ritual, the male releases an enclosed packet of sperm called a spermatophore. The female walks over the spermatophore and positions her cloaca directly above it. A cloaca is a single body opening shared by the excretory and reproductive systems. The sperm in the spermatophore is then received by the female's cloaca. Through this process, the female's eggs are fertilized.

Like all amphibians, salamanders have fragile eggs that must remain moist. Many species of salamanders lay their fertilized eggs in a pond or in another suitable water source. However, some species lay their eggs on land. Eggs laid on land must be deposited in a moist area, such as beneath rotting logs or decaying leaves. The larval stage is completed while inside the egg, and hatch as fully formed juveniles. A few species of salamanders retain the fertilized eggs within the female's body. After the eggs hatch, the female gives birth to live young.

North America's most common newt, the red spotted newt (*Notophthalmus viridescens*), has an unusual life cycle. Most species of salamanders lay eggs in the water and the young hatch as aquatic larvae. Later, they develop into terrestrial adults. In the case of red spotted newts, the process is reversed. These salamanders also lay eggs in water, but soon after hatching, the young move onto land as terrestrial juveniles. During this stage, the juveniles (also called efts) breathe through lungs and are bright red in color. After several years, they return to the water and develop into permanently aquatic adults.

### **What Amphibians will I see during my visit to Adventure Aquarium?**

You will see the following frogs: Milk, Vietnamese Mossy, Tomato, Argentine Horned, Waxy Monkey, Blue and Black Poison Dart, Green and Black Poison, and Dyeing Poison. You will also see the following salamander: Axolotl. We make every effort to keep the species list updated, but please check the website for current species on exhibit.

**For detailed information on each of these species, visit [www.AdventureAquarium.com](http://www.AdventureAquarium.com).**

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