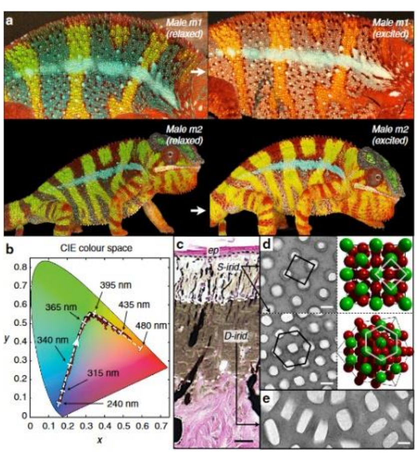
Amazing Lizard Feats! How Do They Do That!?

Lizards, which make up a large part of the order of reptiles known as “Squamata” (and which also includes the snakes), and the suborder “Sauria”, make up one of the largest and most uniquely diverse groups of reptiles, and vertebrate animals on Earth, for that matter. There are well over 7,000 different species of lizards found throughout every continent except Antarctica. From some species of geckos and chameleons, which are some of the smallest reptiles on the planet, to the large and well-known Komodo Dragons of Indonesia, it is easy to see how they can be such a large and diverse group of animals.

As one could also easily imagine, lizards of many different genera and species have many different unique evolutionary adaptations and natural histories for living in the environments that they do. How do chameleons change their color? How do geckos stick to and climb walls? How are some lizards able to run across water for short distances? It turns out, there are scientific and certain, unique physiological components to how these animals have evolved and are designed that enable each of them to accomplish these seemingly impossible feats!

In this article, we will be taking a closer look at all of these, plus other amazing lizard feats, for how they are able to accomplish what few to no other animals out there are able to! Let’s check them out!



How do chameleons change their colors?

Chameleons are the first group of lizards which one might likely think of for having many different unique feats and characteristics. But perhaps the one that stands out the most, are their color changing abilities, or their abilities to change and alter their color patterns and intensity. But are they really changing colors as their way of camouflage or being “cryptic”, or are they doing so for other reasons as well? While chameleons aren’t the only groups of lizards out there which can change colors, they have perhaps the most elaborate and interesting mechanisms for doing so. But if they were to be put up against a piece of colored paper or backdrop, would they really turn whichever color the background happens to be? Well, not exactly. Let’s take a look!

To explain this, a chameleon's skin and scales have two superimposed, thin, superficial layers of skin containing specialized pigments with underlying specialized cells comprised of very tiny (nanoscale) guanine crystals in which they are actively able to "turn on or off". More specifically, they are able to do this by tuning and adjusting the phonic responses of a lattice of small guanine nanocrystals into s-iridophores. Although the exact molecular mechanism for this remains yet to be known, this, in other-words, is changing or adjusting the wavelengths of light reflected off of these nano-crystals, thereby changing the color of their skin! Thus, in a relaxed state these crystals reflect blue and green, which are most species' of chameleons normal coloration, but in an excited state the longer wavelengths such as yellows, oranges, greens, and reds tend to be the colors which get reflected as a result.

Different species of chameleons can change colors for different functions, depending on where they are from naturally, and camouflage and crypsis certainly can be functions of that. However, more commonly, color changing in chameleons is used as ways of social signaling and communication among chameleons, thermoregulatory behaviors (they use their color changing abilities to "lighten" up when "cooling-down" or "darkening-up" in order to "warm-up"). Another common reason why chameleons may change their color has more to do with their current psychological "state", or "mood". So for instance, many species of chameleons will intensify their colors or "fire-up" as their ways of signaling their dominance and territoriality over other chameleons, while likewise, the more submissive chameleon will become duller or darker colors.

How do some lizards run across water?

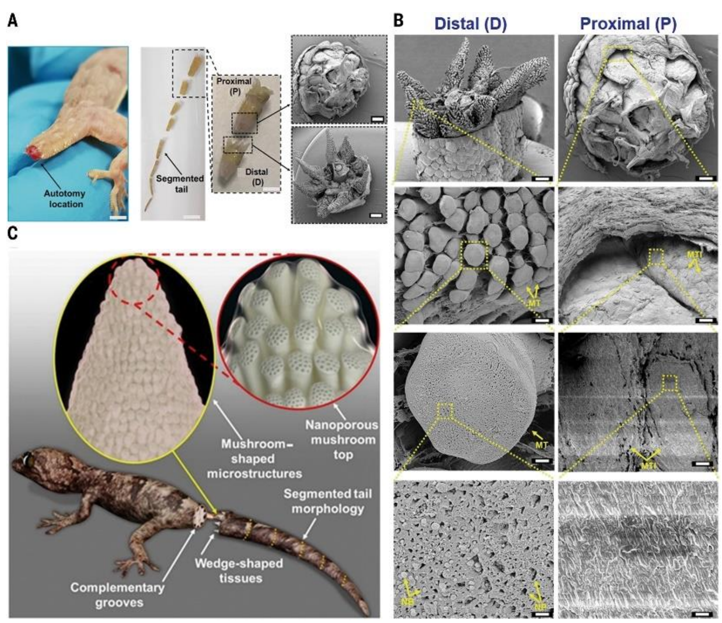
Another group of lizards with a unique adaptation and feature are the basilisk lizards (*Basiliscus spp*.) comprising of several different species from Mexico, Central, and South America. Often dubbed the "Jesus Christ" lizards, for their abilities to run bi-pedially for up to 4.5 meters (or about 15 feet) across open water before either reaching the other side, or sinking to the bottom on all-fours as their means of evading threats or predators, these lizards have another one of the most bizarre abilities out of any other lizards!

How do they accomplish these seemingly supernatural water-walking feet? Well, these lizards possess specialized flaps of skin and scales in-between their toe digits which help support them while running bipedially, giving them a greater surface area over the water, while also creating pockets of air giving them the buoyancy needed to run across water!

<u>How do some lizards squirt blood from their eyes?</u>

Perhaps one of the most bizarre defense mechanisms among lizards, and one which might not be for the squeamish, are the Horned lizard's ability to "squirt" an aimed stream of blood from their eyes as a defense mechanism to deter predators! At least seven or eight different species of horned lizards are able to do this, and here's how! These lizards are able to voluntarily restrict their blood flow from leaving their heads, which thereby increases their blood pressure, which then ruptures tiny, specialized ducts and blood vessels around their eyelids.

Furthermore, it is believed that certain chemical compounds that these lizards derive only from their specialized and unique diet of venomous harvester ants, further giving the blood a bad or foul taste. However, the exact origin and structure of these chemicals responsible are still unknown. The blood-squirting mechanism is believed to have been an evolutionary defense adaptation to wild canine and other mammal predators, and have an evolutionary advantage. Ocular autohemorrhaging has also been documented in other lizards, which may suggest that this blood-squirting could have evolved from a less extreme defense in their ancestral history. Recent phylogenic research supports this idea, but not all horned lizard species are capable of this blood squiring defense, so the species incapable of squirting blood apparently have lost the adaptation for reasons yet unstudied.



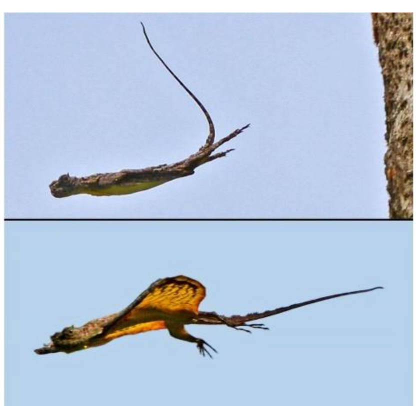
<u>How do many lizards "drop" their tails, and then regrow them?</u>

Another unique defense mechanism shared by many different groups and species of lizards, is known as caudal autotomy, which is the voluntary dropping, or loss of all, or parts of their tails in order to escape or evade predation. This defensive mechanism is most widely believed to be a mechanism designed to distract a potential threat long enough for the lizard to make an escape. Not all species of lizards can voluntarily “drop” their tails, and not all species which do can, or will “regrow” them. But for the many species with this unique defense mechanism in one form or another, how are they able to do this? Let’s examine another amazing lizard feat, looking at their tail structures!

Inside of the tail, are essentially built-in, natural fracture lines or “fracture points” which are evolutionarily designed to break and release in the event of a predation attempt. In addition to these fracture points, many lizards are able to voluntarily contract their muscles in and around their tail, and these fracture lines, to facilitate the tail’s release or discharge. As a result, this also severs the blood vessels and nerves of the tail, causing it to still oftentimes “twitch” after being detached, although there is also usually very little to no bleeding as a result.

So in orderwords, if a point on the tail is struck or becomes stressed, the muscles along this fracture plan pull away from one another rather than together, which is also known as a reflex muscle spasm. Over time, many lizards which are able to voluntarily drop their tails are able to then regrow them in the span of several weeks to months by producing a new rod of cartilage with the new muscles and musculature growing around it, thereby producing a replacement tail. This tail, in most cases, is usually shorter and oftentimes will not have the color of the original tail.

While not quite limb regeneration (as might be depicted by Marvel’s Spider Man’s The Lizard), some amphibians are actually capable of regeneration not only tails, but their limbs as well. Nevertheless, lizards aren’t the only animals capable of this autotomy; over 200 species of invertebrates, and even at least two species of rodents (mammals) are capable of this unique feat. Although for lizards, it is almost certainly worth mentioning! But as far as we currently know, no other groups of reptiles have this unique ability of tail regeneration!



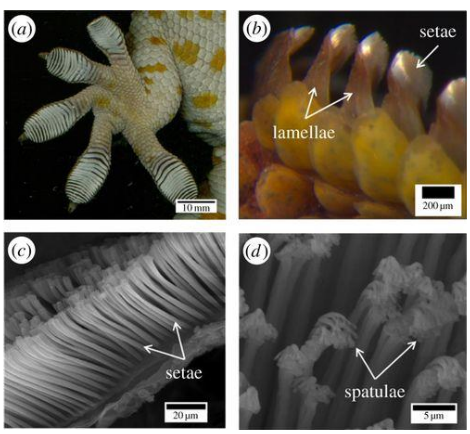
<u>Are there lizards which can actually “fly”?</u>

Another unique group of lizards worth looking at are the flying lizards, or “flying dragons”, Draco spp., which are small, arboreal agamid lizards from southeastern Asia and Indo-Australia. While these, and no lizards or other reptiles for that matter, are capable of true “flight” per say, they still have a very unique way of large scale locomotion that we will take a closer look at!

Simply put, these lizards are well known for their display structures, which are wing-like patagial membranes (which flying squirrels and some other mammals also possess), supported by their elongated thoracic ribs in order to generate the lift forces needed for them to glide from tree-to-tree in order to escape predators or in simply moving from tree to tree.

The hind limbs, in cross section, form a streamlined and contoured airfoil, which are also thought to aid in generating lift. The folding and unfolding of their patagial membranes are controlled by intercostal muscles along their bodies, which in other lizards, are used to regulate their breathing. At takeoff, the lizard jumps and descends headfirst, orientating itself so that the underside of the body is parallel to the ground. During flight, the back arches, forming the patagium into a cambered surface, and the forelimbs grab the front of the patagium, forming a straight front edge to the aerofoil. The forelimbs are used to manipulate the patagium in order to adjust the trajectory during flight. During landing, the glide then mostly becomes horizontal. Immediately before landing, the forelimbs release the patagium. The landing is forefeet-first, followed by hindfeet.

Similarly, some species of snakes (most notably the Flying Snakes, *Chrysopelea spp*.) also are able to spread and elongate the ribs along their neck and anterior halves of their bodies in order to achieve a similar feat!



How do geckos (and some other species of lizards) stick to and climb walls?

No article on unique lizard features and adaptations would be complete without mentioning geckos, another very large and diverse group of lizards with many unique features *most* other lizards do not have; from lacking eyelids (in most groups), to their ability to vocalize and make sounds. Not all groups of geckos have these toe pads, of course, but what about their feet, and toe pads more specifically? How are geckos (and some other lizards) able to stick to, or climb and adhere to walls or other vertical or even upside-down horizontal surfaces with ease?

It is estimated that at least 60% of gecko species have adhesive toe pads, and this feature has been lost and gained repeatedly throughout the course of gecko evolutionary history, believing to have evolved independently in at least 11 different lineages, and lost in at least 9 lineages. Well, for a long period of time, it was most widely believed that the spatula-shaped setae arrange in pads on the toes, called lamellae, were attributed to Van der Waals forces, which are the weakest of the chemical forces.

However, more recent findings in more recent years have made a different finding in that the ability of many species of geckos to climb and adhere to different surfaces can be more attributed to electrostatic interactions between the toes and the surfaces, caused by contact electrification, rather than Van der Waals forces. Biomimetic technologies designed to mimic gecko adhesion have furthermore begun to produce reusable self-cleaning dry adhesives with many applications, among many other technologies!

<u>How do marine iguanas "sneeze" salt?</u>

While many lizards are apt at swimming, very few, if any others, are as well adapted to living amongst and diving in saltwater or marine environments as the Margine Iguana (*Amblyrhynchus cristatus*)! But how are they able to cope with living in such saline environments, and why do they seem to "sneeze" on occasion? What is this behavior for?

The answer to this is when these marine reptiles are diving underwater foraging for, and ingesting algae and other plant matter from the bottom rocks, they are also ingesting large amounts of salt from their saltwater environments through their mouths and nostrils. This excess salt gets filtered from their bloodstream, which then gets excreted and expelled through specialized cranial exocrine glands near the tips of their nostrils. In essence, they are able to remove this excess salt through "sneezing"! Having unusually large nasal cavities compared to other species of iguanas, marine iguanas are able to cope with large amounts of salt in their nasal passageways, and thus having these large salt glands as adaptations for being able to live in such marine environments.

<u>Many lizards have a "third eye"! What is this about, and how do they use it?</u>

A "third eye" is also more formally known as a parietal eye, or pineal eye, and not only do many lizards have this organ, but also many amphibians, and many groups of fish as well. It is a part of the epithalmus, usually located atop the head in-between the eyes, in most cases. It is associated with the pineal gland, and regulates and guides circadian rhymicity, as well as production of certain hormones, and for thermoregulation.

In simpler terms, an organism's circadian rhythm serves as sort of like of the animal's own internal "clock", telling them what time of day it is, what they need to be doing, finding where the best basking spots are throughout the day as the orientation and position of the sun constantly changes, and influencing their other activity patterns and their daily behaviors. Just like how we know when to wake up, when to go to work every day, when to have lunch, and when to go to sleep, this is how many reptiles' "circadian rhythms function in much the same way!

This "third eye", when present, is not a complex optical organ which we might normally think of when we might think of an "eye", but is usually covered by a epithelial layer of skin, and may not be readily visible externally. The parietal eye uses a different biochemical method of detecting light from that of the rod cells or cone cells in a normal vertebrate eye. There are two major parts; the epiphysis (the pineal organ, or pineal gland if mostly endocrine) and the parapineal organ (often called the parietal eye, or if it is photoreceptive, the third eye).

How do some lizards store fat in their tails?

Many species of geckos, as well as some other groups of lizards, utilize their tails for fat storage. Unlike mammals, lizards (and other reptiles) do not have a layer of subcutaneous fat underneath the skin of their tails (and elsewhere on their bodies). Instead, they store fat in a different way in their tails as a reservoir for energy during adverse periods where food and other resources may be more scarce and harder to find.

But how do they do this exactly, physiologically? Well, the tails of these lizards are comprised of a specialized adipose tissue, which is a type of connective tissue composed of fat cells known specifically as adipocytes. These adipocytes have the ability to expand and contract in order to accommodate varying levels of levels of fat. Normally, when food is readily available, these lizards will consume more energy than they actually immediately need or require. Excess energy is stored within the fat of the adipose tissue in their tails, causing these cells to expand and swell, which thereby swells the appearance or thickness of the tail.

Likewise, during times of lower food availability and scarcity, energy gets drawn from these cells, causing them (and the tail) to contract, while releasing stored lipids into their bloodstream for use.