

A PRIMER ON REPTILES & AMPHIBIANS

A Collection of Educational Nature Bulletins



A Conservation Through Education Project by Micha R. Petty

What others are saying about the Primer...

"I hope it gets, because it deserves, wide attention. It is a must-read for anyone, child or adult, interested in or just curious about herps or nature." —Dr. Brian Crother, Professor of Biological Sciences, Southeastern Louisiana University; Chair of the Committee On Standard English And Scientific Names, Society for the Study of Amphibians and Reptiles

"A Primer on Reptiles & Amphibians" looks like an outstanding educational product. I can tell from my first look that Micha has done an excellent job of covering a variety of herp topics everyone wonders about." —Dr. J. Whitfield "Whit" Gibbons, Professor Emeritus of Ecology, University of Georgia; author of numerous books and hundreds of papers on herpetology

"A truly extraordinary and exceptional website and a most remarkable effort to put this amount of herpetological information together. I commend Micha's thorough dedication to the teaching and welfare of herps." —Dr. Stan Trauth, Emeritus Professor of Zoology, Arkansas State University; Past President (2012-2013), Herpetologists' League

"I'd be really excited to see this distributed widely because to me it reads as a lot more accessible than most of what's out there, and that's really important for reaching new audiences and changing behaviors." —Dr. Andrew Durso, Technical and Scientific Publications Editor at Max Planck Institute for Biogeochemistry; Author of Life is Short, but Snakes are Long

"This book is going to make a difference!" —Dr. Harry W. Greene; Professor Emeritus; Stephen H. Weiss Presidential Fellow; Curator of Herpetology, Cornell University Museum of Vertebrates

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A Primer on Reptiles & Amphibians

A Collection of Educational Nature Bulletins

Authoring & Design by Micha R. Petty

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A great deal of work went into the research, creation, and formatting of this Primer.
I decided to give the digital version away freely and charge the minimum amount possible for the print version in order to reach as many people as possible.

However, L.E.A.R.N. has *many* expenses and is not funded by any public agency. Please consider making a donation to help our wildlife rehabilitation, exotic rescue, and Conservation Through Education efforts— your donation *will* make a difference.

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A WILDLIFE REHABILITATION CENTER

A SPECIAL-NEEDS ANIMAL SANCTUARY

A WILDLIFE CONSERVATION ORGANIZATION

***...HERE FOR THE CRITTERS THAT HAVE
NO OTHER PLACE.***

Table of Contents

*Click on a topic to skip there, then
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About this Version	8
Foreword	9
Preface	10
Introduction	11
About Herpetology.....	12

Living With Wildlife

Turtles 101.....	14
Lizards 101.....	15
Snakes 101.....	16
Crocodilians 101.....	17
Frogs 101	18
Salamanders 101.....	19
Caecilians & Tuatara.....	20
Living Around Snakes	21
Snakebite Avoidance	22
Snakebite Treatment.....	23
The Malignant Cottonmouth.....	24
American Box Turtles	25
Mischievous Ratsnakes	26
Hog-nosed Snakes	27
Treefrog Tubes.....	28
Backyard Herps	29
Relocating Reptiles.....	30
Reptile Rescue & Removal.....	31
Watch for Wildlife.....	32
Snake Myths & FAQs	33
Keep Cats Indoors	36
Herps Save Lives!	37
Careful Where You Learn.....	38

Classification & Diversity

A Bit About Names.....	40
Scientific Names.....	41
Species and Orders.....	42
Family Ties	43
Differences & Similarities	44
Miscellaneous Oddities	45

Giants Among Us	46
Life in Miniature	47

Biology

Thermoregulation.....	49
Tail Autotomy.....	50
Ecdysis (Shedding)	51
Sexual Dimorphism.....	52
Hemipenes	53
Fangs.....	54
Rear-fanged Snakes	55
Venom	56
Venomous vs. Poisonous	57
Scales & Scutes	58
Amniotes & Anamniotes.....	59
Frog Life Cycle	60
Salamander Life Cycle	61
Amplexus	62
Hatching & Birthing	63
Parthenogenesis	64
Sex Determination.....	65
Snake Locomotion	66
Forked Tongues	67
Snakes and Swallowing.....	68
“Sticky” Feet.....	69
Hibernation & Aestivation	70
Tortoise Pee!	71

Find The Herp!.....	72
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Natural History

A Complex Web.....	89
When Are Herps Active?	90
Where Do Herps Live?	91
Adapting to Suburbia.....	92
Hidden in Plain Sight.....	93
Non-native Species	94

Conservation

Herp Conservation.....	96
Habitat Loss	97
Commercial Collection.....	98

Table of Contents

Amphibian Diseases	99
Snake Fungal Disease (SFD)	100
Systematic Eradication	101
Preservation Efforts	102
Habitat Management	103
Assurance Colonies	104
Public Policy.....	105
Citizen Science	106
What Can You Do?	107
Become an Interpreter	108
Innovative Solutions	109
Excluders and Underpasses	110
Special Places.....	111
Community Outreach.....	112
Master Naturalist Programs	113
Knowing is Not Enough	114
Laissez-faire?	115

Observation

Field Guides	117
Location, Location, Location!	118
Keep Locations a Secret.....	119
Forget The Rules	120
Know Your Neighbors	121
Learning to Identify Herps	122
Take Nothing But Photos.....	123
Field Herping– Tips & Tricks.....	124
Field Herping– Tools.....	125
Decontamination	126
What is <i>That</i> Thing?	127
The Law and You.....	128
Make It Count!.....	129

Herpetoculture

Read a Book!	131
Consider the Cost.....	132
Size and Longevity.....	133
Responsibly-sourced Animals	134
Code of Ethics	135
We're Not Disposable!	136
Never Release Captives	137

Gradients are Key!.....	138
Replicate Nature	139
Enrichment.....	140
Lighting	141
Enclosures	142
Cohabitation	143
Hiding Places	144
Provide Variety.....	145
Feeder Insects	146
Transporting Animals	147
Cleanliness	148
Choosing a Veterinarian	149
Consider Rescue	150

Lagniappe

Becoming A Herp Vet.....	152
Becoming a Herpetologist.....	153
Scientific Research.....	154
Publishing a Paper	155
Antivenom	156
Nature Photography	157
Social Media.....	158
Roadway Design	159
Wildlife Rehabilitation.....	160
TNR Programs	161
Info for Animal Shelters.....	162
Temporary Enclosures	163
Animal History Record.....	164
Observation Record.....	165
Irresponsible Handling.....	166

Appendices

Additional Resources.....	168
U.S. Snake Links.....	169
Footnotes.....	170
Credits	171
Illustrator Index.....	172
About L.E.A.R.N.	173
About the Author	174
Closing Entreaty	175



About the Digital Version

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L.E.A.R.N. will always have a digital version of this work available for free. We also have very nice hardcovers available. You can purchase those by visiting learnaboutcritters.org/primer. All proceeds go to nonprofit use!

DeKay's Brownsnake photo by Chris Neill



When I began this project, I certainly never expected what it would grow into. I have been writing bulletins about reptiles and amphibians and handing them out at events for years. A year ago, I *thought* I was embarking on a four-week task to compile them into a digital file so that my little information booth could “go green” and visitors could simply scan a QR code to download the collection. That is still essentially what I have done, but it also has become much more than that. This project provided opportunities for me to interact with renowned scientists that I never dreamed would have reason to notice my work, much less proffer such glowing reviews. More importantly, though, it feels like this primer holds real potential for changing hearts and minds about some awesome creatures, so I consider it time well spent.

This book may hold great promise for increasing the public's perceived value of the world's creeping critters, but *only if people read it*. We must get the word out about

this resource. I am doing that, and I hope you will join me. People won't know why it is special until they view it for themselves. Tell people about the Primer and bug them until they download it! There's no reason not to—it doesn't cost anything!

If you have photos, illustrations or information that you would be willing to contribute to L.E.A.R.N.'s educational efforts, please click [here](#).

If you discover any errors, omissions, or have other feedback or questions, you may use the [contact form](#) on our site, or message our [Facebook page](#). Let me know what bulletins you would like to see next—another collection is already in progress!

Tips for the digitally-challenged:

If you are viewing this file in your browser, feel free to download it. On a desktop, simply hover over this page and look for a little downward pointing arrow that should appear in the upper right-hand corner. Click on that to save the Primer, and then navigate to your download folder to open this file. On your phone, a download option should appear in your menu. If you do not have Adobe Reader installed, get it at get.adobe.com/reader.

There are multiple options in Reader for ways to view this file. You may want to play with the settings until you find the best one for you. Single page view, scrolling enabled provides a smooth experience, but you may prefer a different setting.

If you want to be able to click on links without having to tell Reader that it is OK every time, you can adjust that by going to: *Edit > Preferences > Trust Manager > Internet Access from PDF Files outside the web browser > Change Settings > Select “Allow PDF files to access all websites.”*

Bonus Tip: Office Depot has a free account option that will allow you to print these bulletins at a very substantial discount. Ask to speak to the business sales team to get your organization set up with an “SPC” account.

Happy Herping!

Knysna Dwarf Chameleon photo by Bionerds



The best way to get the word out about this resource is to share it! There are sharing tools for your convenience at learnaboutcritters.org/primer. Why not make a post on your website or social media page right now?

Foreword by Brian I. Crother, Ph.D.

Perhaps now more than ever, public understanding of the life we share Earth with needs to rise. Yes, there is some general awareness and understanding of the charismatic life forms like elephants, whales, lions, and condors, but what about insects, worms, salamanders, and lizards? The great bulk, the vast majority, of the diversity of life is poorly known and subsequently misunderstood and as such treated with various levels of disdain. Squash bugs. The only good snake is a dead snake. Toads give you warts. Kill weeds. Can't eat that fish: it's trash. Those attitudes somehow have to change or all the magnificent diversity on our planet will vanish, and humans will be the worse for it.

The present volume is a terrific effort to change those attitudes about some of those life forms. *A Primer on Reptiles and Amphibians* by Micha Petty seeks to pull back the veil of mystery and misunderstanding surrounding reptiles and amphibians and reveal what incredible life forms they are and why they are important.

Delivering science to the public is a challenging endeavor that requires a deft touch, a level of humility, and a thorough understanding of the subject. Without those qualities, the layperson is often presented with a quagmire they are forced to wade through with the hope of finding some nuggets within the sludge of jargon and extraneous detail. While all such volumes have their unique challenges, works on diverse groups of organisms like reptiles and amphibians (snakes and frogs are *really* different beasts!), are perhaps especially difficult because of the breadth of the knowledge one must cover to bring life to the words. In *A Primer on Reptiles and Amphibians*, Micha Petty succeeds in delivering a quality, information-filled volume on reptiles and amphibians, but he wants much more out of the volume than just being able to use it to identify a frog.

Petty considers it a "Conservation Through Education Project," and no doubt the best way to ensure conservation of our natural resources and biodiversity is through education at every level. This Primer does just that. It contains knowledge about reptiles and amphibians in comfortable, easily accessible language. Petty uses only common names, and that surely makes the reading easy for the beginner, or anybody who does not want or need



Mississippi Mud Turtle photo by Justin Sokol

to be confronted with long, strange scientific names that are impossible to pronounce. Petty knows his stuff and his strong background in reptile and amphibian biology and natural history shines through. Besides the biology, the Primer explores our relationship with reptiles and amphibians, delves into various conservation topics, gives tips on observing animals in the wild and keeping a field notebook, and goes into keeping reptiles and amphibians as pets (although the sense you get from Petty is that the animals are better left in the wild, sometimes we just can't help it because the animal is sooo darn cool!). For those readers that get hooked on reptiles and amphibians, there is a Lagniappe section that gives advice on careers, photography, publication, and more. To me, this volume does a huge service for reptile and amphibian conservation, and for humanity. There is no better venue for international access than the Web, so I hope it stays there!



"If I were still teaching herpetology, the Primer would be required reading for all students, both graduates and undergraduates. I am going to recommend to others to do the same." —Dr. J. Whitfield Gibbons, Professor Emeritus of Ecology, University of Georgia



Red-bellied Newt photo by Ken-ichi Ueda



Preface

This work is a collection of bulletins created to educate the public about reptiles and amphibians, otherwise known as herps. I hope to inspire more people to value and conserve these diverse and beneficial animals. This collection in no way purports itself to be a replacement for formal herpetological course materials, and there are, of necessity, some oversimplifications to be found due to space limitations. My goal is to forge or strengthen a con-

nection between herps and those with a casual interest in their natural history. Though it touches on academic topics, this Primer is intentionally more conceptual than statistical. Common names have also been used to keep the work accessible to the average reader. Scientists are kindly asked to overlook a slight degree of anthropomorphizing pursuant to this primer's interpretive goals. Nothing contained herein is new information; I freely admit to standing on the shoulders of giants. These bulletins have gone through a pretty rigorous peer-review of sorts, but we humans all make mistakes—if you notice any, please let me know!

Try to view the Primer less as a book and more as a resource that has its own character. I did not set out to

write a book; I set out to write handouts that people could use and share to spread the word about herps being awesome. As such, you will find important points repeated across topics, a mix of formal and casual elements, and probably other traits that might be considered flaws in other settings. I hope that book aficionados can take this work for what it is and not find its foibles too off-putting.

While this primer may be of benefit to many interested English-speaking readers, examples and photographs used are disproportionately representative of the southeastern United States. This is merely a result of that being my place of residence, and consequently contains the herps with which I am most familiar. Hopefully, readers in other regions can extrapolate from the context which information may be applicable to their region. Where a herp endemic to the southeastern U.S. appears as an example, there is likely a species which fills a similar ecological niche in your area, and a minimal amount of research should reveal how the lesson might apply to your locale.

Using any of these articles in any way other than printing or sharing a complete bulletin falls outside the Creative Commons license for this work, so please contact me before doing so. I will almost certainly grant permission, provided you are using contributed works in an educational fashion and not for commercial or political gain.

While the intent of these bulletins is for the information to be clear and accessible, occasionally terms are used with which the reader may not be immediately familiar. I try to coach lessons in a straightforward manner, but this book does cover biological subject matter, and occasionally being exposed to unfamiliar terminology is a part of learning about the natural world. There is a glossary of herpetological terms available for you to reference at bit.ly/herp-terms. I hope you enjoy my work!

Northwestern Fence Lizard photo by Chad M. Lane



Common Gartersnake photo by Justin Sokol

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Introduction

Feel free to use these bulletins in your outreach efforts as you encourage others to join in preserving our natural heritage. I will even co-brand these bulletins with your organization's logo and web address for free!

This work is not intended to convey everything one might want or need to know about herpetology. It is meant to introduce interested persons to a variety of fascinating and useful information about herps and hopefully instill in the reader a sense of their inherent value. For whatever reasons, an incredible amount of misinformation seems to circulate regarding herps, especially snakes. People often suspect that anything with scales is lurking about to do them harm. The truth is, of course, quite different. By and large, reptiles and amphibians share the same motivations as any other animal—the search for food, water, shelter, safety, the drive to mate, etc.

Despite their appearance in horror movies, snakes do not have the capacity to be sinister—humans are the only animal capable of such a trait. As we learn more about these fascinating creatures, our fear diminishes, and we begin to appreciate the astounding diversity of adaptations that have made them, until recently, amazingly successful animals.

Unfortunately, herps now face anthropogenic (human) pressures of unprecedented severity. We are observing populations in decline and extinction events with alarming frequency. Devoted individuals are working on a variety of projects worldwide in attempts to allay this decline, but much more help is needed. While not all of us have the resources to engage in activities such as traveling to the rainforest to breed and repatriate endangered frogs, each of us can be more mindful of the plight of herps. There are numerous citizen science opportunities wherever you may happen to find yourself. I hope you will choose to familiarize yourself with some of these and

participate where possible.

At a minimum, we can be personally responsible for our actions and attempt to influence the actions of those around us positively. The needless intentional killing of any species of wildlife—reptiles and amphibians included—should be viewed as aberrant behavior. An integral theme of my educational efforts is that every species has



Sinai Agama photo by Laura & Bobby Bok

a role in the ecosystem. This means, for example, that there is no such thing as a “bad snake.” However, we all know people who are fearful of snakes, and some are adamant about killing venomous species. We should, therefore, work to be available and able to quickly and correctly identify harmless species for these folks, thereby reducing the casualty rate as much as possible. We should strive to partake in Conservation Through Education, gradually but consistently increasing in others the perceived value of the natural world.

Plants and animals do not have a voice that most people understand. It is up to us to make a conscious choice to be that voice. We must work to preserve as much of this world's biodiversity as we can—for the critters' sake and our own.

In this digital age, it's easy to become increasingly disconnected with the ecosystem. Watching nature documentaries and reading books are no substitute for experiential learning. Hopefully, this collection inspires you to get outdoors to observe and preserve these fascinating animals in their natural habitat!



Oriental Fire Salamander photo by Laura & Bobby Bok

A Note About Herpetology

Herpetology is the study of reptiles (from the Greek words for “creeping things”) and amphibians (“double life”). Although reptiles and amphibians are not particularly close relatives, they are often grouped and studied together. This is because they often share the same habitats and have several physiological, behavioral, and ecological similarities. It may also simply be that the same people that enjoy one group also enjoy studying the other. Herpetology is a field of study with virtually limitless opportunities. Herps exhibit incredible diversity and have adapted to almost every niche imaginable. The following points are a few examples of the broad range of reptile & amphibian diversity.

Gulf Short-fingered Gecko photo by Laura & Bobby Bok



- Herps inhabit every continent except Antarctica.
- They inhabit land and water, including the oceans.
- They live on mountaintops and down underground.
- They can be diurnal, nocturnal, crepuscular, and seasonal.
- Some lay eggs, others give live birth.
- Many can give birth without mating.
- Some actively forage, others are ambush predators.

- They range from having excellent eyesight to blindness.
- Many can go for months, and some even years, without eating.
- Reptiles are the longest-lived animals in many areas.
- Some live in the hottest deserts, and others freeze solid in the winter.
- They hunt by constriction, venom, luring, tongue adaptations, and many other methods.
- They exhibit almost every color imaginable, with many displaying dramatic and vivid color changes at will.
- Their diets range from prey as large as buffalo to as small as termite larvae.
- Many species don’t drink water, and some don’t even breathe air.
- Amphibians are known for their ability to metamorphose, encompassing very different forms in one lifetime.
- Several species are known to be able to change their sex when needed.
- Some can change how the sex of their offspring is determined if their environment changes.
- They can be herbivorous, omnivorous, carnivorous, insectivorous, or other various specialties.
- They move about in numerous ways, such as walking, jumping, rolling, sand-swimming, concertina motions, and more.
- Some can run on water, and some are hydrophobic (unsinkable).

With such staggering diversity among reptiles and amphibians, it is no surprise that we still have so much to learn from them!



Gorgan Salamander photo by Laura & Bobby Bok

**No matter how long this treatise were to be,
all it could hope to do is scratch the surface.**

**The more we learn, the more we realize how little we know.
Nonetheless, this work hopes to point you in the right
direction and give you a head start on your further studies.**

Part I

Living With Wildlife



Eastern Hellbender photo by Isaac Szabo



Western Pygmy Rattlesnake photo by Armin Meier

**Every animal has a
part to play in the
ecosystem...**

**even if you don't
understand what
their part is.**

***LEARN TO VALUE
LIFE'S DIVERSITY.***



Turtles 101

It's no secret that turtles and tortoises are some of the most endearing critters on Earth. Even people terrified by snakes or lizards often love turtles, and there are good reasons for this. Turtles are beautiful and unassuming. Even seemingly-fearsome snapping turtles do their best to avoid confrontation, rarely exiting their homes in the water. Videos of baby sea turtles dashing madly towards the sea grip the hearts of all but the most cynical among us. The sobering fact of the matter, though, is that turtles are facing unprecedented levels of pressure from human activity and are among the most threatened of animal orders on the planet.

Desert Box Turtle photo by Chad M. Lane



In the U.S., we usually call aquatic species turtles and terrestrial animals tortoises. However, many other cultures have those definitions reversed. For this reason, naturalists often refer to them as a group by the scientific term chelonians (or sometimes testudines). Chelonians are reptiles with four legs and a tail and can be terrestrial, aquatic, or ocean-dwelling. Arid-land-dwelling species are mostly herbivores, while aquatic and semi-aquatic species are typically more omnivorous (some are almost strict carnivores). Their spine is fused to their shell, which is actually an adapted ribcage—a turtle can never “come

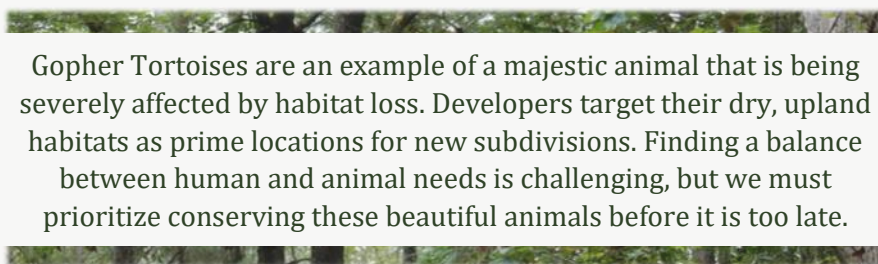
out of its shell.” Chelonians are typically very long-lived animals, with some reaching ages of 200 years or more. The top of their shell is called a carapace, and the bottom is their plastron. Some turtles have hinged shells that allow them to withdraw entirely inside as a rather effective defense mechanism. Despite popular belief, many chelonians are quite fast, as anyone that has tried to help a soft-shelled or snapping turtle across the road has discovered.

Chelonians are disproportionately affected by pressures such as habitat fragmentation and commercial collection. When roadways bisect their habitat (habitat that is already rapidly dwindling), even the strongest of shells are scant protection against vehicle traffic, and their natural defense of withdrawing into their shell serves to increase their mortality in these settings. Likewise, their personable and inoffensive nature makes them prime targets for collection for the pet trade, and populations worldwide are under extreme pressure from this activity. Unfortunately, these pets often experience truncated lives in sub-optimal conditions, and often the ones that survive are eventually brought to rescues. Chelonians are also commonly collected and sold as food items or as alternative medicines, primarily in Asian markets. Even in the U.S., laws have had to be enacted to curb these practices. Unfortunately, only certain species are protected, and funding for the enforcement of these regulations is often limited. Even with protections in place, poaching is a widespread issue for these silent, hardy (and therefore easy to smuggle) animals. The only solutions that offer any real hope are extensive educational efforts aimed at eliminating consumer demand for these amazing animals. Our goal moving forward should be zero extinctions caused by human interference. Represented by a mere 351 species comprising only 3% of the world's reptiles, turtles do not have much margin for error. It is vital that we protect these armored survivors now.

Gopher Tortoise photo by Bronc Rice



Gopher Tortoises are an example of a majestic animal that is being severely affected by habitat loss. Developers target their dry, upland habitats as prime locations for new subdivisions. Finding a balance between human and animal needs is challenging, but we must prioritize conserving these beautiful animals before it is too late.



Lizards 101

Lizards display so much diversity that it is almost hard to believe one name applies to them all. Many lizards, such as the Little Brown Skinks in the U.S. and the Pygmy Chameleons of the African forests, are so tiny that they make a blade of grass look huge in comparison. In other areas, lizards are large apex predators—Komodo Dragons even hunt water buffalo! Lizards live in trees, on the ground, under rocks, in the soil, and everywhere in between. They can be diurnal (daytime active), nocturnal (nighttime) or crepuscular (active at dawn or dusk), and some alternate throughout the year. Some have four legs, and some have two or none. Some have smooth, glossy scales; others bristle with spikes. They are herbivores, omnivores, and carnivores. Some give live birth, and others lay eggs. Some have such perfect camouflage that you could be looking right at one and know it is there and still not see it. Some are venomous, some have prehensile tails, some have hydrophobic skin that makes them unsinkable, and some reproduce without mating!

With all this diversity, forming a concise description of lizards is a challenge. Nonetheless, we can say that they are ectotherms (animals that do not generate significant amounts of heat internally) that belong to the order Squamata (scaled reptiles) and make up over two dozen families which include several thousand species. We can say that they *typically* have four legs, eyelids, and external “ears” (tympanic membranes, technically), all of which are absent in snakes. While lizards are overwhelmingly harmless to humans, some large species can inflict damage; at least two, the Gila Monsters and Beaded Lizards of the U.S. and Mexico, are venomous.

Typically, we find the more massive species of up to 6’ (1.8 m) or more in tropical climes. Sub-tropical zones have a variety of smaller species, typically 6”-12” (15-30 cm) animals, with some species in the 2’-4’ (.6-1.2 m)

range. Colder zones typically have fewer and smaller species, in part because reptile metabolism is relative to temperatures. Australia has the most lizard diversity of any continent by far, which is not surprising, considering the landscape there.



Great Basin Collared Lizard photo by Chad M. Lane



Thorny Devil photo by Daniel Bromley

We call some lizards skinks, geckos, monitors, tegus, and other names, but they all represent a suborder of animals who have shown an astounding ability to adapt and survive. As with other herps, lizards face several pressures in this modern world, and they certainly deserve our consideration. Few children are not fascinated by lizards, and it would be a tragedy indeed if future generations were not still sharing tomorrow’s ecosystems with these beautiful animals.



Komodo Dragon photo by Micha Petty

Reaching lengths of up to 10’ (3 m) in length and weighing up to 150 lbs. (68 kg), the Komodo Dragon is the world’s largest lizard. Despite conservation efforts, these majestic and fascinating animals are listed as vulnerable by the IUCN.

Snakes 101

Snakes!! Where does one begin? Most people have an opinion about snakes, good or bad. The cry, “Snake!” will send some people running away and others running closer to get a glimpse. Many snakes (and animals that resemble them) are killed daily, purely from human ignorance. Naturalists who try to educate people are told that they “just don’t understand” that people need to “protect their kids and pets” and “have to kill snakes” so

California Red-sided Gartersnake photo by Chad M. Lane



they don’t “poison somebody,” or that snakes “chase people.” Of course, none of that is correct. While, logically, the concept that merely lacking appendages makes an organism somehow sinister or aggressive seems laughable, it is no laughing matter that people are intentionally eradicating these beneficial organisms.

So, what is a snake? Snakes are reptiles that are covered in scales. They lack arms, legs, eyelids, and external ear openings. The degree to which snakes hear is a debated topic, but they do possess an internal ear structure, and can surely at least hear low-frequency sounds. They have forked tongues, which collect particles in the air for smelling instead of tasting. Like all reptiles, they shed their skin periodically. Snakes are carnivores, but their diet can range from prey the size of antelope all the way

down to termite larvae. Some live in trees, some in the water, some on the ground, and some under the ground. Subterranean species are often blind. Many are specialist feeders, meaning they have very specific diets such as freshly molted crawfish or the eggs of other reptiles. Only ~20% of the world’s snake species are venomous (an animal that can inject toxins into another animal, such as a cobra or a rattlesnake). Far fewer snake species are poisonous (meaning an animal trying to eat them would ingest a toxin while doing so). Very few snake species are large enough to see humans as potential prey. Snakes are not aggressive, but will defend themselves if threatened (e.g., being approached by a large potential predator). The proper response to seeing a snake you cannot identify as harmless is simply to *Take Three Steps Back and Walk Away*. There’s no need to run; the snake is not chasing you.

The simple fact is—snakes are a part of the environment. Even if someone does not feel shame at needlessly killing wildlife (which they should), doing so is a waste of effort. Killing such a predator causes a spike in prey populations, prompting another snake to take its place. On top of that is the fact that most venomous snake “sightings” are cases of mistaken identity in the first place. The only responsible solution is to learn to live safely with wildlife. Starting when young, everyone should become able to identify the venomous snakes in their area and learn how to avoid injury. Likewise, animals such as domestic dogs can get snake aversion training. It is not possible to ensure you never encounter a snake, so instead of killing wildlife to foster a false sense of confidence—learn to identify and respect these beneficial members of the ecosystem. If they are frequenting your property, they are most likely there to perform a free, eco-friendly pest control service. So *thank a snake today!*



Eastern Copperhead photo by Justin Sokol

Only a small portion of the world’s snake species are venomous. People tend to assume every snake they see is dangerous, but this is usually not the case. The best practice is to learn to identify the venomous snakes in your area and then simply to avoid any potentially dangerous animals you may encounter.

Crocodylians 101

Crocodylians are undoubtedly iconic animals. While crocodylians account for less than a quarter of a percent of reptile species, nine of the ten most massive reptiles are crocodylians (Leatherback Sea Turtles hold 4th place). The order Crocodylia contains twenty-four species in three families—true crocodiles (Crocodylidae), alligators and caimans (Alligatoridae), and the gharial (Gavialidae). All crocodylians are tropical except for the American and Chinese Alligators, which live in temperate climes. They have stout bodies, four legs, and long snouts full of teeth. They are carnivorous predators who can see, hear, and smell underwater. They have elliptical pupils and excellent night vision. The largest is the Saltwater Crocodile, which can grow to twenty feet (6 m) in length, and the smallest is Cuvier’s Dwarf Caiman at less than six feet (1.8 m).

Crocodylians are known for their parental care. Alligators carefully build nest mounds of dead vegetation and utilize the heat of decay to incubate their eggs, whereas crocodiles and gharials lay their eggs in the sand. They remain nearby after depositing their eggs, and when hatching time comes will open the nest back up and carry the hatchlings down to the water. If they hear a crying youngster stuck in an egg—the mother will dig them out, bring them down to the water, and carefully use her imposing jaws to crack open the egg and free the straggler. With many species, the pods stay near the mother for months, and Caimans will trek overland with their young in search of new water holes if theirs dries up.

Crocodylians have several remarkable adaptations that make them the top predators they are. The scales (osteoderms) on their back act as “solar panels.” They can bask when floating by adjusting the blood flow in their bodies to distribute heat from the sun on their back, and their nostrils are on top of their snouts to make breathing easier. They communicate with audible sounds

as well as infrasounds and have sensory organs which cover their body surface and cause them to be highly sensitive to activity in their vicinity. Many species can go potentially months without food, relying on seasonal prey movements to feast. Although they all have webbed feet, they swim by using their massive tails as both a propeller and rudder. They are quite capable of moving quickly on land and can travel long distances if needed.



American Alligators photo by Micha Petty

Adult crocodylians have few, if any, predators in most areas. Humans are, not surprisingly, their biggest threat. While concerted management efforts in the U.S. have brought the American Alligator back from peril, other crocodylians are still under pressure. If we continue to encroach on their habitat, it will be difficult for them to adapt. Hunting and destructive fishing habits persist in some parts of the world, and several species are in grave peril. Although coming up on a crocodylian in the wild may be unsettling to some, they certainly deserve our protection. Educating the local human populations in areas where crocodylians are in peril is probably the best solution for protecting these fascinating giants.



In Louisiana (USA), American Alligators were brought back from crisis through hunting and farming. Farmers collect eggs from the wild and rear the young, and 12% (the approximate natural survival rate of offspring) are returned to the wild. This program has been very successful in raising their numbers.



American Alligator photo by Micha Petty

Frogs 101

Anurans, better known as frogs and toads, are certainly an order of herps with plenty of fans. Comprising roughly 6000 known species, with more discovered each year,



Western Spadefoot Toad photo by Chad M. Lane

frogs exhibit an enormous variety of colors, shapes, sizes, and unique behaviors. They also live in a wide range of habitats. There are even frogs that live in deserts beneath the soil and only come out a few days a year to eat and mate! Frogs are tetrapods (four-legged animals) that range in size from 12.6" (32 cm, Goliath Frog) down to .3" (7.7mm, *Paedophryne amanuensis*). They are all carnivores, and their diet typically consists of anything they can catch, subdue, and fit in their mouths. Most frogs use vocal sacs to make sounds audible from an impressive distance away. These sounds serve a variety of



Gulf Coast Toad photo by Ashley Tubbs



Paedophryne dekoti photo by Fred Kraus CC BY 3.0

purposes, including males advertising for a mate. Many species produce and exude toxins that range from irritating (e.g., North American toads) to lethal (e.g., dart frogs) as a deterrent to predators.

While there is no specific demarcation biologically between frogs and toads, we tend to call frogs toads when they can live in drier areas, hop more than jump, or have visible paratoid glands. Frogs are amphibians (meaning 'double life') which lay gelatinous eggs (typically in water) that hatch into larvae called tadpoles (with some exceptions). The tadpoles undergo metamorphosis wherein they lose their tails and gills and grow legs, after which most become terrestrial (land-dwelling). Frogs shed their skin like other amphibians and reptiles. Some frogs can even freeze solid in the winter and thaw out in the spring unharmed because of a natural "antifreeze" in their cells that prevents damage from ice crystals.

Worldwide, frogs are vulnerable animals. Many species have gone extinct in recent years, and more are expected to follow. One of the biggest reasons for this is habitat loss due to human development of wetlands and other areas frogs call home. Another factor is disease, most notably Chytrid fungus or *Bd*. Chytrid is a grave issue, having caused more extinction events than any other infectious disease known to science.

There are numerous frog conservation efforts going on globally—there are probably even some going on in your region. Consider researching and being a part of these efforts. For example, some needed tasks are as simple as photographing animals you encounter and uploading those records to the web or listening for and recording frog calls at various times of the year. Please consider taking part in at least some of these efforts, as these fascinating, diverse, and personable animals need all the help they can get. We want future generations to have the opportunity to enjoy them, too!

With adults averaging less than 8 mm long, *Paedophryne* is a genus of microhylid frogs from New Guinea that holds not only the title of smallest frogs but also the smallest vertebrates in the world. It is astounding that fully functioning organs, eyes, and brains fit inside so small an animal.

Salamanders 101

Salamanders may have four legs and a tail like lizards, but they are not reptiles at all. They are amphibians, like frogs and caecilians. They are members of the order Caudata (from Latin *caudatus*, or “tailed”), and biologists often refer to them as “caudates.” The United States has more salamander species than any other country. Some salamanders are terrestrial (living on land except to breed), and some are aquatic (living their lives in the water). Some newts switch between the two—they live in the water when young, then live on land for a time (called an “eft” during this stage), and then return to being aquatic. Salamanders lay anamniotic eggs (gelatinous eggs without a hard shell), and most salamander larvae live in the water until they metamorphose into adults. There are some salamanders, such as the endangered Axolotl, that live in their larval form and retain external gills for their entire life—a trait called neoteny. Salamanders have a permeable skin that can be affected by various irritants, so it is best to avoid excessive handling.

Salamanders of the Cryptobranchidae family—the Chinese and Japanese Giant Salamanders which reach almost five feet in length and the Hellbenders of the eastern U.S.—are the most massive. All of these giants are classified as “near-threatened.” There are many tiny salamanders, such as the one-to-two-inch members in the U.S. of the Plethodontidae family, many of which are also in decline. Many of these tiny amphibians do not have an aquatic larval stage and do not have lungs—respiration occurs directly through their skin or by gills. All salamanders are carnivorous predators. If they can catch it and fit it in their mouth, it’s generally fair game.

Being ectotherms and comfortable at cooler temps, many salamanders can make do on only a few meals a year, and at least one (the olm) can go more than a decade without eating. Many salamanders are so secretive that you’ll only see them above ground for short forays

or during nighttime rains in the spring for breeding purposes. Some, such as the Eastern Newt, produce toxic secretions. While most are too small to bite people, the largest ones can deliver a painful bite and certainly command respect. Many animals prey on salamanders, and some animals feed almost exclusively on them. Western Mudsnakes, for example, are so specialized that their tails end in a sharp point to help them restrain their slippery prey. Salamanders are relatively long-lived, with some species reaching sixty years of age or more.

Marbled Salamander photo by Ashley Tubbs



Salamanders are yet another category of herps in crisis. Besides habitat loss, which is a looming threat to all orders of herps, salamanders are suffering from epidemic chytrid fungi known as Bd and Bsal. In simple terms, these fungi affect the skin of the host animal, often eventually preventing respiration and causing cardiac arrest. The effects of these diseases are dramatic and worrisome, and they appear to be spreading. There are professional and citizen science efforts to help identify possible occurrences in the U.S. and worldwide. Please research what you can do in your area and consider supporting global efforts to prevent extinction events from this disease.

It is important to photograph and report any dead or sick salamanders so that biologists can more quickly respond to potential incidences of Bd. One way to do this is at bit.ly/saving-salamanders

Oriental Fire Salamander photo by Laura & Bobby Bok



The “Other” Herps ~ Caecilians & Tuatara

There are a couple of orders of herps that most people will never see. One is Apoda, or caecilians, and the other is Rhynchocephalia, or Tuatara. Older texts also refer to another order, called Amphisbaenia (worm lizards), but those have since been reclassified as lizards.

There is only one species of Tuatara. They may look like lizards, but these New Zealand reptiles are the only surviving member of a different animal altogether. Measuring a little over two feet (61 cm) and weighing up to 2.2



Tuatara photo by Phillip Capper CC BY 2.0

lbs. (1 kg), Tuataras prefer cooler temperatures than most reptiles. They have elliptical pupils and possess some unique skeletal features, including two rows of teeth on their upper jaw that fit over one row of bottom teeth. They can hear sounds, but lack external ears, and have a pronounced parietal (third) eye for sensing light cycles. Though they do enjoy some legal protections, these “leftover dinosaurs” are under a great deal of pressure from habitat loss and introduced predators, most notably the Polynesian Rat, which raids their nests. Thankfully, conservation and repatriation efforts are underway, as the loss of this species would mean a whole order of animals disappearing from Earth!

Comprising only 3% of the world’s amphibians, caecilians are found in parts of Asia, Africa, South America, and North America as far north as southern Mexico. Represented by 207 known species, caecilians are legless and virtually blind. Most spend their time hidden underground, where they feed on earthworms and other small creatures that live in the soil. A few South American species are aquatic. They have a segmented appearance, making the smaller ones look like earthworms. Their skin can excrete toxins that presumably deter predators. One species is lungless. Caecilians have a small pair of tentacles behind their nostrils that seem to enhance their sense of smell. These probably assist with finding prey, partially offsetting their poor eyesight.



Caecilian (brooding) photo by Davidyraju CC BY-SA 4.0

Caecilians reproduce by internal fertilization (the males have a tubular organ called a phallodeum that accomplishes this), and most species give live birth. Around 25% lay eggs, and the young of some species hatch already metamorphosed.

Some people believe caecilians are so poisonous that merely touching them can be fatal. Consequently, they are often needlessly killed on sight, even though there are no reports of human deaths from these innocuous animals. More public education about these fascinating animals is certainly needed!



Mexican Burrowing Caecilian photo by Franco Andreone CC BY-SA 2.5

Rarely encountered and poorly understood, caecilians are routinely killed in many regions because of the myths and superstitions that surround them. Caecilians are a prime example of animals that would benefit from more people practicing *Conservation Through Education*!

Living Around Snakes

Snakes are a natural part of our environment. While they may cause some people apprehension, objectively they are essentially like any other animal. They have the same motivations that other animals and humans have, such as finding food, shelter, a mate, etc. Many people view snakes as sinister, but that is an imaginary personification. Humans are the only animal capable of such a trait. Snakes are not aggressive, though they can be defensive. As humans, we should view ourselves as part of the environment and work to preserve it, rather than contribute to its destruction.

Snakes are animals that many people kill needlessly, unaware that such behavior is quite ill-advised. Among other functions in our diverse ecosystems, snakes serve as natural “pest control technicians.” They efficiently consume many species that negatively affect our lives, such as mice and rats. Those versed in the natural world appreciate seeing snakes, as they are one sign of a healthy ecosystem. Moreover, besides the ethical compunctions we should feel at destroying wildlife, killing snakes is a fruitless and risky endeavor. Killing such an integral natural predator merely causes a spike in the population of the prey it was there to consume, which in turn prompts another snake to move in and fill the gap. Meanwhile, choosing to interfere with the animal dramatically increases your chance of injury.

The proper response to seeing a snake you cannot identify as harmless (which most species are) is simply to leave the animal alone. An easy rule is to “Take Three Steps Back and Walk Away.” This will prevent needless harm to both you and the animal. If you wish to reduce the number of snakes on your property in an ecologically sound and ethical manner, here are some tips:

Seal gaps and cracks in your foundation and siding. Many animals seek refuge in artificial shelters. This critical step cannot be emphasized enough. Merely removing snakes without precluding their re-entry is pointless, as another animal will simply find the same entry point.

Keep your yard manicured. Tall vegetation and debris on the ground are attractive to wildlife. Frequent watering may also attract thirsty animals. Piles of wood, rocks, and lumber are especially attractive and should be neatly stacked in a safe area away from dwellings.

Don’t offer an easy meal. A property that contains mice, rats, squirrels, frogs, fish, or other prey items will invariably attract predators. Examples of items that attract prey include uncovered trash receptacles, pet food bowls, and messy bird feeders. If you feed the prey, you are inviting the predator.

Attract predators from a higher trophic tier (higher up on the “food chain”). Installing perch poles may invite raptors to keep an eye on your yard for you.



Northern Rough Greensnake photo by Justin Sokol

Install snake fencing. Two-foot-high, partially sunken barriers made of flat metal or tight mesh tend to do well at keeping snakes out. While most snakes are efficient climbers, their natural tendency is to travel along such a barrier rather than over it.

Do not waste money on repellents. Products that claim to keep snakes away are ineffective, and many are poisons that should not be released into the environment.

Remember—there is no way to keep the outdoors wholly snake-free. These measures should only be a supplement to properly educating and training yourself, your family, and your pets about wildlife safety and identification. Only a small percentage of snakes are venomous, and everyone should familiarize themselves with those species. Even if you try to “snake-proof” your yard—you should still teach your children to watch where they put their hands and feet and to walk away from snakes. Likewise, pets should have snake aversion training for their safety and that of wildlife. Do not try to interfere with (handle, relocate, kill, etc.) any venomous species without proper training (and there should be no reason to interfere with harmless species!).

Snakebite Avoidance

Did you know? Statistically, in the U.S., you are over ten times more likely to die from a bee sting than from a snakebite! You are more likely to die in an automobile accident this week than from a snake in your entire lifetime. Most snake species are harmless. Even the venomous snakes in the United States are reluctant to bite people. They are not stupid animals and know that you are not prey. In fact—trying to kill a snake that you think may be venomous increases your chance of being bitten. This is because snakes, like any other animal, will usually defend themselves if they feel threatened. The best and safest course of action for you and the snake is simply to leave the animal alone. Every animal has a place in the ecosystem, and it is never a responsible or ecologically sound action to needlessly kill wildlife of any species.

While many people may feel that it is not their fault if they get bitten by a snake, the fact remains that it is ultimately up to you to pay attention to your surroundings and be aware of the dangers inherent to the natural world. Despite the vehement opinions of some outdoor enthusiasts, snakes do not chase people (though one may come toward you if you are between it and what it perceives as safety). If you encounter a snake that you think may be venomous, an easy rule to remember is to “Take Three Steps Back and Walk Away.” Only those people with specific reasons and proper training should ever consider handling a venomous snake. Also, just as you should treat every gun as if it is loaded, treat every snake as if it is alive. Many people have been envenomated by handling “dead” snakes. Even if decapitated, a snake’s head may be able to envenomate by reflex action! If you are bitten, do not attempt any sort of home remedies—calmly and quickly proceed to an emergency room (don’t forget to call and let them know you are coming).

Here are some outdoor safety tips you should know and teach to your family:

- **Don’t** put your hands or feet in places you have not

examined.

- **Don’t** sit, stand, or walk in the wild without looking.
- **Don’t** handle “dead” snakes with your hands.
- **Don’t** attempt to capture snakes unless you are skilled.
- **Don’t** get within striking distance (generally about half of its length) while trying to identify a snake.
- **Don’t** travel alone in areas with high populations of snakes.
- **Don’t** disturb snakes or try to kill them.
- **Don’t** gather firewood after dark or without looking carefully.
- **Don’t** wear low-cut shoes or swim in areas known to harbor venomous snakes.
- **Don’t** sleep on the ground near woodpiles, cave entrances, or swampy areas.
- **Don’t** turn over rocks, logs, etc. with your hands. Don’t be careless when moving boats left on shore.
- **Don’t** crawl under fences, buildings, etc. without carefully looking under them.
- **Don’t** forget that snakes can climb trees, bite underwater, do occur at high elevations, and may enter saltwater.
- **Don’t** stay near a snake if it bites you—a competent doctor can diagnose snakebite clinically without an identification.

Snakes and other wild animals try to avoid or hide from people. Many snakes will stay motionless hoping to go unnoticed. If they think they have been seen, they typically try to give you a courteous warning such as vibrating their tails or gaping their mouths (cottonmouths). That is the animal equivalent to saying, “Excuse me please and watch your step.” They are not looking for trouble, and they’re hoping that you are not, either. If we do our part to cooperate by not stumbling into them unawares and by leaving them alone when we encounter them—we can all get home safely!



Eastern Copperhead photo by Justin Sokol

**Remember that snakes are not “out to get you.”
Snakes bite for the same reasons other animals do (typically surprise or self-defense). Be aware of your surroundings, and if you see a snake—SIMPLY LET IT BE.
You do not have to kill animals to be safe.**

Snakebite Treatment

There is a lot of incorrect information still in books and often repeated about what to do if a snake bites you. Fortunately, the correct response is straightforward enough for anyone. You probably already have the most effective and up-to-date snakebite treatment kit in your pockets right now. The only two items you really need are a car key and a cell phone. The key is to have someone drive you to the nearest qualified emergency room, and the phone is to let them know you are coming (or to call an ambulance, if needed).

The following is a list of things NOT to do in response to a snakebite:

- **Do Not** hang around the snake trying to kill or capture it. Take a photo if you can do so safely, but **DO NOT** bring the snake to the hospital. Any doctor that is competent to treat snakebite can diagnose your symptoms clinically. If your doctor cannot tell whether you were bitten by a viper or an elapid, consider transferring to a different hospital. If you must stay, you can request that your physician contact your regional Poison Control Center for a medical toxicology consultation.
- **Do Not** make incisions and attempt to “suck the venom out.” That only serves to damage tissue that has already been traumatized and provides a path for infection.
- **Do Not** apply heat. Heat will circulate the venom faster and will probably make the area hurt worse. A short application of a cold pack (less than five minutes) may be acceptable.
- **Do Not** apply a tourniquet—your appendage needs blood circulation to stay healthy.
- **Do Not** apply electricity to the bite (yes, some people think you are supposed to do this!).
- **Do Not** bother with “extractor” products that claim to be able to remove venom—they will not help and may do harm.
- **Do Not** consume food, drink, or blood thinners (including Aspirin or alcohol) which would help the

venom circulate faster.

- **Do Not** apply a compression (Ace® type) bandage following a hemotoxic or cytotoxic envenomation, such as one from a Rattlesnake, Cottonmouth, or an American Copperhead. These toxins work to break down tissue, so restricting the venom to the bite area may amplify this effect. If you receive a bite from a species with neurotoxic venom (coralsnake, mamba, etc.), a light compression bandage may be indicated, as this toxin works primarily on the nervous system, so preventing it from reaching vital organs may be of benefit. Compression bandages are more important with several Old World elapids.
- **Do Not** delay treatment. While many people may elect to forgo treatment to save money, an envenomation is a medical emergency, and you should seek treatment immediately.

Here are the only things you should do if bitten:

- **DO STAY CALM.** An elevated heart rate will only circulate the venom more quickly. Your chance of dying from snakebite in the U.S. today is a mere 0.0007% (other countries vary). You are not about to keel over dead—calm down.
- **DO** remove all rings, bracelets, or other constricting items which may cut off circulation or be difficult to remove later.
- **DO** position a viper bite at or above heart level, if possible. Position an elapid bite below heart level.
- **DO** proceed calmly to the hospital. If you experience systemic symptoms (e.g., difficulty breathing), stop and call for help.

Proper wildlife education helps to dispel the myths and fear surrounding these valuable members of our ecosystem. While snakebites are painful and best avoided, hopefully, this information helps you to stay calm and respond appropriately!

Texas Gulf-Coast Coralsnake photo by Armin Meier



It is a good idea to identify the hospital nearest you with a competent medical toxicologist ahead of time so that you know where to go *before* there is an emergency.

The Maligned Cottonmouth

Cottonmouths, also called Water Moccasins, are perhaps the most unjustly maligned animals in North America. These snakes do everything in their power to avoid issues with people, but somehow they have an infamous reputation among serpents. It is ingrained in the American psyche that cottonmouths are deadly, mean, and aggressive. They supposedly chase people, lie in wait to drop in boats, collect in huge “nests,” and many other myths.



Northern Cottonmouth photo by Peter Paplanus

People believe these statements so firmly that merely remarking that cottonmouths are not aggressive can be enough to enrage some people. So feared are these little animals that people regularly claim to have narrowly escaped with their lives from cottonmouths in states where they do not even occur.

Oddly enough, there are no reports of this behavior from the multitude of professionals that regularly encounter these snakes in the wild. If these animals were as fearsome as everyone claims, one would expect that there would be at least a little bit of empirical evidence of these behaviors. On the contrary, published scientific accounts regarding cottonmouths paint a very different picture. One notable example is that of biologists “Whit” Gibbons and “Mike” Dorcas, who designed tests and equipment to measure cottonmouths’ responses to human intrusion. They recorded eighty interactions with cottonmouths, focusing carefully on their reaction to ever-increasing harassment. Of course, many snakes es-

caped before the men could get close enough, which is what snakes prefer to do. When they did manage to approach a snake, they first stood next to it, then stepped on it (in protective gear), and/or picked it up with tongs fashioned to resemble an arm and hand. The scientists counted how many animals responded by 1) attempting to escape, 2) acting defensively (gaping, musking, feigning a strike, tail rattling), or 3) biting the boot or “hand.”

Can we agree that *any* animal would have ample excuse to bite anyone acting in such a fashion? Nonetheless, of the snakes they stood right beside, **none** (0%) bit them. Of the 22 that they stepped on, 15 made a defensive display, but only **one** (<5%) bit their boot. Of the 36 they picked up, only **thirteen** (36%) bit the “hand” where it was grasping them. Most any unbiased person would admit that these results show a great deal of forbearance on the snakes’ part.

These results are precisely what people familiar with snakes would expect to see. Cottonmouths flee if they can, but they are not particularly agile creatures and sometimes remain where they are in hopes that the threat will pass. If a person gets close, they display their telltale white mouths by gaping and often vibrate their tails. Wise naturalists interpret this as a clear and polite warning. Even if stepped on, the snakes (who are not stupid) will try to avoid biting, if possible—and why shouldn’t they? A bite would not immediately incapacitate the person and would likely escalate the encounter. Even if we are so dense as to ignore their warnings and go so far as to pick them up, they are still unlikely to bite, even when they have reason to assume we intend them harm.

It is hard to know how to help these snakes overcome the ridiculous reputation we have imposed upon them, but hopefully, education can help at least some people shed their causeless hatred for them. You only need to know one cardinal rule—if you see a snake that you are not positive is harmless: simply take three steps back and walk away. *You do not need to kill wildlife to be safe!*



Northern Cottonmouth photo by Peter Paplanus

The vast majority of “cottonmouth” sightings are cases of mistaken identification. Many people in the eastern U.S. tend to assume that most snakes are cottonmouths, but this just isn’t so.

Study cited: Gibbons, J. W., & Dorcas, M. E. (2002). Defensive behavior of cottonmouths (*Agkistrodon piscivorus*) toward humans. *Copeia*, 2002(1), 195-198

American Box Turtles

Most anyone who has ever seen a box turtle remembers the experience fondly. They are endearing, intelligent, and long-lived. When we set up our box turtle pen at wildlife events, children make a beaten path around it in their excitement to see and touch them. Many would agree that the world would be a poorer place if box turtles were no longer in it, but that is a real risk if we allow their populations to keep declining at the current rate.

“Boxies” are unique animals with loads of charm. Potentially reaching ages of over 100 years, they are a semi-aquatic species, capable of swimming, but preferring to spend most of their time in mesic forests and grasslands. Their name derives from their hinged plastron (underside), which enables them to shut themselves up completely against predators. Most wild individuals have numerous battle scars that tell the tale of this successful adaptation. They are true omnivores. When you are only a hand’s breadth tall, it is a handy trait to make use of any available foodstuffs found in that narrow plane. The unique shape of their domed shell lends a remarkable strength that allows them to remain unscathed even if stepped on by our largest land mammals.

Alas, as varied as their remarkable adaptations are, they are of little use against the onslaught of human expansion. Their habitat is almost universally fragmented, and their natural response of closing themselves up makes them sitting ducks to passing motorists when crossing roads. Their strong dome shape is no match for car tires. People tend to collect them as pets; in fact, commercial collection for the pet trade has wreaked havoc on their populations in some areas. Unfortunately, it is not the norm for people to account for their varied diets or longevity in captivity, so a slow decline is the norm for these wild-caught pets. Another tragic aspect of their interactions with humans results from their high site fidelity (attachment to their home range). Caring but misguided individuals will often relocate them when they are dis-

covered in yards or on roads, but studies have shown that mortality for translocated individuals is exceptionally high. Another important aspect of box turtle biology is their low replacement rate. In the wilderness, it can often take a turtle’s entire lifetime to leave behind enough offspring to hold their numbers steady. This means that each casualty or collected animal may mean not just the loss of that individual but also the loss of their number in that population for the future. When combined with other results of human activity—invasive fire ants, pollution, habitat loss, etc.—it is easy to see why in just our lifetime we have seen a drastic reduction in their numbers.



Eastern Box Turtle photo by Bob Ferguson

More so than with many other animals, it is crucial that we preserve their habitat now, and leave them in it when we see them there. If you encounter one in the wild—take a picture if you like, but never take the turtle. Each of us can also be attentive as we drive, especially in the spring and summer in rural areas. If you help one across the road, leave it nearby and not some other place you think is “better.” You can also educate others about their plight. “Boxies” need as many people on their side as possible! Effectively rebounding from population decline is not one of their many remarkable traits, but with more people practicing Conservation Through Education there is still hope for these wonderful little animals.



If ever there was a reptile that needs and deserves our help, box turtles would surely make that list. Take the time to educate yourself about their unique qualities and consider educating others in turn. These special animals face tremendous pressures and need all the help they can get!



Eastern Box Turtle photo by Tim Spuckler

The Mischievous Ratsnake

In the southern and eastern U.S., a particular genus of snakes is virtually synonymous with getting into trouble—*Pantherophis*, also known as ratsnakes (or, sometimes, “chicken snakes”). As someone who routinely receives calls to rescue snakes in homes, cars, offices, garages, etc., as soon as the phone rings my first thought is, “What did a ratsnake get itself into this time?” This is in large part because they are such active foragers. Rather

fires. If a ratsnake is frequenting your property, it is likely performing a valuable service! While it is true that they also consume birds and eggs, the wise chicken keeper considers a few missing eggs a small price to pay for the services they provide.

In urban settings, ratsnakes often find their way into houses and other structures while in search of prey or shelter. There is no reason to get upset at the snake in these circumstances. Snakes cannot be expected to understand and respect human property rights, nor should they have to, as they were in North America before any humans set foot here. When encountered, simply let the animal go its own way—there is typically no need to interfere. If they are somewhere unsafe, it is not difficult to move them. They are harmless, but it is best to stay calm and try to avoid making them feel threatened. You may wish to don gloves or use a broom to “shoo” them into a container, though just picking them up is usually the simplest option. There really is no reason to kill a ratsnake—they are beneficial animals and not out to harm anyone. If you see one outside and you really feel you must do *something*, a quick spray with a garden hose should make the animal move along.

There are several species of ratsnakes, but if you are not in their range, there is likely a similar species filling the same ecological niche in your area. Take some time to familiarize yourself with common beneficial snakes like these and try to overcome any trepidation you may feel at sharing their habitat. While all snakes are beneficial in different ways, ratsnakes and their kin are a good “starter species” to resolve not to kill. Hopefully, once you begin to respect these animals, you will progress to appreciating every species for the role it plays in the ecosystem. Adopt the outlook that cooperating with nature is preferable to fighting with it!

Western Ratsnake photo by Justin Sokol



than waiting for food to show up, they greet the day by going out to find breakfast. They possess considerable assets to help in their quest—a tongue that can sense minute particles in the air (even indicating the direction a prey item traveled), good eyesight, and the ability to climb an amazing range of surfaces.

For whatever reason, people commonly confuse ratsnakes with venomous snakes, and many tragically die because of misidentification. Such actions are shortsighted, as these are very beneficial animals. They are remarkably efficient rodent predators (hence their name), and rodents are responsible for a great deal of agricultural destruction and are a leading cause of house

Western Ratsnake photo by Micha Petty



Like many snakes, ratsnakes tend to become darker as they age. Many people are surprised that juveniles and adults are the same species. Become familiar with the range of their appearance so that you can identify them confidently and quickly, and encourage your friends not to kill these harmless snakes.



Hog-nosed Snakes

Many reptile enthusiasts consider hog-nosed snakes (*Heterodon* spp.) to be their favorite snakes, and rightfully so! These enigmatic critters, often called “spreading adders,” are certainly the thespians of the reptile world. Hog-nosed snakes are variable in coloration, though they start their lives with a brown over tan pattern and many become darker before they reach their adult length of up to 47” (1.2 m). Like many colubrids, they have enlarged (but still tiny) teeth that seem to assist them in subduing prey, but they are considered harmless to humans.

They are quite innocuous unless you happen to be a toad. They have an up-turned rostral scale (a “scooped” shape to their snout) which they put to use searching for their favorite amphibians beneath loose soil or leaf litter and which many people find quite endearing. Also handy when using their face like a shovel is their ability to spread their necks out very wide and flat, and they have been observed to dig quite determinedly at times in search of dinner.

If they feel threatened, they usually respond by spreading their neck out and hissing in an attempt to appear as menacing as possible. Upon witnessing this act, many people unfamiliar with snakes have indeed wondered if they had somehow encountered a loose cobra. If approached closer, they will often feint as if to strike, though it is exceedingly rare for one to bite a person (the only reports of it happening have been feeding mishaps with captive snakes). To those that know how harmless “hoggies” actually are, it can be quite comical to see them pretending to be so ferocious.

If a predator is not scared off and persists in their attention, the snake will often play dead with a remarkable enthusiasm. They flip on their backs, let their tongue loll about, and will often even expel musk from their vent to try to smell unappetizing. If righted, they will flip back

over and continue acting. Anyone not familiar could easily believe this play they put on. After a few minutes, they will often raise their head up to look about, and if anyone is still watching, they will flop down harder and try to stick their tongue out even farther!



Western Hog-nosed Snake photo by Armin Meier

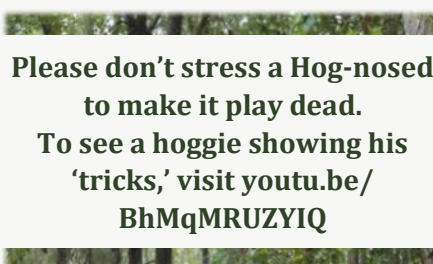


Mexican Hog-nosed Snake photo by Mike Kolb

Unfortunately, many believe their attempts to appear menacing and kill these snakes as a result. If you live in their range—please take a moment to become familiar with their appearance and behavior. Then you can help others appreciate these harmless little actors and be confident advising them that there is no reason to harm these unique members of the ecosystem!



Eastern Hog-nosed Snake photo by Tim Spuckler



Please don't stress a Hog-nosed to make it play dead. To see a hoggie showing his 'tricks,' visit youtu.be/BhMqMRUZYIQ



Eastern Hog-nosed Snake photo by Leah Jones

Treefrog Tubes

Here is a quick, easy, and cheap project that can make the lives of some endearing animals a little easier and provide increased opportunities for observation. Whether as a fun project for the family or to engage your youth or nature group, building treefrog habitats is something anyone can do. Hanging a tube that holds a small amount of water creates a humid microclimate where treefrogs can rest and feel secure during the day. No special skills are needed, the tubes are quick to construct, and you only need a few tools and materials.

Green Treefrogs photo by Renee L. Strnad



There are two ways to go about making the habitat. Some people simply drive tubes into the ground and either let them drain into the soil slowly or drill a drain hole above ground level. The more common method is to make a tube and hang it on a vertical surface such as a wall, tree, or fence. There is no set length that the tubes must be, but two feet (61 cm) is a decent recommendation. Many home supply retailers stock PVC pipe already cut to this length, or you can buy ten-foot lengths to cut multiple pieces from. Retailers sell saws for cutting PVC, but any fine-toothed saw will do the job. You will need to drill two holes in the PVC, so you will need a drill and a bit. The bit needs to have a larger diameter than the head of the nail or screw you will use to hang the tube. Exercise caution when drilling round material to ensure the drill does not slip and catch your body. Some people

paint their tubes for cosmetic reasons. While many paints may stick to PVC, spray paints designed for plastic are easier to apply and are more resistant to scratching or peeling.

Once you have your tools and materials, start by drilling one hole near the top to slide over your nail (or to affix a cord, if preferred). Drill another hole for a drain about 5" (13 cm) from the bottom and cap that end with a pipe cap. The pipe cap should fit snugly enough to hold water without being glued, as the tube will be easier to clean if the cap is removable. Brush off any shavings created by sawing or drilling, and apply paint, if desired. Your tube is now ready to be hung!

Find a quiet, partially-shaded spot and insert a screw or nail to hang your tube. You can hang it above eye level and take it down to check it, or you can install it low enough to allow an observer to glance inside easily. Pour some water in the bottom and hang up your new tube.

Depending on the season, rainfall may keep the water in the tube replenished, but you may want to check it periodically to make sure it is not dry and that the drain is not clogged. Non-chlorinated water is preferred. It may take a little while for your local frogs to find it, but they will almost certainly appreciate their new hangout once they do!

Tools Needed:

- Hammer
- Drill & bit (larger than the head of your nail)
- Saw (if purchasing and cutting longer lengths of pipe)

Materials Needed:

- 1.5" (40 mm) to 2" diameter (50 mm) by 2' (60 cm) long PVC pipe (Schedule 40)
- Pipe cap of the same diameter
- Nail or screw for hanging (may also use wire or cord)

Time to Complete:

- 30 minutes (add 30-45 minutes if painting tube to allow paint to dry completely)



Pinewoods Treefrog photo by Todd Pierson

An instructional video by the Texas Wildlife Diversity Program about creating treefrog tubes is located at youtu.be/smQtNmHqOYo

Backyard Lizards and Garden Snakes

Conserving charismatic animals like elephants and whales is undoubtedly worthwhile, but a passionate appreciation of nature often begins with those animals we feel a personal connection to. As such, becoming more familiar with the critters in your backyard just might be the best first step to appreciating your ecosystem. Each organism in your yard has a unique role, and “tuning in” to them will reveal fascinating life-and-death dramas unfolding around you each day.

One example here in the U.S. is the Green Anole. These little lizards (6”-8”/15-20 cm) have huge personalities. The males are very territorial and may be observed traveling along fence rails or basking on walls while flashing their bright red dewlaps to let the world know that is *their* fencepost. Even though many people do them the indignity not to notice, they can often be seen doing push-ups and bobbing their heads if you get too close. They are trying to make it clear that you are invading *their* space, seemingly undaunted by the fact that you are twenty thousand times their size.

If a rival male dares approach, an intricate display of posturing and bobbing ensues, with their colors getting ever-darker as each becomes increasingly irate at the gall of the other. If neither backs down, they will engage in an epic miniature battle, sometimes clamped down on each other’s faces for an hour or more, circling and holding on, faces black with rage, the skin on their neck standing up like hackles on a dog, both refusing to give way, each confident that they will vanquish this brazen interloper. Keen naturalists find that the interplay between little critters such as these can be more riveting than many a Hollywood drama!

From the other end of the personality spectrum, you almost certainly have small snakes in and amongst the leaves and soil of your yard or garden, such as DeKay’s Brownsnakes or Rough Earthsnakes. Scarcely more

than a handspan and about as harmless as an animal can be, these peaceable little snakes can be fun to watch catching a worm. When you don’t have any

Green Anole photo by Bronc Rice



limbs and your slippery prey is almost as big as you are, struggling to get the best of it can get intense. These adorable serpents will grab onto a plant stem with their tails and play tug of war for as long as it takes to get that juicy worm up out of its hole. The fact that some people kill these little guys is tragic and unnecessary, particularly when it is so easy to learn what they are.

Get to know the toad that lives under your porch or the skink that lives under the flagstones. None of them want to harm you, your pets, or your children. As you learn their ways, you will begin to appreciate an increasing variety of complex interactions going on all around you that you will hopefully want to protect and conserve. An intimate knowledge of nature comes from “little things” such as these, and it is all happening right outside your door!

DeKay’s Brownsnake photo by Mario Ramos



It can be disconcerting for some people to notice snakes in their yard. However, these snakes are overwhelmingly harmless and contribute to the health of your yard and garden. Learning to identify the animals that share your space will reduce any fear you might have and help you appreciate these little guests!

Relocating Reptiles

Translocating any wild animal should not be done needlessly or thoughtlessly. Often, snakes are moved (or killed) out of fear. Instead of trying to eradicate or control wildlife, we should increase our willingness to live peaceably with nature. Though there are times where introducing an animal to a new location may be warranted, such as repatriation of a species back into its historic

Translocation is also bad for the individuals being moved. One reason for this is that many animals display a high degree of site fidelity. Well-studied examples include North American Box Turtles and Timber Rattlesnakes. The animals become familiar with their home range and do poorly when removed from these surroundings. While calling translocation an automatic death sentence may be a bit of an overstatement, studies have shown that mortality among translocated animals may exceed seventy percent. These animals occasionally establish new home ranges at or near their introduction site, but more often they will wander indefinitely, apparently searching for the home they once knew. While transient, these animals often succumb to starvation, temperatures, road injuries, attacks by domestic animals, or other hazards.

Many people think that more animals have a “homing instinct” than is actually the case. While some animals (e.g., sea turtles) do possess an uncanny ability to return to a known location across great distances, many other species (e.g., box turtles) apparently do not. When tracked with radio telemetry, translocated individuals of the latter type set out in directions that appeared statistically random, rather than a guided effort to return to their origin. Consequently, moving some animals as little as a mile or two may prove disastrous.

Some caring humans make a habit of moving an animal “somewhere safer” when they observe one crossing a road or entering populous areas. However, published accounts indicate that, at least with many species, these attempts at assistance may be misguided. The wise naturalist, therefore, will focus on education and improving habitat instead of piecemeal relocations. With so many species in decline, each animal matters even more, making it important that we learn to leave each one be. Please encourage those you know to leave animals where they are found!



Three-toed Box Turtle photo by Justin Sokol

range, moving an animal more than a short distance (such as across a road or back outside) is usually inadvisable. There are many reasons for this. One concern that biologists have is maintaining the natural genetics of wild populations. Transplanting an animal into a population with a different gene pool confuses study of these animals and may have subtle but deleterious effects. Another huge reason not to move wildlife is the possible transmission of disease, such as the various chytrid fungal strains currently killing snakes and amphibians. Affected animals may appear healthy (these diseases are often undetectable outside of a laboratory setting), and the introduction of even one carrier may have devastating effects on a wild population. As much as we may want to help an individual animal, it is irresponsible to do so at the potential expense of entire populations.



Northern Pacific Rattlesnake photo by Chad M. Lane

Most reptiles do better in the area they know than when moved to unfamiliar territory. Trying to help by moving one to a “better” location is a bit like dropping a young child off in a new city by themselves and expecting that they will be okay.

Reptile Rescue and Removal

Reptiles manage to get themselves into all sorts of trouble. I get calls to extract snakes from all manner of odd situations. In my area, the culprit is usually a Western Ratsnake, as they have excellent climbing skills and are active foragers. You likely have similar species in your area. These animals could benefit from more people willing to help them out of predicaments.

If you are a kind soul that wants to rescue snakes so that people don't kill them—the first step is become competent at identification. You need to know at a glance whether the animal you are approaching is harmless. The next step is to research wildlife laws in your area. Some government authorities require licenses or permits to interact with wildlife, others may only require them if you charge a fee for your services. There may also be separate laws that address releasing wildlife. The best practice ecologically is to release the animal as closely as possible to where you find it. In some areas, you may need express permission to use a release site, or there may be other restrictions. Make sure you are safe and legal before you do anything else.

Once you know you are capable and cleared, you can start by reaching out to various places that the public might call to look for help—nature centers, municipal animal control agencies, pest services, police and fire departments, etc. Let them know you are willing to save a snake if the situation arises, and you will probably get your chance. People sometimes call to report a snake outdoors. I use those conversations as educational opportunities, since seeing an uninjured wild animal outdoors does not require a response. Let the caller know that they should appreciate the free eco-friendly pest control service that snakes provide. If they are still concerned, I advise them that a couple of quick sprays from a garden hose usually bridges the language barrier and

send them a link to more information on how to make their yard less attractive for wildlife, if desired.

For situations where a snake does need removal from where it is, I usually bring some rubberized gloves, a snake hook, and a cloth sack with a drawstring for transport (always tie the bag securely!).



Western Ratsnake photo by Tasha Conley

An assortment of tools may also be helpful for tasks like removing a trim panel to extract a snake. I also carry vegetable oil for glue traps and some blunt-tipped grooming scissors for netting entanglements. Always sterilize any equipment used to prevent cross-contamination of the animals. For venomous species, it may be advisable to have snake tongs and a bucket with air holes and a screw-on lid. Never free-handle a snake you cannot positively identify as harmless!

Most calls are quite routine. It is usually a simple matter of collecting a harmless animal that others are too scared to approach. Try to use every call as an educational opportunity to impart some natural history and tips for living with wildlife and commend them for calling for help instead of needlessly killing the animal. Always be honest with the public and observe applicable laws. This will help you and the animal avoid trouble and helps portray wildlife lovers as a whole in a positive light. **Stay safe!**

Often, snakes seem to sense that they have gotten in over their head and act as if they appreciate your help. Others may insist that they didn't ask to be rescued. Always remain calm and cautious. If an animal is injured, call a licensed wildlife rehabilitator.

There are helpful links at learnaboutcritters.org/wildlife

Western Ratsnake photo by Micha Petty



Watch for Wildlife on the Road

There are many threats to wildlife in our modern world. While not all those threats are of human creation, the pressures we have created are taking a remarkable toll on many species. Habitat destruction (the clearing and changing of land for development or other uses) and habitat fragmentation (the dividing of land into sections separated by altered landscape) have a significant impact on wildlife, particularly for terrestrial species such as

Eastern Box Turtle photo by Paul-Erik Bakland



mammals, reptiles, and amphibians. For example, slow-moving turtles are especially vulnerable to road traffic, as their natural inclination when threatened is to withdraw into their shell, which makes them unable to avoid a collision and appear more like debris in the road. Traveling animals likely took quite some time to build up the courage to cross this strange barrier in their habitat, and a moment's carelessness on our part can spell disaster. While it is not reasonable to expect that humans will stop developing land or building roads anytime soon, each of us can do our part in reducing road injuries while we drive. Here are some simple tips you can practice to help reduce road injuries.

Be alert as you drive. If you see a dark shape on the road surface, don't assume it is just debris. In springtime and around dusk especially, it may likely be wildlife. Stay alert in wooded areas—the fewer cars there are around, the more likely you are to encounter wildlife.

Northern Cottonmouth photo by Luke Smith



Be especially cautious near bodies of water. Turtles, frogs, salamanders and other creatures live in and around water and many emerge to find food, seek a mate, find nesting sites, or look for new homes at various times of the year.

Be cautious on rainy nights. Many amphibians choose this time to migrate to or from nearby bodies of water for mating or other purposes. Consider using fog lights in adverse weather to better illuminate animals on the road surface.

If you see an animal and can do so safely, slow down and maneuver around them. Always be aware of surrounding traffic!

If you see an animal and cannot maneuver around it safely, try to avoid hitting it with your tires. Many small animals will clear a vehicle's chassis and may be passed over without harm.

If you are a kind soul who wants to stop and help—the first thing to remember is traffic safety. Never cause a human safety hazard for yourself or other motorists. Be aware also of the effect a stopped vehicle has on other traffic. People may focus on your car and hit an animal they might otherwise have seen and avoided.

If you can move a turtle or other reptile safely, try to move it in the direction it was going. Bring the animal as far off the road as reasonably possible.

If it is not injured, leave it in the wild where you found it. This is particularly important for box turtles. They have a high site fidelity (attachment to their small home range) and often will wander indefinitely if relocated.

If you find an injured animal, contact a wildlife rehabilitator. Bear in mind that rehabilitators do not get government funding and are merely concerned citizens trying to help animals out of their own pocket, so please consider donating if you can. If no wildlife rehabilitator is available, consider bringing the animal to a vet, even if it is only for humane euthanasia. Injured animals should generally be kept warm and transported in a sturdy, dark container with a minimum of handling. Don't forget to wash or sterilize your hands after handling any animals and take care not to get injured—an animal in pain is more likely to lash out. More info at learnaboutcritters.org/wildlife

Roads cover around 1% of the world's land surface, but scientists estimate that they affect 15-20% of wildlife habitat through fragmentation. Let's do our part and be alert as we drive!

Snake Myths & FAQs

What can I buy to keep snakes out of my yard? Nothing. Products that purport themselves as snake repellents do not keep snakes away, and most of them are harmful to the environment, wildlife, and your family. L.E.A.R.N. has a bulletin about ecologically reducing snake sightings if that is your desire.

How do I keep snakes out of my home? To keep snakes and other wildlife out of any building, you must physically preclude entry. This means sealing gaps and cracks in your foundation, siding, utility entrances, etc. Consult a local home repair contractor for assistance, if needed.

Are all snakes poisonous? No. Only about one in five of the world's snake species are venomous (a more correct term regarding vipers and elapids). Regional percentages may fluctuate from this percentage, but most snakes you might encounter are harmless. All snakes—even venomous snakes—are beneficial and integral members of the ecosystem and should be treated with respect.

Are there any snakes that are poisonous (instead of venomous)? Yes, there are a few species of snakes, such as the Tiger Keelback in Asia, that sequester toxins from their prey and cause ill effects in predators that try to consume them.

Do rattlesnakes gain a rattle each year? A rattlesnake adds a segment to their rattle each time it sheds its skin. Snakes shed multiple times per year, with the frequency being relative to age and growth rate. Older snakes typically have incomplete rattles, having lost portions in the course of life in the wild. You cannot accurately determine age by rattles; however, you can tell how many times the animal has shed if you see a complete rattle that still contains the original button at the tip.

Can venomous snakes crossbreed with non-venomous ones? No. While there are snake species that are closely related enough to hybridize, venomous and harmless snakes are not that closely related. All reports regarding any venomous-harmless crossbreeds are unfounded.

What are “glass snakes?” This misnomer refers to legless

lizards. One recognizable difference is that these lizards have eyelids, whereas snakes do not. The description of “glass snake” or “glass lizard” refers to these lizards being able to autotomize (drop) their tails when threatened. The tail continues to wriggle, which makes both halves seem alive. In the past, people may have witnessed this and possibly noticed that the tail was gone the next day (often consumed by another predator). When the lizard was again seen with a regrown tail, this evolved into the belief that the animal could “put itself back together.”



Mohave Rattlesnake photo by Kameron Orr

Do snakes bite underwater? Yes, snakes, including venomous species, can bite underwater. In fact, many snakes do most of their hunting underwater.

Do snakes chase humans? No. Snakes do not view humans as prey items and prefer escape over a potentially dangerous encounter. However, a snake may approach a person that it does not perceive as a threat. It may also flee in a human's direction if the human happens to be between the animal and what it views as safety. If made to feel cornered, many snakes will defend themselves, as will most animals. Snakes may also bite out of surprise if stepped on or approached suddenly; for this reason, it is important always to be aware of your surroundings, so as not to place your hands or feet on or near a snake unwittingly.



Eastern Copperhead photo by Micha Petty

In this age of information, it may seem absurd that some of these myths still abound. However, these and other myths are still quite prevalent in many areas. This is one of the reasons why Conservation Through Education is so important.

Snake Myths & FAQs 2

Do milksnakes really drink milk? No. Milksnakes are a type of kingsnake. They eat small vertebrates, such as mice, lizards and other snakes. They got their name from being seen around barns smelling and searching for the small animals, but some people thought they were there to get milk. They are not the only snakes that people might see near barns, but their unique coloration makes them memorable. This belief became widespread, and they still retain the name milksnake to this day.

Northern Cottonmouth photo by Justin Sokol



If I see a baby snake or snake eggs, is the mom nearby? Probably not. While some snakes give live birth, and it is possible to stumble upon them during that time, snakes are secretive, and this event is rarely witnessed. Most young snakes do not receive parental care like birds or mammals and disperse soon after being born. For most egg-laying species, the mother deposits the eggs and then leaves them to hatch many weeks later. Many people do not realize that several harmless small snake species grow to less than a foot in length as adults. Many “baby snake” sightings are people seeing adults of these small species.

Do Cottonmouths wait in trees for boats to drop into? No. Cottonmouths rarely climb trees, so any snake sighted in a tree near water will almost always be a watersnake or other harmless animal. Although snakes may fall into boats, this is not something they do intentionally. Many wild animals respond to large animals that they

view as potential predators by remaining still in the hopes of going unnoticed. In the case of a snake on an overhanging branch, a snake that accidentally falls into a boat would be trying to slip into the water, having decided that you are approaching too close for comfort. The animal is attempting to escape, not attack.

Isn't the only “good” snake a dead snake? *Absolutely not!* All snakes—including venomous snakes—are beneficial members of the ecosystem. Without these key predators, we would soon be overrun with the animals upon which they prey. For example, many snakes eat mice and rats. These rodents, which are often non-native animals, are substantial culprits in agricultural destruction and are a leading cause of house fires as they chew on electrical wire insulation. If you encounter a snake in your yard, the best thing to do is leave it alone and thank it for performing a free, eco-friendly pest control service.

Shouldn't I at least kill venomous snakes? Again, no. Not only are venomous snakes highly evolved and fascinating, beneficial animals, but a great many bites occur as a person is trying to kill or harm a snake. Attempting to kill a snake puts you in more danger, as almost any animal will attempt to defend itself if threatened. The best response to a snake you cannot identify as harmless is simply to take three steps back and walk away.

If I get bitten by a snake, should I attempt to suck out the venom? No. This and other techniques such as applying a tourniquet have been refuted by medical toxicologists for quite some time now. However, since this information is still written down in so many books, many people still believe it to be true.

What about electricity? I was told that “shocking” the poison would neutralize it. Is this true? *Heavens no.* If a venomous snake has bitten you, please proceed quickly and calmly to an emergency room. Please do not stop to shock yourself. (However, if you do, please upload the video to YouTube as soon as you are well!)

Do snakes hypnotize their prey? No. As snakes lack eyelids, they may appear to exhibit a piercing and prolonged stare. Animals that freeze at the sight of a snake would be doing so out of fear and the hope of going unnoticed.

Santa Cruz Gartersnake Photo by Chad M. Lane



It may be tempting to scoff at people who still believe some of these myths. However, we are all ignorant until taught. To learn more, visit these Facebook groups: [Introduction to Herpetology @HerpIntro](#) [Wild Snakes: Education & Discussion @snakeED](#)

Snake Myths & FAQs 3

Don't dangerous snakes have "cat eyes?" Yes and no. While pit vipers such as rattlesnakes do have elliptical pupils, elapids such as coralsnakes have round pupils. Also, several harmless species of snakes have elliptical pupils. This by itself is not a reliable method of identification.

Aren't dangerous snakes the ones with the "triangular heads?" Again, yes and no (but mostly no). While venomous snakes do have venom glands towards the rear of their head, which can give the heads of some snake species a somewhat triangular appearance, this is an **extremely unreliable** indicator of whether a snake is dangerous. All snakes can flare their head or neck out to appear more menacing if they need to ward off a predator. Some harmless snakes, such as Hog-nosed Snakes, are known for doing this to a dramatic and almost comical degree. Most snake species are harmless, and most identifications based on head shape are in error.

I heard a snake rattle its tail at me, but I didn't see rattles on the snake. Was it a rattlesnake? Probably not. Many snake species, such as kingsnakes and ratsnakes, will rapidly vibrate their tails to communicate agitation. Like head flaring, this is an attempt to seem more menacing than they really are. While it is possible that you might see a rattlesnake that has lost its rattles, it is almost certainly a harmless snake merely trying to ward you off.

Do snakes whip people with their tails? No. Snakes defend themselves by fleeing, hiding, 'musking' (excreting a foul-smelling substance from their vent), playing dead in some cases, flailing, and (usually if all else fails) biting. While many large lizard species will use their tail in defense, snakes do not. Coachwhip Snakes got their name from their coloration and scale pattern appearing whip-like.

What about "hoop snakes?" Stories about snakes that bite their own tail and then roll away or down a hill in a hoop shape are entirely mythical. Snakes do move about in many different ways, but this is not one of them.

Can't some snakes sting you with their tails? No. Stories

like this probably originated with animals such as mudsnakes. Mudsnakes prey on salamanders, which happen to be slippery. They have a sharp, pointed tail, which probably facilitates them holding or positioning their prey. No snake species has any sort of "stinger" on its tail.

Do snakes spit? While some African and Asian species can project venom as a defensive mechanism, no American species are able to do so.



Cape Cobra photo by Bionerds

If I see a snake in my yard, shouldn't I call someone to remove it? No. Snakes are a sign of a healthy ecosystem, and if one is hanging around it is likely performing a valuable service by consuming species that people consider pests, such as rats or slugs. Removing a snake from its home area will only result in three likely outcomes—the snake may die before it reestablishes itself in unfamiliar territory, the animals it was keeping in check will have a spike in population, and another snake will discover the abundance of prey and move in to take its place. Learning to live with and appreciate wildlife is the goal we should set for ourselves and our families. Most snakes are harmless, but if you do encounter a venomous snake, attempting to move or kill it actually increases your chance of being bitten, as almost any animal will defend itself when threatened. *Please simply let the animal be.*

Sinaloa Milksnake photo by Armin Meier



Baby venomous snakes are not more dangerous than adults. Young snakes produce essentially the same venom as adults, but in smaller quantities. The amount of venom delivered—not the age of the snake—determines the severity of a bite.

Please Keep Domestic Cats Inside!



For their own good and the good of wildlife...

Please Keep Domestic Cats Inside!

Domestic cats are great companions to many people and deserve a safe and happy life. The outdoors presents many dangers to them and outdoor cats present a hazard to wildlife. Please make sure your feline friends and wildlife stay safe and happy by keeping your cat indoors! Likewise, even though it may be an emotional issue, the humane elimination of feral feline populations will reduce both their suffering and the staggering destruction they cause annually.

Why are cats an issue for wildlife?

Cats have contributed to the decline and even the extinction of many species of birds and many small mammals around the world, mostly on islands. Scientists estimate that every year in the United States free-roaming cats kill hundreds of millions of native birds and small mammals, amphibians, and reptiles, including species of conservation concern and more common species. Cats are recognized as a widespread and serious threat to the integrity of native wildlife populations and natural ecosystems. Although many free-roaming cats appear healthy or happy at a given point in time, they typically have hard lives and high death rates that result in reduced longevity. Their run-ins with wildlife include competition, predation, and disease transmission.

fws.gov/nationalkeydeer/pdfs/FeralCatsFactsheet.pdf

JUST A FEW EXAMPLES OF THE DANGERS TO OUTDOOR CATS...

GETTING STOLEN
POISONING
BEING TRAPPED
BEING RUN OVER
HEARTWORMS

ANIMAL ATTACKS
PREGNANCY
GETTING LOST
CATFIGHTS
FELINE LEUKEMIA

OVERHEATING
HYPOTHERMIA
INTERNAL PARASITES
EXTERNAL PARASITES
FELINE AIDS



Herps Save Lives!

Of course, reptiles and amphibians have inherent value as beneficial and fascinating members of the world's ecosystems. However, even if you or those you know have not embraced this philosophy, there are literally millions of great reasons to value them anyway—all the lives they continue to save! Many significant medical advances of our modern age were made possible because of research into herps, particularly snake venoms. It's not a big stretch to say that by committing to herp conservation the life you save could one day be your own!

Here are just a few examples of ongoing research and breakthroughs made possible by herps:

- Eptifibatide (Integrilin) prevents blood from clotting and is used by doctors to prevent heart attacks. It is derived from a protein found in Pygmy Rattlesnake (*Sistrurus miliarius*) venom.
- Tirofiban (Agrastat) is derived from a protein contained in the venom of saw-scaled vipers (*Echis* spp.); it prevents blood clots from forming and is used with Heparin in the treatment of heart attacks and coronary artery disease.
- Studies into the venom of the Jararaca (*Bothrops jararaca*) led to the creation of ACE Inhibitors in 1971. Since that time, these have become the 4th most prescribed drug class in the U.S. and are used by millions of heart attack and kidney failure patients worldwide. Examples of people this viper has helped save include anyone who has taken: Benazepril, Captopril, Enalapril, Fosinopril, Lisinopril, Moexipril, Perindopril, Quinapril, Ramipril, and Trandolapril.
- α -Cobratoxin is a substance from the venom of certain cobras (*Naja* spp.). A modified version of α -Cobratoxin is being investigated for use as a treatment for Multiple Sclerosis.
- A component from Eastern Brown Snake (*Pseudonaja textilis*) venom is being developed as a treatment to stop bleeding at surgical sites.
- Proteins isolated from Horned Viper (*Vipera ammodytes*) venom are being used in cancer research for their anti-tumor activity.

- Vicrostatin, a protein derived from Eastern Copperhead (*Agkistrodon contortrix*) venom, has shown promise in slowing the growth of breast cancer tumors in mice and also their ability to spread to other parts of the body.
- Mambalgins are peptides isolated from Black Mamba (*Dendroaspis polylepis*) venom; these peptides are being investigated for use as painkillers. When tested on mice, they were found to be as potent as morphine with fewer side effects.



Eastern Copperhead photo by Armin Meier

- Amphibians are being used as research models for regenerative medicine, as some have the ability to regrow limbs after amputation.
- Exenatide, derived from a component of Gila Monster venom, is used to treat Type 2 diabetes.
- Antimicrobial peptides in Komodo Dragon blood are being researched as a potentially breakthrough class of antibiotics which could overcome the resistance common in bacteria today.

As you can see, herps have a lot to offer the world, and many of us already owe them our lives. The truth is that their value is inherent as living organisms, but the information in these bullet points may help you help others appreciate them even more!

Numerous existing medicines and the hope of many more have been made possible by our research into the fantastic adaptations that reptiles and amphibians exhibit. Consider sparing any reptiles you encounter, as their cousins have likely already helped save your loved ones—and may one day save you!



Indian Cobra photo by Kamalnv CC BY-3.0

Be Careful Where You Get Your Information

There are plenty of myths and much misinformation surrounding reptiles and amphibians. These range from the idea that snakes will chase you to devices that supposedly “suck venom out” to things as off-the-wall as shocking yourself if you get bitten by a snake. There are (no kidding) people that carry electrical weapons into the woods to possibly use on themselves! I hope they never try to treat snakebite with one of these (but if they do, I hope they upload the video to YouTube!).



Green Anole photo by Eddie Ledbetter

Many professional snake removal experts encounter the same calls day after day. Virtually every person that calls claims there is a venomous snake in their house, shed, or vehicle. They are usually confident of their identification because their neighbor or relative confirmed it or they did a ten-second image search on the internet. Upon arrival, the snake turns out to be a harmless snake virtually every time. For whatever reason, many people just seem to believe everything they are told about herps, regardless of how outlandish that information is.

The sensationalism that drives American television fuels this in part. It seems like every time a show about reptiles airs on certain networks, the knowledgeable moderators of the herp education forums must spend the rest of the evening fielding the same questions over and over. “Can Rock Pythons interbreed with Reticulated Pythons?” “Do Cottonmouths have to stay near the water or they’ll dry up?” “Are giant invasive man-eating constrictors expanding their range to encompass half the country?” The list goes on. Half the time, veteran herp enthusiasts can tell what TV rerun someone just watched simply based on their questions.

Another source of misinformation is people trying to sell you something. If you are on a website that is offering you a product to get rid of snakes in your yard or any similar service—please do not blindly take the information you find there away with you. Likewise, sites with seventy percent of the page space devoted to advertising may be feeding you information based on its shock factor rather than accuracy. Many news outlets are also a poor choice for sound herpetological advice. Although there are some devoted and knowledgeable journalists out there, too many reporters pull info from bad sources and spread misinformation.

There are reliable sources of information available, such as books, certain online groups and websites (see appendix), herpetological associations, conservation organizations, wildlife refuges, etc. Herps are worth taking the time to learn about. The trick is making sure you get your education from the right places and being willing to accept that not everything you have heard is true—even things that are “common knowledge.”

Many people fear these animals. The good news is that knowledge conquers fear. Decide to find and learn from reliable sources, and then take the time to pass that knowledge along to others!



Rough-skinned Newt photo by Ken-ichi Ueda

Many of the things people think they know about reptiles and amphibians are myths and misinformation. It would be wise to view most of what you hear from friends and relatives with a good deal of skepticism.

Part II

Classification & Diversity



Eastern Indigo photo by Lance Paden

**SNAKES ARE NATURE'S FREE, ECO-FRIENDLY PEST CONTROL
IF YOU SEE ONE IN YOUR YARD—THANK IT FOR STOPPING BY!**



LEARN
Louisiana Exotic Animal Resource Network



Eastern Coachwhip photo by Justin Sokol

A Bit About Common Names

Reptiles and amphibians tend to go by many different common names, depending on where you live and who you are talking to. One animal may have many names, or one name may be used for many different animals. This can cause a great deal of confusion and contention and is one of the main reasons biologists prefer scientific names. Of course, you will also run across many people to whom everything is a “copper-headed-water-rattler,” because they really don’t care what the animal’s correct name is. Nonetheless, we must use names in our study of these animals, so let’s look at how they work.

Alligator Snapping Turtle photo by Luke Pearson



First, you have your truly common names, meaning whatever name is commonly used to refer to a given species. This is the category that creates all the confusion. For example, in many areas, Alligator Snapping Turtles are called “Loggerheads.” Now, not only is there a Loggerhead Musk Turtle in the same range, but Loggerhead Sea Turtle is also the common name for *Caretta caretta*. You can see how quickly two people from different areas might confuse each other by using the names they are familiar with. Nonetheless, all of these various names are valid in their own right, so it behooves the curious natu-

ralist to learn these colloquial monikers.

Next, we have “official” common names. Think of these as the names that an author would use when writing a field guide. There are various committees that decide which of the names floating around are going to be the “official” names (e.g., the Committee On Standard English And Scientific Names established by the Society for the Study of Amphibians and Reptiles). In this instance, the word “common” is not referring to how widespread the usage is, but rather that it is a plain-language name and not the scientific (Latin) name. While some people consider “official” common names to be unnecessary, many institutions adhere to these names, and this reduces some of the confusion associated with common names.

A few more facts about common names:

- Sometimes “official” names are assigned for taxonomic reasons and are not in common usage.
- Some recently described or rare animals may not have a common name until lay people become involved.
- Many names that people think of as two words are officially considered compound or hyphenated words. Ex. watersnake, kingsnake, hog-nosed snake, etc.
- When referring to specific animal species, common names are proper nouns and should be capitalized. Ex. Tokay Gecko. (This rule is sometimes controversial.)

Regardless of whether you choose to keep calling *Pantherophis obsoletus* a “Black Ratsnake” or a “Texas Ratsnake,” it is probably wise to learn that the official common name is “Western Ratsnake.” This way, when someone adheres to official usage, you will know what is being discussed. This can be a lot to learn, but you don’t have to learn it all at once. Every name serves its purpose, so pick them up as you go and try to appreciate all the variety you will encounter!

Green Anole photo by Eddie Ledbetter



Names can be a major source of confusion. It is ultimately up to you how official or technical you wish to be. If your audience understands what animal you are referring to, you have passed the most important test on the subject.

The Usage and Importance of Scientific Names

It is worth taking a moment to consider scientific names. Most of us are aware of their existence; far fewer know what any of them are or why we should bother learning them. Nonetheless, the more focused someone becomes on studying the natural world is the more likely that person is to gravitate towards learning and using scientific names. Why is this? You may suspect that people just suddenly become pretentious once they get some “book learning,” but in truth, it is because scientific names are of great value to any naturalist. Common names can vary wildly from one area to the next; it is routine for two animals to be called the same name or for one animal to be called many different names. Having only one scientific name eliminates this confusion, as that name will only refer to one taxon at any given time. This becomes a valuable tool rather quickly for those engrossed in learning about nature. Scientific names also usually descriptive, albeit in Latin or Greek. Once you start picking it up, you will find that scientific names often provide insight about the animal.

These rules may help demystify scientific names a bit:

The ordering of animals into groups of related species is called taxonomy. A unique name given to each animal group of any rank is called a taxon (plural taxa).

Organisms are referred to by their generic and specific epithet. Ex. *Plestiodon fasciatus*

The general breakdown of how animals are classified is: Kingdom > Phylum > Class > Order > Family > Genus > Species. A couple of mnemonics for this are *Kindly Professors Cannot Often Fail Good Students* or *King Philip Came Over For Ginger Snaps*. There are often other classifications between these, e.g., super-order, sub-family.

When writing the scientific name of a species, only the genus is capitalized. Ex. *Coluber constrictor*.

Many people refer to scientific names as “Latin” names, but that is a bit misleading, as they may also derive from Greek and sometimes other languages. Many species are named after a person (generally someone the researcher proposing the name wished to honor).

When referring to a scientific name multiple times in the same article or post, it is proper to use the full name the

first time you type it and to abbreviate it thereafter. The proper way to abbreviate is a capital letter followed by a period for the genus, followed by the specific epithet (*C. constrictor*). With sub-species, the first two names may be abbreviated (*C. c. constrictor*). It is not proper to do this until *after* the first instance of the name being used so that it is clear what is being discussed. Also, do not begin new a sentence with an abbreviation.



Eastern Copperhead photo by Micha Petty

A taxon consisting of two words (genus & specific epithet) is called a binomial (two-part) name. An animal classified down to sub-species is referred to by a trinomial (three-part) name. When trinomial names exist, the first animal described is called the nominate subspecies. Nominate subspecies will have the specific name repeated to indicate that they were the initially described taxon. Ex. *Coluber constrictor constrictor*.

Genus and species should be italicized or underlined; higher classifications and common names should appear as plain type, and proper names should be capitalized. Ex. Animalia, Prairie Kingsnake.

Taxonomy is very fluid and dynamic. We have developed new methods of research and discovery, which allow animals to be more “correctly” classified than ever before, so changes are regularly made.

Although this rule is starting to fall out of use, the traditional form when writing a paper is to cite the source for a scientific name, meaning who initially described it and in what year (possibly helpful if the name changes later).

In North America (north of Mexico), an official list of names is maintained by the Society for the Study of Amphibians and Reptiles ([searchable database](#) or [PDF](#)). You may also be interested in a [Latin pronunciation guide](#) or a [Latin translator](#).



Dyeing Dart Frog photo by Bernard Dupont

Species and Orders ~ By the Numbers

The scientific ordering of animals may at first seem cryptic and disconnected from everyday life. However, taxonomy is not all that difficult to understand, and it is an excellent way to become familiar with animals and their relationships to each other. The classification of organisms is ordered into Kingdom > Phylum > Class > Order > Family > Genus > Species. All reptiles and amphibians belong to the kingdom Animalia and phylum Chordata (animals with spinal cords). From there, herps are split into the classes Amphibia and Reptilia and then seven orders, followed by many families, genera, and species.

Things start to get more complex after that, with additional rankings such as superorders, suborders, superfamilies, subfamilies, etc. These are valuable classifications to learn about but beyond the scope of this volume. It is a great learning experience to become more familiar with the animals in your area and determine how they are related, as those relationships tell you a great many things.

For example, the family Viperidae consists of vipers, such as rattlesnakes and copperheads, which usually have cytotoxic and/or hemotoxic venoms. Family Elapidae contains coralsnakes, cobras, mambas, and similar snakes which generally have more neurotoxic venoms. Natricinae is a subfamily of Colubridae con-

taining watersnakes and gartersnakes (among others), and these common snakes have many similarities, such as bearing live young. When you learn about these various classifications, you are learning about many species at once. Consider researching the herp families and subfamilies in your area in

more depth. As you learn these animals' rankings and groupings, you may be surprised at how much this reveals about reptiles and amphibians.

The number of extant (currently living) described species of reptiles and amphibians is always in flux for several reasons. One is that researchers regularly discover new species. Another

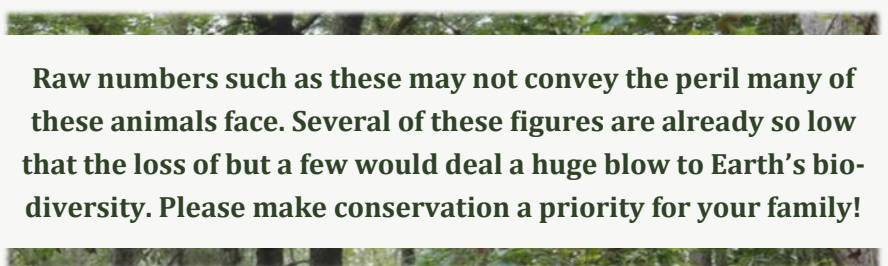
reason is that animals that scientists believed to be one species are sometimes determined to be made up of two (or more) taxa. Conversely, animals that have been considered to be separate species are sometimes shown to be one species after additional research.

Unfortunately, this number all too frequently varies because a species has been ruled extinct, further highlighting the need for conservation education. We humans must make more significant efforts to preserve what biodiversity remains on Earth. If we continue upsetting the delicate balances that sustain us—the species we lose may one day be our own.

Reptiles (Class: Reptilia) 10,793 Total Species			
Source: reptile-database.org/db-info/SpeciesStat.html (August 2018)			
Order	Animal	Species	% of Total
Crocodylia	Crocodylians	24	.2%
Rhynchocephalia	Tuatara	1	.01%
Testudines	Turtles	351	3%
Squamata Suborder: Serpentes	Snakes	3,709	34%
Squamata Suborder: Sauria	Lizards	6,708	62%
Amphibians (Class: Amphibia) 7,910 Total Species			
Source: amphibiaweb.org/amphibian/speciesnums.html (August 2018)			
Caudata	Salamanders	716	9%
Anura	Frogs	6,985	88%
Apoda	Caecilians	209	3%



American Bullfrog photo by Bronc Rice



Raw numbers such as these may not convey the peril many of these animals face. Several of these figures are already so low that the loss of but a few would deal a huge blow to Earth's biodiversity. Please make conservation a priority for your family!

Family Ties

As you are learning about herps, pay attention to how they are related. Learning the relationships between members of various families of herps is a great mental exercise. Plus, there are far fewer taxonomic families in the world than there are species, so it is more manageable list to study. A good part of this task, naturally, is finding out how relatives are the same and how they are different (from each other and other animals).

For example, the Komodo Dragon is a huge monitor lizard, which can grow to more than 8' and 150 lbs. (3 m 68 kg). The Sand Goanna (pictured beneath) belongs to the same family, Varanidae, along with 78 other known species. Members of this family are all so closely related that they also all belong to the same genus, *Varanus*. Though disparate in size, they are all very active, intelligent lizards and are very similar in form. Once you know a monitor lizard well, you can easily identify their relatives.

The Teiidae family is more diverse with eighteen genera. Nonetheless, you can look at the large Gold Tegu and the small Six-lined Racerunner and see physical similarities. Besides genetic traits, similarities among Teiids include a ground-dwelling lifestyle, long tails, forked tongues, and rectangular belly scales. They are active hunters and all lay eggs. Once you learn these family traits, you can apply this knowledge to any more you come across.

Below are a few lizards from the Agamidae family. Note the similarity in head shape amongst each of these animals. Many other lizards in this family share these cranial features. Body morphology is only one aspect of family relationships, but traits like this make it relatively easy to make educated guesses as to who is related to whom.

As you learn more about the various relationships among different families, you will pick up on more of these traits and will find it easier to learn about each new species you come across. Sometimes herps will still fool you, but the learning process is fun in and of itself!



Komodo Dragon photo by Tim Vickers



Sand Goanna photo by Donald Hobern CC BY 4.0



Gold Tegu photo by Ariosvaldo Gonz  les CC BY 2.0



Six-lined Racerunner photo by Kyran Leeker



Southern Tree Agama photo by Bernard Dupont



Green Water Dragon photo by Bernard Dupont



Inland Bearded Dragon photo by Weimar Meneses CC0

Differences & Similarities

It is challenging to describe the differences between reptiles and amphibians in a concise manner. This is because they exhibit such profound diversity that you must insert an “except” or a “however” into the middle of almost every rule. For example, many people say one rule is that amphibians do not have teeth or claws like reptiles; however, most amphibians have exclusive teeth called pedicellate teeth and turtles have beaks, and some reptiles don’t have feet, so, therefore, have no claws. Nonetheless, there are some rules or guidelines which we can identify.

Natterjack Toad photo by Laura & Bobby Bok



Here are a couple of helpful lists, though neither should be considered all-inclusive:

Similarities

- Both are ectothermic (sometimes referred to as “cold-blooded”), meaning their internal sources of heat are so insignificant that they must rely upon external factors to regulate their body temperature. Body heat regulation is primarily required for operation of their metabolic processes.
- Both reptiles and amphibians are vertebrates with a spinal column.
- Reptiles and amphibians shed their skin.

- Skin color alteration by concentrating or dissipating melanin is possible in many amphibians and reptiles. Altering their skin coloration can facilitate camouflage, communication, and thermoregulation.
- Many lizards and frogs have sharp eyesight.
- Both reptiles and amphibians use camouflage, biting, and inflating of the body to avoid predation. Many lizards and salamanders practice autotomy. Mimicry occurs in both groups; some harmless kingsnakes look like venomous coral snakes, and a harmless frog may look similar to a poisonous one.

Differences

- Reptiles are amniotes; amphibians are anamniotes (more on this in the biology section).
- Reptiles do not undergo metamorphosis.
- Reptile breathing is via lungs (except hibernating aquatic turtles), as opposed to cutaneous respiration (through skin or gills) in many amphibians.
- Reptiles have multiple vertebrae in the neck, amphibians have one vertebra in the neck.
- Reptiles have dry, scaly, watertight skin and chelonians have bony scutes; amphibians have moist, permeable skin that allows for the transfer of oxygen and CO₂, water, electrolytes, as well as some other compounds (e.g., anesthetics are administered to amphibians like bath salts).
- Reptiles tend to exhibit greater longevity.
- Some reptiles possess loreal pits (heat receptors), which are not found in amphibians.
- Some amphibians possess lateral line systems which are absent in reptiles. These tactile sensory organs detect minute changes in water and may alert the animal to prey or threats and improve spatial awareness.

Texas Threadsnake photo by Frank Portillo



As you learn more about these diverse animals, see if you can add to these lists. It may be more difficult than first expected, but it is a great way to learn. Be on the lookout for exceptions to any “rule” you hear and you will often find them!

Miscellaneous Oddities

Herps are among the strangest animals on Earth!

- There is a snake with a tail that looks like a spider, which it uses to lure prey.
- There is a lizard that cannot sink, even if it is standing on top of the water in the rain.
- Snakes and many lizards use their tongue for smelling instead of tasting.
- There are many blind, limbless reptiles and amphibians that live underground.
- One frog that is believed to have gone extinct recently would turn off its stomach acids and swallow its eggs so they would have a safe place to develop.
- There is a toad that will roll down a mountain if it gets startled.
- Some lizards will shoot blood from their eyes to startle predators.
- The smallest vertebrate is a frog the size of a pea.
- Some salamanders can regrow their limbs.
- Several lizards and snakes can give birth without mating.
- Several species of snakes can go for months without eating, and one salamander species has been observed to go more than *a decade* without food.
- Many species of reptiles and amphibians don't drink water, and some amphibians don't even breathe air!
- Several species of toads live underground—even in the desert—and only surface for a few days each year. Some make a froth in their hole for their eggs to hatch in.
- Some frogs and turtles freeze solid in the wintertime and then thaw out in the spring unharmed.
- Several species can change their sex if needed, and some species can change how the sex of their offspring is determined.
- Some lizards can run on water.
- Some tortoises can live for over 200 years.
- Some iguanas live on volcanos and feed under the ocean.

- Some snakes can swallow an egg and crack it on their spine before spitting out the shell.
- Turtles that live in ice-covered waters in the winter “breathe” through their vent (the same place their wastes come out).

Spider-tailed Horned Viper photo by Laura & Bobby Bok



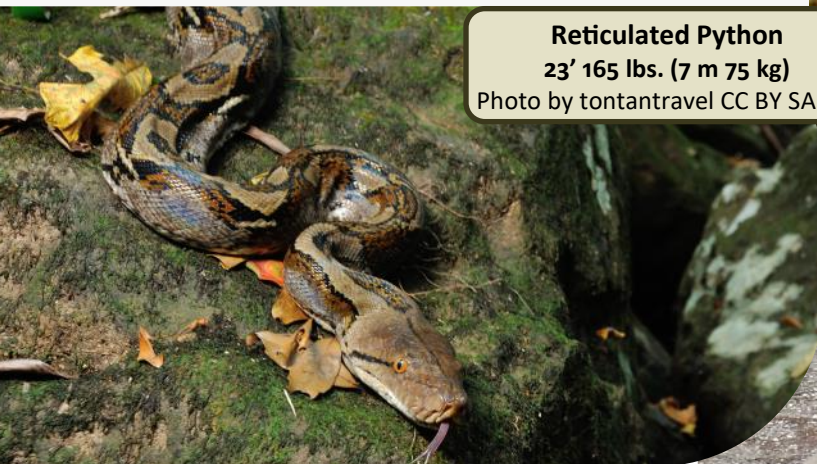
- Sea turtles can travel for thousands of miles but return to the same beach they were born to lay eggs.
- Many herps can see UVA light, allowing them to see colors we cannot.
- Some snake organs double in size when digesting a meal.
- Tiny frogs that live in the rainforest are some of the most poisonous animals in the world.
- Reptiles and amphibians are born knowing how to survive and don't need to learn from their parents.
- Many female herps mate with multiple males and have offspring of mixed parentage.
- Many lizards can detach their own tail, if needed, and then grow a new one to detach again.
- Some lizards can eat 80% of their body weight in 20 minutes.
- Some snakes, frogs, and lizards can even “fly!”

Namaqua Rain Frog photo by Luke Verburgt



Humans regularly discover new and amazing things about reptiles and amphibians that we didn't know or even think were possible. Try to do some research and figure out what species these examples refer to! Get started by watching the little frog on the right let out a “roar” at bit.ly/rain-frog

Giants Among Us



Reticulated Python
23' 165 lbs. (7 m 75 kg)
Photo by tontantravel CC BY SA 2.0



Goliath Frog
12.6" 7 lbs. (32 cm 3.25 kg)
Photo by Matej Dolinay



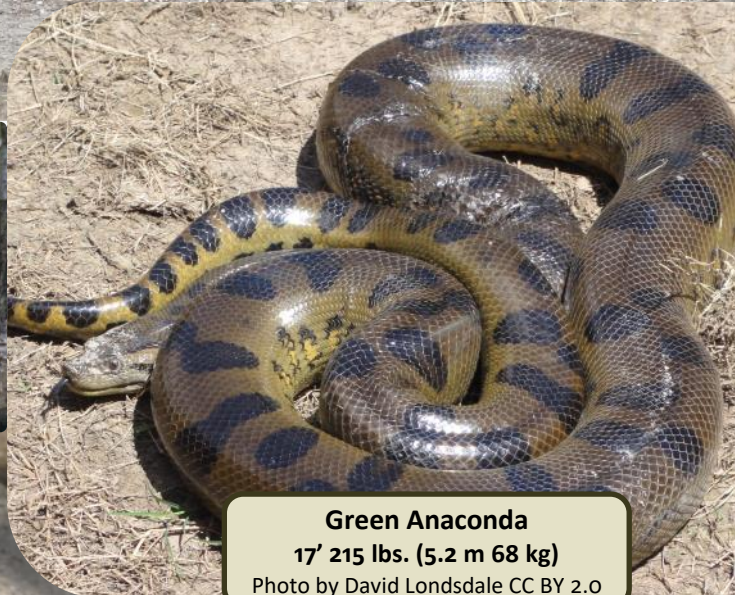
Leatherback Sea Turtle
7' 1540 lbs. (2.1 m 698 kg)
Photo by Claudia Lombard CCo



Aldabra Tortoise
4' 550 lbs. (1.2 m 250 kg)
Photo by Micha Petty



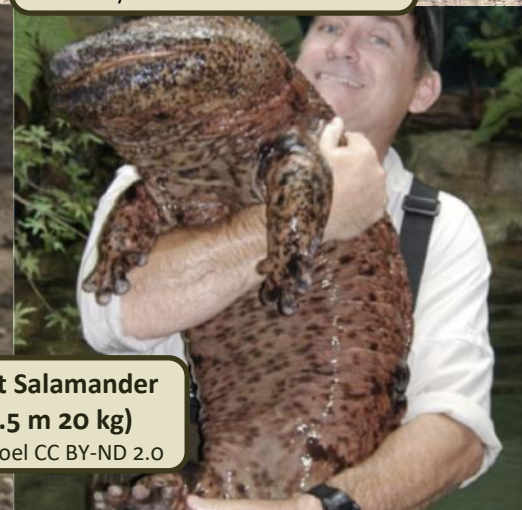
Saltwater Crocodile
17' 2,200 lbs. (5.2 m 997 kg)
Photo by Bernard Dupont



Green Anaconda
17' 215 lbs. (5.2 m 68 kg)
Photo by David Londsedale CC BY 2.0



Komodo Dragon
10' 150 lbs. (3 m 68 kg)
Photo by S. Rohrlach



Chinese Giant Salamander
5' 45 lbs. (1.5 m 20 kg)
Photo by James Joel CC BY-ND 2.0



Seepage Salamander

2.5" (63.5 mm)

Photo by Daniel Thompson



Life in Miniature

Brookesia micra

20 mm (body) 29 mm (w/ tail)

Photo by Frank Glaw et. al. CC BY 2.5



Eastern Musk Turtle (juvenile)

2-5" 21 oz. (5-14 cm 600 gm)

Photo by Grover Brown



Barbados Threadsneak

4" .02 oz. (10 cm .5 gm)

Photo by Blair Hedges

Collared Dwarf Gecko

1" (25 mm) (body)

Photo by Laura & Bobby Bok



Paedophryne amauensis

0.3" (7.7mm)

Photo by Chris Austin



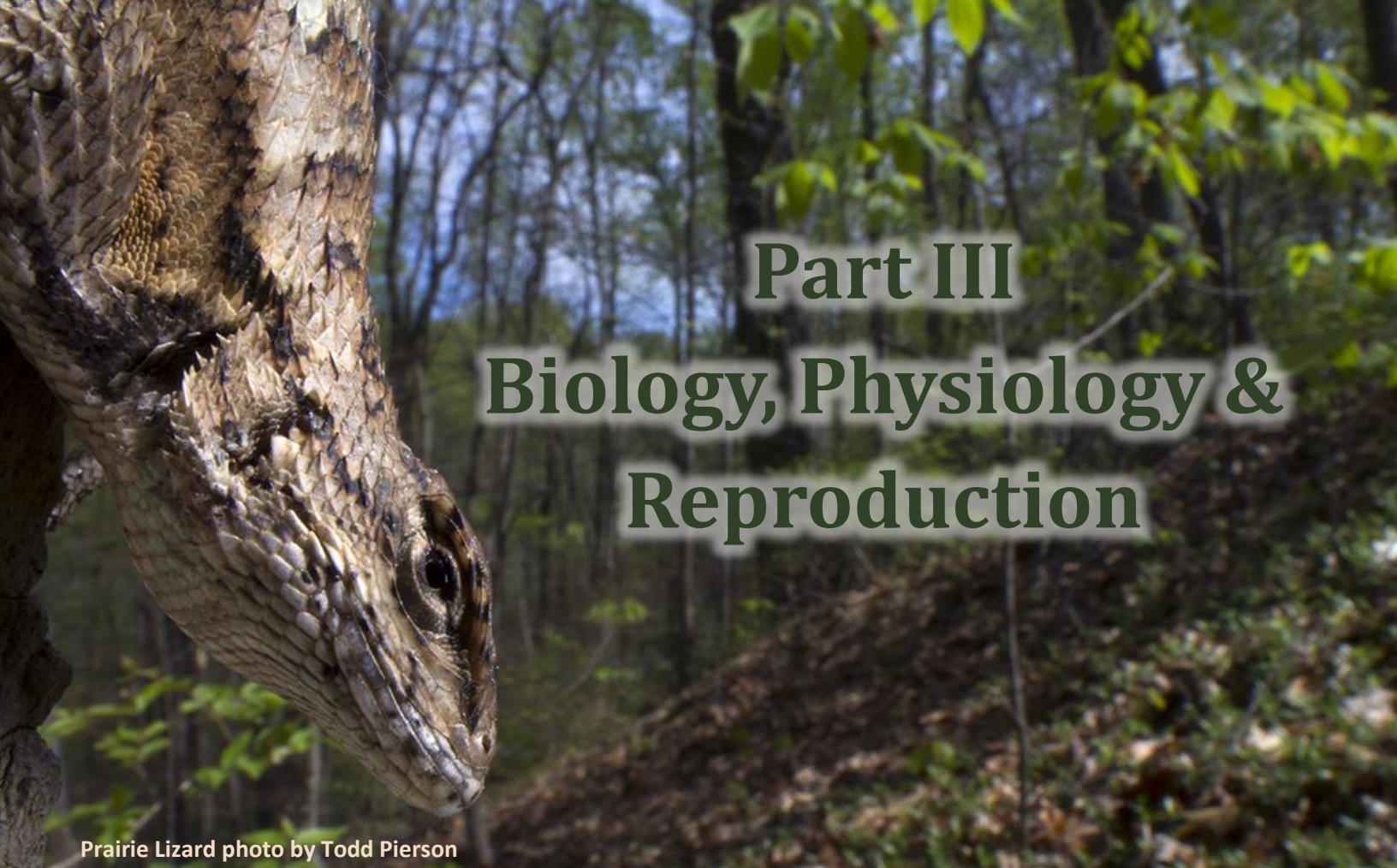
Virgin Islands Dwarf Gecko

18 mm (body) 38 mm (w/ tail)

Photo by Alejandro Sánchez, CC BY-SA 4.0



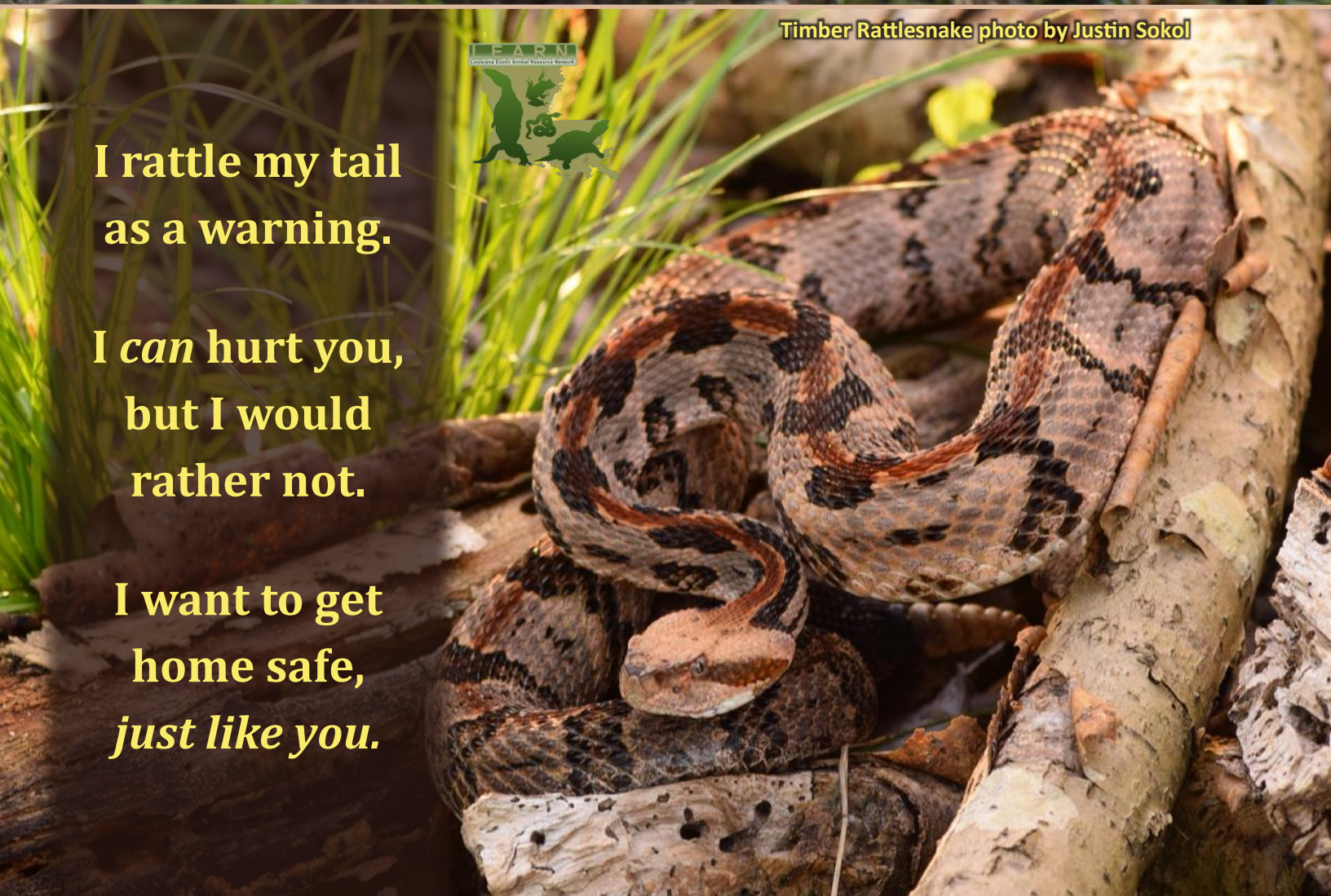
Miniature herps have unique ways of solving problems. Barbados Threadsnares produce one egg at a time- any more and hatchlings would be too small to live on their own! *Paedophryne* sp. are too small to start as tadpoles, so they hatch as frogs! (Stats are normal adult sizes.)



Part III

Biology, Physiology & Reproduction

Prairie Lizard photo by Todd Pierson



Timber Rattlesnake photo by Justin Sokol



I rattle my tail
as a warning.

I can hurt you,
but I would
rather not.

I want to get
home safe,
just like you.

Thermoregulation

The concept that reptiles and amphibians have cold blood is not always entirely accurate. Depending on the time of day and year, many reptiles commonly have blood temperatures higher than that of humans—being variable does not equate to always being cold.

This is a relevant distinction from a scientific standpoint, but there is also a social component. The term cold-blooded has come to mean “unfeeling” or “creepy.” Indeed, “cold-blooded” is often used to refer to a person who is callous or vicious. Since reptiles are none of these things, and since public support is needed to increase conservation efforts, herps could benefit from us dispensing with this imprecise terminology.

Herps are poikilothermic and ectothermic. Poikilotherms are animals whose body temperature varies with their surrounding environment. Ectotherms are animals whose bodies do not generate a significant amount of heat internally, and therefore regulate their internal temperature through their behavior, rather than by methods such as sweating or shivering as seen in endotherms (the biological term for what we call warm-blooded animals). Of the two words, “ectotherms” seems to be the more commonly used replacement terminology.

Some larger reptiles are virtually homeothermic, meaning their body temperature does not fluctuate substantially. Large crocodilians and sea turtles are examples of this. They are so much larger and more insulated than smaller reptiles that, even though they are ectotherms, their temperatures remain relatively constant—an excellent trait when swimming in cold water.

A couple more useful terms to describe herp thermoregulation habits would be heliotherms and thigmotherms. Heliotherms are animals, typically diurnal, that usually raise their temperature by basking directly in the sunshine. Turtles are often seen on a log, soaking up the sun’s rays; lizards are often seen on fence lines doing the same, many snakes make it a habit upon waking to go find a patch of sunny warmth to start the day. An alternate method of gleaned warmth is practiced by thig-

motherms—these are animals who imbue their bodies with warmth by finding places to sit or lie that have already soaked up the heat from the day. Nocturnal animals are often thigmotherms, of course, as direct sunlight is not available during their times of peak activity. It may also be interesting to note that animals may alternate these methods throughout the year. One common example would be subtropical and temperate-zone snakes, many of which are active during the day in the spring and fall but become nocturnal in the “dog days” of summer. This is to prevent overheating by avoiding the direct sunlight when ambient temperatures are already sufficient for their metabolic processes.



Eastern River Cooter photo by Charles Paxton

We humans often assume that being ectothermic must be a disadvantage. In all fairness, there are drawbacks. If a reptile or amphibian becomes trapped somewhere too hot and cannot escape, they are unable to sweat like we do and will die very quickly if their body exceeds a critical temperature. However, there are advantages to the ectothermic life. Whereas we mammals must continuously be on the hunt for food and water to maintain our internal “furnace,” herps are able to go days, weeks, months, or more (depending on the species) without ill effect from lack of food. There is a consummately efficient lifestyle that has enabled them to colonize virtually every habitat on Earth. In our modern quest to conserve resources, we could surely learn a thing or two from them!



Turtles are often seen with “soaking up the rays” with outstretched legs. They thermoregulate by basking when too cold or sliding into the water if they get too hot. This allows them to live on much fewer resources than we mammals, since, like other herps, they don’t need to generate their heat.



Sliders and map turtle photo by John Williams

Caudal (Tail) Autotomy

You may have heard that you should be careful handling lizards because you could “pull their tail off.” But did you know that is not precisely what happens? Some geckos, skinks, and other lizards, as well as tuatara and salamanders, will shed part of their tail if it is grasped, but this is not just because it was pulled off. This is a trait called autotomy, or the removal of one’s own body part, and is partly the result of powerful muscle contractions by the

ments, which often serves as a compelling distraction to whatever animal was looking for a meal. This frequently allows the lizard or salamander the time it needs to escape. Some animals take this a step further and, especially when young, have brightly colored tails, thus increasing the chances that a predator may notice and grasp their tail first. Some geckos (e.g., Chameleon Gecko) even have tails that make noise after being dropped!



Common Wall Lizard photos by Daniel Hediger

animal. We are still learning the intricacies of this ability, but we know the separation occurs in lizards along vertebral cleavage planes and is an excellent adaptation to avoid predation!

One obvious benefit to this behavior is that if a bird or other predator has captured the animal by its tail, shedding the tail provides an immediate opportunity for escape. This adaptation is all the more likely to be useful, since, for many lizards, their tail is half or more of their body length. As they start to run, their tail takes up the space where their body was a moment before, so an animal that was aiming for their body is likely to grab the tail as the animal is fleeing.

Making this adaptation even more effective is the fact that the tail usually continues to wriggle for several mo-

In species that have developed the trait of true autotomy, the tail regenerates over a period of several weeks. Studies have shown that in the interim the animal seems to know that they are temporarily missing the ability to use this tactic again. Several species have been observed to act more cautiously until their tail regenerates—basking and hunting closer to cover, for example. The regrown portion is often a different color and pattern than the original, and the lizards do not regrow bone, but instead generate cartilage that acts like bone in the new section. Some snakes and lizards also exhibit a pseudo-autotomy wherein their tails may break off but are not regrown.

So, what you heard about being careful when handling lizards is true—many of them do drop their tails. It takes time and energy to regenerate a body part, so please try to avoid causing this. Now you also know that this is not because they are just fragile, but is instead another fascinating adaptation like many others that have made reptiles and amphibians amazing and diverse survivors!



Skink tail photo by Metatron CC BY-SA 3.0



Little Brown Skink photo by Frank Portillo

Little Brown Skinks are great examples of autotomy. Their dropped tail sections typically wriggle so vigorously that often the skink and the tail both escape predation. The skink may sometimes be observed to locate the missing tail and ingest it to regain lost nutrients.

Ecdysis (Shedding)

Like many invertebrates, reptiles and amphibians periodically shed a layer of their skin all at once (this differs from humans and other mammals, which continuously shed individual skin cells). This process is called ecdysis, sloughing, or molting. Ecdysis is a function of growth, and, as such, it occurs more frequently in younger or well-fed individuals. Ecdysis may also occur in response to illness or irritations, such as a skin infection or parasite infestation. Many animals ingest the shed skin, partially to retain nutrients and partially because pulling at the loose skin with their mouths aids in removal.

Ecdysis in lizards and snakes is a complex process wherein cells of the intermediate (germinative) layer of the animal's skin diverge to form three new epidermal layers. Fluid (lymph) and enzymes then act to detach the old layer from the new ones, after which mechanical force is used to separate the old outer layer of skin. The entire process typically takes up to two weeks, although the visible act of shedding often only takes a few minutes to an hour, depending on the species and environmental conditions. Snakes typically shed their skin in one piece, whereas lizards usually shed in patches. Ecdysis in other orders of herps occurs in a roughly similar fashion, with some variation as to the specific mechanisms. A partial or "bad shed," is called disecdysis. Disecdysis is not an illness in and of itself but is always a symptom of other issues, such as low humidity or skin conditions.

Instead of eyelids, snakes possess ocular scales called brilles that protect the eyes. During ecdysis, the fluids at work across the animal to separate the old skin layer are visible behind the brille, giving the eyes a bluish

appearance. This usually takes place from several days to a week before the old layer is shed. Normally docile snakes may become defensive during this time, as their eyesight is compromised, putting them at an increased risk for predation.



It is a common misconception that you can tell how old a turtle is by the rings on its shell (called annuli) or a rattlesnake by its rattles (each shed adds one segment). Unlike trees that gain annuli once per year in response to the progression of the seasons, reptile and amphibian growth is based on the relative abundance or scarcity of food, climatic conditions, and other factors. Ecdysis typically occurs every few weeks in younger or afflicted individuals up to every few months for older, slower growing animals (reptiles continue to grow throughout their lifetime, but their growth rate slows progressively as they age).

For guidance identifying a snake from its shed skin, visit bit.ly/snake-sheds

For some time, biologists could not determine what neonate caecilians were eating in their underground nurseries. The mystery was solved when a mother was observed to go into a rapid ecdysis cycle and the young were seen to feed on the skin she shed every few days!



Sexual Dimorphism

The presence of sex-specific differences in the external appearance of a species is called sexual dimorphism. This trait is not unique to herps—many animals are dimorphic, including humans. Not all reptile and amphibian species are sexually dimorphic, and the ones that are span a wide range of differences from “obvious to a layman from a distance” all the way down to “really have to know what to look for and

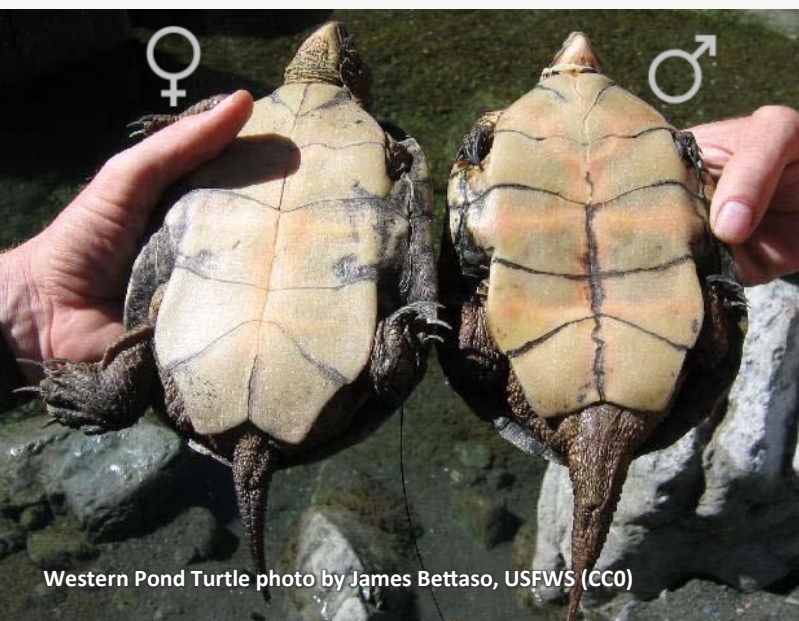


bring a micrometer.” Some differences are unique to one particular species, while other indicators hold true across dozens or hundreds of genera. Sexual dimorphism can take many forms, such as overall size, head shape, tail length or shape, claw length, eye color, skin color, or other features.

Many of these traits require a learning curve to recog-

nize with confidence, such as the relative thickness and length of many reptiles’ tails. Some species, such as Little Brown Skinks, have differences so subtle that even a researcher manually sexing individuals with the aid of specialty measuring devices would need to sample several hundred individuals before being proficient enough to make an educated guess as to sex. However, as you pick up on various dimorphic traits and observe more and more animals, it will eventually become second nature to differentiate the sex of more and more species.

Probably the general trait that applies to the most species is the tail shape in lizards and snakes (squamates). While this rule has plenty of exceptions and is more noticeable in some species than others, it can quickly assist in determining the sex of many animals. Male squamates have hemipenes which reside caudally (farther away from the head) to the cloaca when not in use. This means that many male snakes and lizards have tails which are wider at the base and somewhat longer than the females’. In many lizards, you can even make out hemipenile bulges, which appear like two slight bumps under the skin pointing toward the tip of their tail. As you observe more and more animals, these subtle differences will start to become apparent. Many male lizards also have femoral and preanal pores that secrete pheromones, visible as a horizontal line above the tail of the male (*see illustration above left*).



Examples of chelonian (turtle) dimorphism:

- Anal scutes typically have a more pronounced notch in females to facilitate egg laying.
- Males tend to have a concave plastron to facilitate breeding.
- Males tend to have thicker tails to accommodate their sex organ.
- Males’ cloacae tend to be farther out to facilitate breeding.
- In many species, females tend to be larger.
- In several genera, males tend to have longer foreclaws, which they use in courtship displays.

They Have Two *What??*

One of the features that squamates (snakes and lizards) have in common with each other that distinguish them from other reptiles are dual reproductive organs in males, called hemipenes (or hemipenis, if referring only to one side). When at rest, this organ resides in the male's tail, just to the rear of the cloaca (vent) and is inside-out. It is everted (brought to bear outside the body) or retracted similarly to how you might turn a sock inside out. One can often discern hemipenile bulges in lizards, which appear as symmetrical "bumps" under the base of the tail. In some lizards and snakes, the male's tail is slightly longer and thicker at the base to accommodate the hemipenes. Both features may be subtle, and even an experienced herper may not always be able to make a clear determination, but it may be your best chance of making an educated guess as to the sex of many species without resorting to more invasive methods.

When performing studies, biologists often either manually evert the hemipenes to confirm gender (also known as "popping"), or sometimes a probe is used. When operated by an experienced person, a small probe can be gently inserted more deeply to the posterior of a male's cloaca than is possible with females, as the probe will be traveling the length of this organ. Hemipenes vary significantly in shape and size from species to species and are one of the factors used when naming animals. This is because the male and female organs fit together, and a male and female having radically different shapes would indicate that they are unlikely to be compatible. Hemipenes are everted by lymph fluid filling the erectile tissue. Urination does not take place through the organ, and only one lobe is used at a time.

The dual nature of hemipenes means that fertilization can take place through either side, and males may indeed copulate with females from either the left or right, but that is thought to be a secondary purpose of this adapta-

tion. Because each lobe is supplied by its own testis, a male is still able to copulate a second time at full potency after an engagement. In animals who might rarely see a member of the opposite sex, it is a distinct advantage not to miss any chances! It is also not unheard of for one lobe to become injured either during mating or as the result of being everted too long and desiccating (drying out), so having another at the ready is of obvious benefit in such a circumstance.

Red-sided Gartersnake photo by Dave O'Connor



Timber Rattlesnake photo by Ashley Tubbs



This adaptation may seem foreign to us, but snakes and lizards have repeatedly proven their sublime adaptability. Outdoorsmen have a saying, "Two is one, and one is none," meaning that having a spare of a valuable item is a good idea. Hemipenes are yet another example of reptiles having mastered survival tactics such as that long ago as they were colonizing almost all the ecological niches imaginable. It may be that theirs is the better way!



Seeing everted hemipenes for the first time can be understandably disconcerting for some people. Hopefully, knowing what this organ is and that it is natural for it to come out of the body should at least help to allay any concern that the animal needs medical attention!



Green Iguana hemipenes photo by Sahaquiel9102 CC BY-SA 3.0



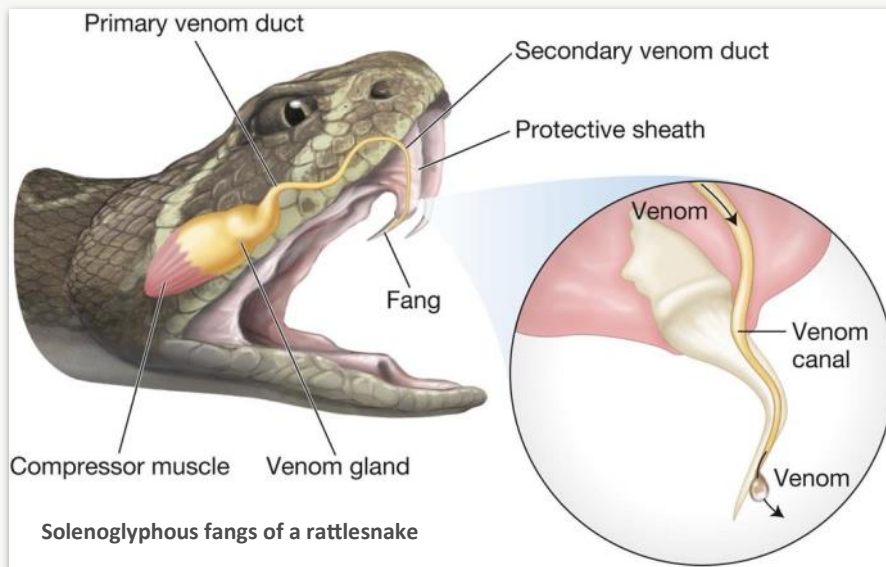
Fangs

Not all snakes have fangs. Snakes that have fangs also have other solid teeth; fangs are merely a pair or more of teeth that have adapted to assist the animal with hunting. Fangs take several forms, known as solenoglyphous (found mostly in viperids), proteroglyphous (found in elapids), and opisthoglyphous (in some colubrids). There is a great deal of variation among species as to mechanism and use. There are also venomous lizards which envenomate by capillary action, rather than musculature pressure. Fangs are replaced periodically, and a “spare” set of fangs may sometimes be seen behind the first ones. Since snake venom is primarily a tool for predation and less useful for defense, many bites that humans receive are “dry bites” (no venom) to conserve this limited resource.

First, we have the solenoglyphous fangs of pit vipers such as rattlesnakes and ‘true’ vipers such as Puff Adders. These deliver venom through a canal inside the tooth, similarly to how a hypodermic needle operates. These fangs pivot to deploy and retract as needed, allowing them to be much longer than other types of fangs—the Gaboon Viper’s fangs can be up to 2” long! Mole Vipers and a few other African snakes even have fangs that pivot to the side, allowing them to envenomate prey in subterranean tunnels with their mouth closed. Snakes with these fangs typically strike and envenomate quickly, then withdraw to let the venom take effect.

Then there are the proteroglyphous fixed fangs of the elapids, which include cobras, mambas, sea snakes, and

coralsnakes. Venom in elapids is also delivered under pressure, and spitting cobras can even project venom at an attacker. While elapids often bite and hold their target slightly longer than viperids, envenomation is still very rapid—elapids do not need to “chew” on a person to be dangerous. Some of these snakes have extremely potent venom, with Australia’s Inland Taipan being considered the most venomous snake in the world.



There are also various colubrids with opisthoglyphous fangs, commonly referred to as “rear-fanged” snakes. Rear-fanged snakes produce venom from Duvernoy’s glands, which flows down channels in the fangs to reach the target. The mechanism of operation for colubrid

fangs ranges from simple grooves for the venom to trickle down all the way up to virtually enclosed channels similar to those of proteroglyphous fangs. Venom delivery ranges from delivery under slight pressure down to simple capillary action. While virtually all these snakes produce venom that is not considered medically significant to humans, there are a couple of notable exceptions such as the Boomslangs and twig snakes of Africa.

Venom is a common mechanism in nature that many animals employ to catch their prey more efficiently and with less risk to themselves. Other animals, such as honey bees, use venom as a defensive technique. Better understanding these mechanisms will hopefully help us convert any fear we might have of venomous animals into a healthy respect for the diverse ways in which animals solve the problems they face in the wild!



White-lipped Viper photo by TontanTravel CC BY-SA 2.0

Although we may associate them with scary movies, possessing fangs does not make an animal sinister. Humans are the only animals capable of that character trait. Venom is merely another tool many animals use in their struggle for survival.

Rear-fanged Snakes

Did you know that many harmless snakes have tiny fangs in the back of their mouths? Don't be alarmed! There's no need to start running away from every snake you see. Venom is a widespread mechanism in the animal kingdom. It is used as an aid in hunting or defense—ants, bees, and spiders are some familiar examples of this. We have discovered that many species generally considered harmless to humans do produce relatively mild venoms.

While there is still a great deal of research to be done before we understand all the ramifications of both the fangs and venom of these snakes, a natural hypothesis is that these compounds assist the snakes in their predation in one way or another. The small fangs may also help with grasping and manipulating their quarry, and the venom may further help them to subdue their prey. For example, many suspect that these fangs may help snakes which prey on toads to defeat the frogs' defensive technique of inflating with air. In any event, we know that nature exhibits continual "arms races" as animals develop more and more effective offensive and defensive mechanisms in turn which contribute to their success within their various niches.

Believe it or not, rear-fanged snakes such as these can be a controversial topic within the herpetological community. Many people prefer to use terms such as "mildly venomous" or "non-medically significant" to portray these adaptations. This often stems in part from a desire not to alarm members of the public who may run across this information and then commence to killing even more snake species than they already do. Such a reaction would indeed be unnecessary and unfortunate. Some shy away from the term venom altogether, either because they feel an acute need to avoid panic, or because they don't view these mild toxins as worthy of the term. Nonetheless, these animals possess an intentionally induced, modified toxic saliva which produces an adverse effect in another organism to aid in predation or defense—which it is fair to say

fits the definition of venomous. Be all of that as it may, we needn't view these unique survivors with fear. These are generally small animals that are reluctant to bite people.

In the case of the Hog-nosed Snake, they will go to extraordinary lengths to avoid a fight by flaring their head and necks like a cobra, feinting as if to strike, and



Eastern Hog-nosed Snake photo by Ashley Tubbs

then often playing dead. Even in the rare cases of someone receiving a bite (all of which have been from captive feeding mishaps), the effect produced is typically a mild swelling or itchiness, akin to the bite or sting of many insects. A very few more severe and prolonged reactions have been reported, but no special antidote is deemed needed.

It is possible for people to be allergic to any venom (such as being allergic to bee stings), and it would be prudent to exercise care when handling these animals. Nonetheless, the best result of this knowledge is not more fear, but rather an increased respect for reptiles and their incredible diversity!

Many snakes have enlarged rear teeth. While some of these are technically venomous, they are generally considered harmless to humans. There are a very few dangerous rear-fanged snakes, such as the African Boomslang.



Boomslang photo by Bernard Dupont

Venom

Venom is a fairly common mechanism in nature that animals use to help them survive. Some animals use venom in a defensive role (e.g., bees) and others use it to help subdue prey (e.g., spiders, shrews, and snakes). Many types of venoms cause little more than a stinging sensation in humans, while others are potentially lethal. While many people assume that any venomous snake is deadly, that is not an accurate assessment. What's more, animals that employ venom tend only to use it when necessary, as it requires energy to produce.



Cape Cobra photo by Bionerds

Reptile venoms are simple to complex mixtures of proteins, peptides, and small molecules. The components within an individual venom sample can range from small allergens to extremely large enzymes, and the specific composition depends on the species from which the venom is isolated. The variation in venoms in the reptile world is incredible, ranging from differences among species at the same taxonomic level to differences among individuals within the same species to ontogenetic differences within the same individual.

Although there was a longstanding tendency to lump venoms into the two general categories of “hemotoxic”

or “neurotoxic,” these terms oversimplify the effects and compositions. Individual venoms may contain toxins that can function on both (or neither) physiological systems or may affect other systems (e.g., cytotoxins, which destroy cells, or myotoxins, which target muscles). We still have a lot to learn about venom composition and effects, as well as which animals employ them and to what degree.

There are many methods employed to evaluate the strength of different venoms, such as median lethal dose or LD₅₀, but understanding the effects and dangers of various venoms cannot be reduced to a simple number. For example, gram for gram, widow spider venom may be five times more lethal than venom from an Inland Taipan snake, but deaths from spider bite are virtually unheard of, partly because so much less venom is injected. Statistics about hospitalizations or fatalities are also apt to be misleading, as the frequency and effectiveness of treatment are highly variable from nation to nation. Furthermore, an individual's susceptibility to organic proteins can vary (e.g., some people being severely allergic to bee stings), complicating any effort to categorize animals as harmless or deadly. Nonetheless, it is reasonable to describe many species as “harmless” if their bites do not typically require medical intervention.

Another noteworthy aspect of venom is not how many lives it takes, but rather how many lives it saves. For example, studies into the venom of the Jararaca (*Bothrops jararaca*) led to the creation of ACE Inhibitors, which are used by millions of heart and kidney patients worldwide. There are other drugs derived from reptile venoms, and more appear to be on the horizon. All in all, venom is not something that should cause blind panic. We should appreciate venom as a natural adaptation that many organisms employ, and we should treat those animals with respect and even admiration. Rather than fearing them, if we take some time to educate ourselves about their natural history, it becomes a simple matter to live in harmony with them.



Variable Coralsnake photo by Armin Meier

Many (if not most) people assume that many more snakes are deadly than is actually the case in most areas. It is also important to understand that venom is simply another natural adaptation that some animals use for survival, and does not indicate that the animal is “mean” or “sinister.”

Venomous vs. Poisonous

The term “venom” refers to a toxin that is intentionally delivered for the purposes of defense (e.g., bees) or to assist in predation (e.g., vipers), whereas “poison” refers to a toxin that is ingested by the affected animal (e.g., some frogs, certain mushrooms).

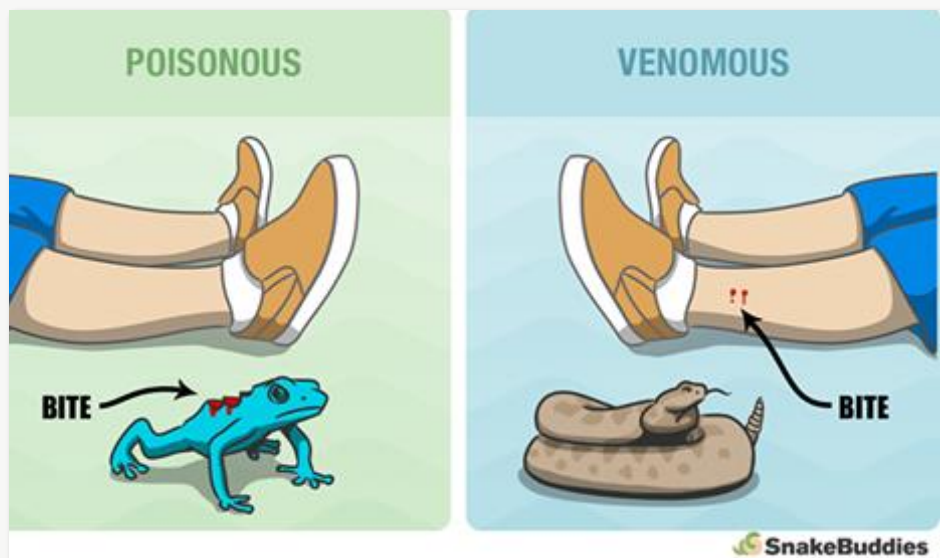
If you are concerned with adhering to the most technically correct usage, all you need to remember (though this is a bit of an over-simplification) is that if you bite something and get sick, that organism was poisonous. If you get bitten or stung by something and experience ill effects, that organism was venomous.

For example, many toads are poisonous, because they excrete a toxin from parotoid glands behind their eyes as a means of deterring predators. Viperids and elapids are venomous. A few amphibians are also venomous, and some snakes, such as the Tiger Keelback, are both venomous and poisonous because they have venomous qualities to their saliva and also excrete toxins from the nuchal glands on their neck. These are all fascinating adaptations which assist these animals in their struggle for survival.

For whatever reason, this terminology tends to spark frequent debate among reptile enthusiasts. This usually develops when a novice asks if a snake “poisonous.” Your average person would respond with either a “Yes,” “No,” or “I don’t know.” Nowadays, though, there is often a herp enthusiast who insists on turning the conversation to semantics and responds, “No, it is venomous. Snakes are not poisonous.” Someone else then responds in turn with, “Actually, several species of snakes are poisonous, and some species are both venomous and poisonous!” Occasionally, the person asking for an identification may be interested to learn this distinction. More often, they really aren’t looking to learn new terminology so much as

asking if their kids can play outside safely, so the seemingly irrelevant back-and-forth can be off-putting.

If your first instinct is to routinely correct people on this issue, you might do well to remember that most people only learn what they are interested in knowing. If a person is made to feel talked down to, they generally stop listening. Simple identification requests are best used to impart helpful information, such as mentioning that ven-



omous snakes, while best admired from a distance, are essential members of the ecosystem, and that every snake is a good snake. Trying to take a person that is barely at the point of not wantonly killing snakes and shoving a herpetology lecture at them may be counter-productive. You’ll know you are on the right track when people stop inching toward the door and start telling you how much they appreciate your lessons!



Tiger Keelback photo by Kim, Hyun-tae CC BY 4.0

Cane Toad exuding bufotoxin photo by Kenneth Cole Schneider

In the simplest terms-

If you bite an animal and get sick, the animal is poisonous.

If it bites you and you get sick, the animal is venomous.

Some animals, such as the Tiger Keelback, are both!



Some facts about scales:

Snakes have clear scales that cover and protect their eyes. • Besides providing physical protection, scales also help prevent water loss. • Some reptiles have chromatophores which perform rapid color changes to facilitate camouflage, communication, or thermoregulation. • The large scutes on crocodiles' backs act like solar panels. Crocs alter the blood flow to and from these areas to adjust the temperature throughout their bodies. • Some snakes use the scales on their bellies to move in a straight line like caterpillars by gripping the ground or branches in a rectilinear fashion. • Some reptiles have large scales in key spots that aid in defense. Turtles who pull their legs into their shells or lizards that wedge themselves in cracks and only expose these scales can often survive attacks from predators. • Many lizards have tiny, granular, non-overlapping scales covering their heads or other parts of their bodies. • Many scutes are made up of bony plates called osteoderms (meaning "bones in the skin") that provide added strength and protection. • Some scales are smooth; others are heavily or lightly keeled (a ridge that runs down the scale



Armadillo Girdled Lizard photo by Bionerds



Photo by Ken-ichi Ueda



Photo by Andrew Mercer CC BY-SA 4.0



Photo by Hans CC0

like the keel on a boat). These and other characteristics can be a key tool in identifying unfamiliar animals. • Rattlesnakes' rattles are actually specialized scales. • Some desert lizards have developed special channels in and among their scales that act as rain gutters and direct any falling water into the animal's mouth. • Scales are made of keratin, like our hair and fingernails. • Scales often serve to camouflage reptiles—either through their irregular shape breaking up the animal's profile or through their color blending in with the surroundings (or both). • Burrowing species often have smooth, polished scales which help them slip through the soil or sand more easily. • Some reptiles have scales which repel water so well that they stay dry even in the rain. • Many reptiles have iridescent scales, particularly after shedding. • Adapted scales (called scansors) allow geckos to adhere to glass and other smooth surfaces. • Scales usually overlap in lizards and snakes, but rarely do in turtles and crocodiles. • Some colubrids and vipers are occasionally born with virtually no scales at all. • Turtles' shells are comprised of modified interlocking ribs and vertebrae, usually overlaid with horny scutes.



Photo by John Williams

Scales come in many varieties. Depending on the species, location, and structure, they can be called plates, scutes, shields, laminae, lamellae, scansors, or tubercles.

Scales can be many colors and serve a variety of (sometimes very specialized) functions.



Amniotes & Anamniotes

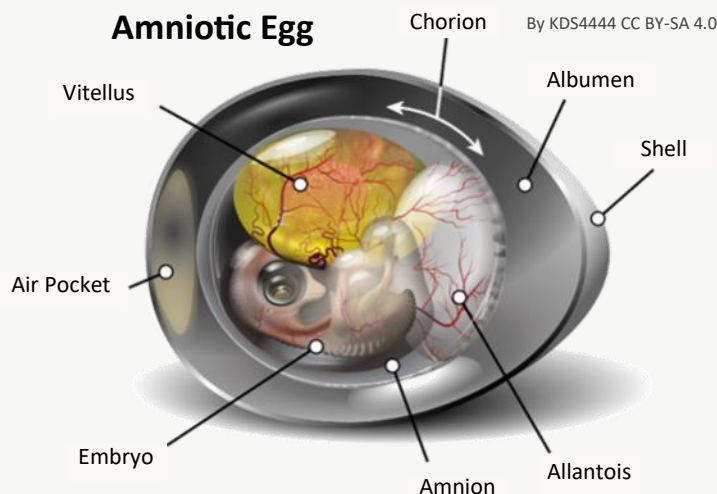
Reptile and amphibian eggs are quite distinct from one another, although both are similar enough to other types of eggs that they misidentified by the casual observer. Reptile eggs have shells like those of birds, and amphibians have jelly-like eggs like those of fish. These differences are important because they determine what is required for the animals to reproduce successfully.

Reptiles—snakes, lizards, turtles, crocodilians, and tuatara—lay amniotic eggs, meaning the embryo inside is surrounded by an amnion (a trait shared with humans). Nutrients are contained in a yolk sac and gasses (oxygen and carbon dioxide) transpire between an allantois and the surrounding air, or in viviparous species, the mother's body facilitates this exchange via a placental structure. These features and functions occur outside the amnion, and the embryo is connected in a fashion reminiscent of an umbilical cord; in fact, reptiles are often born with vestiges of this connection where you might expect a navel to be. This more "advanced" egg structure allows reptiles to colonize areas not accessible to amphibians, as their leathery eggs are more resistant to desiccation (drying out) than anamniotic eggs.

Amphibians—frogs, salamanders, and caecilians—lay anamniotic eggs (no amnion present), which are more basic in nature. The yolk is contained in the inner layer with the embryo, and gas exchange occurs between the embryo and the surrounding water (or sometimes air) directly through the intermediate layers. These eggs must be either wet or in very high humidity, or they will dry out. Amphibians have several remarkable adaptations to push the envelope of these limitations, but they cannot mature everywhere that reptile eggs can.

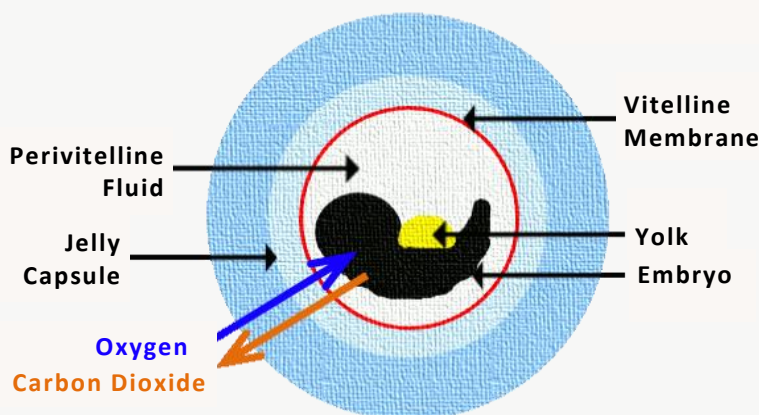
Notably, embryos develop an awareness of their surroundings before they are hatched. Reptile embryos have been observed to thermoregulate by positioning themselves differently in the egg. The larvae of several amphibians have been observed to exit their eggs prematurely if the water they are in is drying up or sometimes in response to predators discovering the egg mass. Some species of reptiles and amphibians brood their clutches, meaning the mother (or sometimes another relative) will

Amniotic Egg



guard and tend the clutch until the young emerge. Dart frog fathers even move each of their tadpoles to its own bromeliad and the mother will feed each in turn with unfertilized eggs until they metamorphose into frogs! In fact, we have observed so many remarkable adaptations and examples of care by herps that the term "cold-blooded" should start to be viewed as a compliment!

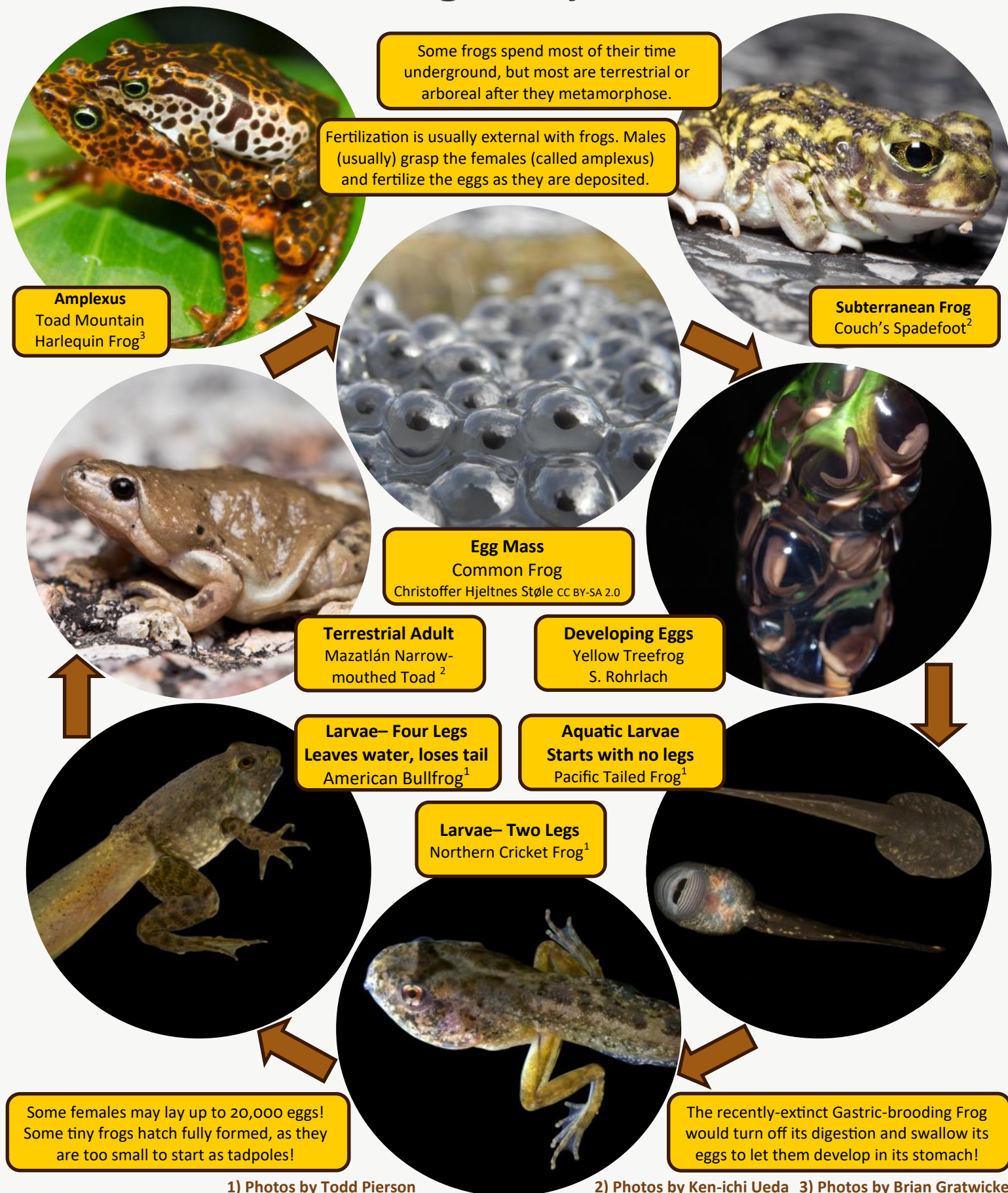
Gas Exchange in Amphibian and Fish Eggs



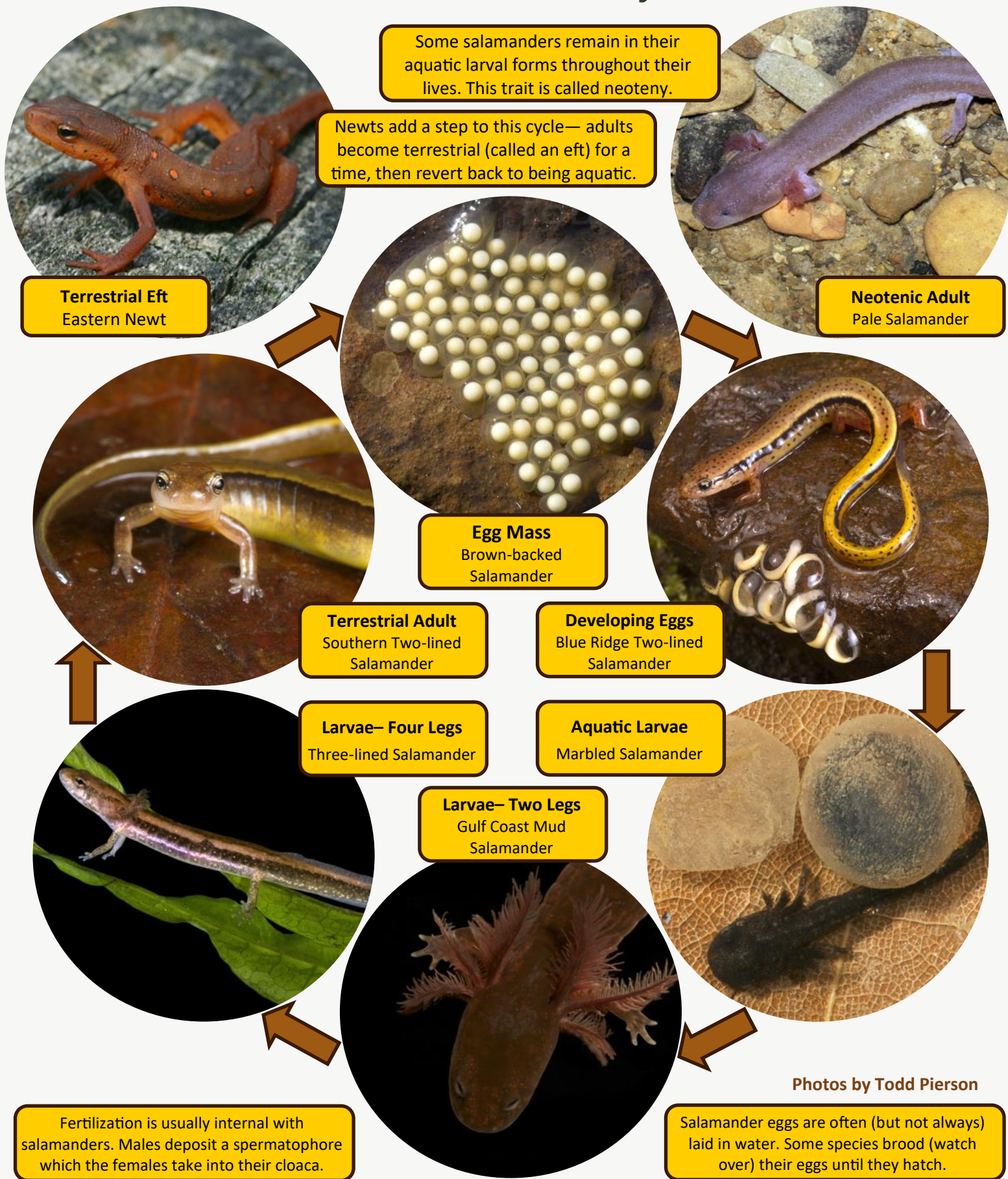
Southern Two-lined Salamander with eggs photo by Todd Pierson



Frog Life Cycle



Salamander Life Cycle



Amplexus

In many areas, frogs can be heard calling, especially on rainy evenings, from any available body of water. Some species' calls may be heard one by one; others can be a veritable cacophony that drowns out the night. Frogs' calls are essentially the males advertising that they "have found a good spot and are ready for some action." Although many species unfortunately fall silent when man moves in and alters their habitat,

scribed yet. While fertilization in frogs is almost always external, a few species practice internal fertilization—their embrace is called coplexus. The eggs are jelly-like and usually laid in water. The parents generally leave them to develop on their own, but there are a few species, such as dart frogs and African Bullfrogs, that tend to their young until they are old enough to fend for themselves.



Plain Rain Frog photo by Bionerds

others manage to adapt to the disturbed environments we create. Bufonid toads, for example, will readily call from almost anything humans leave lying around that holds a bit of water. The females of many species may approve even questionable selections for nursery sites, so it is considerate to check inside buckets before pouring them out.

Frogs and toads have a wide array of mating strategies. Amplexus (from the Latin "embrace") is the term for frog mating grasps. There are a variety of ways that males and females position themselves for fertilization: straddle, axillary, glued, cloacal apposition, inguinal, cephalic, and probably a few more no one has de-

You'll notice that most statements about frog reproduction have caveats, as their diversity really defies simple definitions. For example, some desert frogs dig a hole in the ground and produce a frothy mixture for their eggs to develop in, as there is often no other water available. There are even some species of tadpoles that can generate their own foam if the mother's dries up! Where predators abound, frogs sometimes get very creative. Some rainforest frogs deposit their eggs on leaves to protect them from aquatic predators until they hatch, which they will do prematurely if a predator starts raiding their group. Gladiator Frogs dig a depression near streams for their tadpoles to develop in. A few frogs lay eggs underground, and the tadpoles later surface and head for nearby water similarly to how baby sea turtles dash for the ocean.

These are just a few examples of why anurans (frogs) are one of the most diverse orders of life on Earth. They are also one of the most susceptible to the habitat degradation humans are causing worldwide. We have almost certainly lost species before we even had a chance to discover them and describe their behaviors. Fortunately, there are organizations like Save the Frogs! working to preserve them. Consider joining these efforts today. Frogs could sure use the help!



Fowler's Toads photo by Micha Petty



Toads (*Anaxyrus* spp.) tend to get overly-excited during mating times. They have such a tendency to hop on anything that moves that the males have developed a special "release" chirp. The one on the bottom (left) is saying, "Get off me, I'm a boy!"



Hatching & Birthing

It is relatively common knowledge that turtles lay eggs—think about sea turtles nesting on beaches and watching cute turtle hatchlings running pell-mell for the ocean. Although many people assume that all reptiles lay eggs, over twenty percent actually give live birth. These methods fall into two general categories, with members of each exhibiting a diverse array of individual mechanisms.

Oviparous: (egg laying, from the Greek *ovum* or “egg” and *parere* “to bring forth”) These are the animals who deposit eggs in a nest or other suitable location to be hatched later. A few examples would be birds, turtles, ratsnakes, kingsnakes, geckos, and anoles.

Viviparous: (live-bearing, from the Greek *vivus* “alive”) These animals give birth to fully-formed young. During development, the offspring grows in a placental or similar structure and derives nourishment from the mother. Examples include mammals, some snakes (e.g., boas), the Viviparous Lizard (*Zootoca vivipara*), and many species of skinks.

Much literature still exists that lists a third class called ovoviviparity, described as a combination of the two wherein the mother retains the egg but the embryos derive nourishment from the yolk. However, recent research indicates that even when the eggs appear to develop independent of the mother, respiratory gas exchange, water transport, and nutrient transport still occur. This has brought many researchers to the conclusion that oviparity and viviparity are the only valid classes, at least in reptiles.

Although aquatic turtles typically dig nests near water to make their hatchlings’ lives a little easier, reptiles are not nearly as dependent on water as their amphibian cousins. The adaptations responsible for this independence are a significant factor in reptiles’ collective

success at colonizing and surviving in so many different ecosystems. If an organism is in a hostile environment (for example, one that is too dry or too cold to incubate eggs externally), being able to retain eggs during incubation is quite the useful adaptation. The mother may then thermoregulate the eggs or young by basking or hiding to ensure proper conditions, as well as providing protection from predation.



Desert Tortoise photo by K. Kristina Drake, USGS CCO

Within these categories, various species’ methodology may take numerous forms. For example, the Green Anaconda gives birth in water, and the Pig-nosed Turtle lays eggs that do not hatch until submerged, thereby ensuring synchronicity with the rainy seasons. The Yellow-bellied Three-toed Skink switches between oviparity and ovoviviparity, depending on the climate their population dwells in!

If one thing can be said of reptiles and amphibians, it is that they have developed remarkable strategies to excel in almost any environment. It seems the only thing many cannot adapt to is the loss of habitat, making Conservation Through Education vital!



Often mistaken for the babies of larger species, there are many herps whose adult size is still very small. Most naturalists find any baby animal endearing, but the young of tiny species are especially adorable, such as this neonate Dekay’s Brownsnake, whose whole litter could fit in a bottle cap!



Dekay’s Brownsnake photo by Micha Petty



Parthenogenesis

Reproduction without mating is called parthenogenesis. Parthenogenesis is relatively common in some invertebrates and lower plants, but this trait is shared by only a fraction of a percent of vertebrate species. Scientists have documented parthenogenesis in at least eight lizard families and four snake families so far. This trait can occur in a few individuals or across an entire species. This is a dubious adaptation in some regards, as it limits genetic



Chihuahuan Spotted Whiptail photo by Daniel Thompson

diversity, which could result in parthenogenetic species or populations being less adaptable to adverse environmental changes. On the other hand, it can enable a single immigrant to a new area to begin establishing a population. Interestingly, sometimes single females of species that typically reproduce sexually may parthenogenetically produce male offspring. This could ensure that, even if she were the first individual in a new locale or if males had been eliminated through predation or disaster, her production of male offspring would instantly enable sexual reproduction to resume. Circumstances such as these may be more prevalent than we realize, as it is difficult to determine if an individual in the wild has mated without observing the act or sequencing DNA from the parent and offspring for variation. Documented notable exam-

ples of periodic parthenogenesis include the Komodo Dragon as well as Copperhead and Cottonmouth snakes of the genus *Agkistrodon*.

Some well-studied examples include North American Whiptail Lizards of the family Teiidae, several species of which are believed to be all or mostly female. Interestingly, some of the females in these populations practice pseudocopulation, wherein one female will simulate a mating embrace with another female, each acting in a male or female role, respectively. This is thought to stimulate fertility and has caused some researchers to refer to their reproduction as unisexual, rather than asexual.

Some parthenogenetic whiptail lizards have even been discovered to have three sets of chromosomes, which starts to get complex and interesting. One theory is that this may have resulted from sexual males mating with parthenogenetic females, with the male chromosomes complicating the females' existing ability to clone chromosomes (which, in turn, may have resulted from two species interbreeding and somehow imparting both sets of chromosomes). As if all that was not mind-bending enough, Dr. William Neaves (then a Harvard grad student) found one in 1967 with FOUR sets of chromosomes. It was theorized that it was a sexually conceived hybrid of one parent possessing three-chromosomes and another parent of a similar species. In the late 2000's, this hybridization was proven in a laboratory setting, and they now have a colony of a few hundred parthenogenetic lizards which reliably produce apparently healthy cloned offspring. These offspring each have four chromosomes, and are considered to be a new species, *Aspidoscelis neavesi*. What the future might hold for this species may be uncertain, but what is certain is that reptiles undoubtedly exhibit enough staggering complexity to keep any inquisitive mind fascinated!



Eastern Copperhead photo by Justin Sokol

While the idea of venomous snakes and 150 lb. lizards having the ability to “clone themselves” may seem alarming at first blush, this trait does not mean these animals will suddenly become an epidemic. This is just another example of reptiles’ fascinating adaptations.

Sex Determination

Reptiles have a few different means of determining the sex of their offspring. Sex determination falls into two broad categories: Temperature-Dependent Sex Determination (TSD) and Genotypic (genetic) Sex Determination (GSD). With TSD, the incubation temperature of a clutch at an early critical stage in embryonic development determines whether the hatchlings will be all male, all female or a mixture of both. With GSD, sex chromosomes of the parent or parents determine the sex of the offspring. Crocodilians, Tuatara, and many turtles appear to have sex determined by temperature.

With GSD, one parent typically carries a homogametic set of chromosomes (e.g., Female=XX), and the other carries a heterogametic set (e.g., Male=XY). How these combine determines the sex of the offspring. Many vertebrates, including humans, follow this same pattern. Even setting aside parthenogenetic examples (where a parent may have three or even four sets of chromosomes), reptiles vary this in several ways, such as homogametic (ZZ) males and heterogametic (ZW) females.

With TSD, the sex of the offspring is not relative to the genetic code imparted, but rather the temperature of the eggs at a formative stage in embryonic development after they are laid. This can often be seen where high temperatures produce females, low temps produce males, and median temps produce a mixture of both. Again, reptiles vary this, so we have also observed thermosensitive determination wherein median temps produce males, but high or low temps produce females.

True to the reptilian rule that variety is the norm, we have observed other combinations as well. Some species appear to have the ability to switch from TSD to GSD, which is an adaptation that could act as a fail-safe in the event of changing climates (otherwise, populations of a

species that exhibits TSD could soon become unisexual if higher or lower than historical temps became the norm). The variety doesn't stop there, though. We are now seeing evidence in some species thought to exhibit GSD and whose embryos begin with a sexual imprint may have their sex over-ridden or reversed by temperatures during development. This would be seen as genotypic (XX) females becoming phenotypic (genetics + environmental



Eastern Three-lined Skink photo by Pepyn Thyse

factors) males. As scientists conduct more research, more mechanisms continue to be uncovered. For example, at least one study indicated that some species may even be affected by factors such as how much yolk the egg contains!

It is likely that the more we look at the intricacies of reptiles, the more we will keep discovering facets of their biology that defy our current understanding. The best course of action is for us to work to preserve all species, so that we don't miss any of these fascinating opportunities to learn more about how our world—and the organisms in it—operate.

Some species, such as the Eastern Three-lined Skink from Australia, determine sex through a combination of factors, including the genetics imparted from the parents as well as the temperatures of the eggs during development.



Buttermilk Racer eggs photo by Micha Petty

Snake Locomotion

You might assume that an absence of limbs would be a hindrance to movement. On the contrary, snakes generally find a way to get where they want to go (as the ratsnake on the left illustrates), often with more ease than us. Considering that various snakes can traverse land, climb trees, burrow, swim on or under the water, scale walls, and even “fly,” it’s hard to consider not having legs as any hindrance at all! Some of their methods are:

Lateral Undulation—also called “serpentine,” this is what most people think of when they picture a snake in motion. The snake undulates from head to tail and uses surface irregularities to propel itself forward. This method is quite an efficient and effective complex interaction of vector forces.

Slide-push—similar to undulation above, but used on slick surfaces if a snake suddenly needs to hurry across. With nothing to propel against, this has the appearance of “flailing,” but does get the animal where it needs to go.

Concertina—when faced with needing to pass through tight spaces, a snake will bend its sides against two surfaces to get a grip by pressing outward to get friction (or inward, if climbing up a vertical surface like a post). The steps are—grip > pull > grip > stretch > grip > pull, etc.

Sidewinding—also similar to undulation. When traveling somewhere with few solid irregularities to push against, several snakes may use gravity to their advantage. While maintaining two points of contact with the ground, a snake will then roll the rest of its body forward; the animal then repeats using two new points of contact. This results in travel following a roughly diagonal vector.

Rectilinear—also called “caterpillar.” This method is used by many snakes to travel in a straight line. The animal uses its ventral (belly) scales to gain purchase in several places at once, then pushes forward, resets, and repeats.

Gliding—a few species of snake can “fly” (glide) by flattening their bodies and rapidly undulating against the resistance of the air. They cannot generate lift, but these snakes can glide a surprising distance.



Snake tracks through duckweed photo by Rob Hunter

Forked Tongues

Did you know that the forked tongues in snakes and some lizards are for smelling rather than tasting? When these animals flick their tongues, they are collecting microscopic particles from the air. When the tongue is retracted, it transfers those particles to a vomeronasal organ, known as Jacobson's organ, which then transmits information about any scents collected to the brain for further interpretation.

The forked tongue in these reptiles not only senses what particles are in the air but also which direction those scents came from. When you hear a noise, your brain automatically interprets which direction the sound is coming from. It can do this because either ear is sampling the vibrations independently. The forked tip to squamates' tongues provides similar capabilities by sampling the air in two spots and interpreting minute differences in particle density. The flicking motion serves to increase sampling effectiveness by causing small vortices in the air, enabling the tongue to contact even more particles. This method is so effective that even blinded snakes often still find their quarry, as evidenced by the Tiger Snakes of Australia. Although 10% of these snakes have been blinded by gulls defending their nests, these blind individuals still manage to continue successfully locating their meals, apparently by smell alone!

Snakes and lizards certainly make heavy use of this ability and have developed cooperative adaptations to utilize scents further. For example, studies indicate that some of the proteins in viperid venom act as chemical signals which assist the snake in locating animals that flee after being bitten. Some venom combinations even include a diuretic, potentially making tracking prey much easier by causing it to leave a urine trail. Humans have studied venom for a long time, but it still seems we may just be scratching the surface of its astounding ramifications, not only regarding the benefits to the animals

that use it, but also the many medical breakthroughs that remain to be unlocked by better understanding its complexity.



Northern Pacific Rattlesnake photo by Tim Spuckler

It is apparent that reptiles are far from rudimentary. In fact, these fantastic animals possess skills and abilities that we ourselves do not. Some of these abilities are so refined that even with all our modern technology available, we must work diligently to comprehend even significant portions of reptilian capabilities. As we learn more, it becomes apparent that it is well worth the effort to preserve their place in the ecosystem, even if only to give ourselves more time to unlock their secrets!



Rock Monitor photo by Bionerds

The next time you see a snake or lizard flick its tongue at you—now you know the animal is just trying to get to know you by figuring out what you smell like!

Snakes and Swallowing

How and what snakes swallow is the source of many a myth. The number of people who think that an eight-foot snake will consume a person or a three-foot snake will eat their dog is amazing. While it is true that most snakes can swallow prey items that are bigger around than their head, and there are a very few large species that can consume a gazelle or other large prey, people's imaginations tend to blow this ability out of proportion. Let's look at the facts.



Florida Watersnake photos by Luke Smith

The bones in a snake's jaw are connected by elastic ligaments which allow their mouths to stretch around much larger items than would be possible with a rigid jaw. Contrary to popular belief, snakes do not dislocate their jaw when swallowing. While some snakes routinely consume prey items that cause their mouths to stretch to amazing diameters, most snakes prefer more easily digested prey. Having prey inside you that weighs as much as you do is not very tactical, which is why it is not uncommon for snakes to regurgitate a recent meal if they feel the need to flee from a threat. Nonetheless, snakes are generally opportunistic feeders, and in the wild one takes what one can get.

Another essential adaptation is situated in the bottom of their mouths, namely the glottis (windpipe), through

which they breathe. This can be extended out of their mouth (illustrated in the photo below) to enable them to keep breathing while swallowing large prey items that might otherwise choke them. Since snakes swallow their food whole and lack appendages to assist with this process, snakes "walk" their mouths around their meals. They use muscles in their jaw and neck to repeatedly and progressively grip alternating sides of their mouths a little further down their prey until they work it into their throats, where other muscles take over and move the meal to their stomach. Snakes' teeth are usually recurved (pointing back toward their bodies) to enhance their ability to grip their prey during this process.

Some snakes have adaptations which allow them to specialize in prey that might otherwise be difficult to consume. For example, some snakes swallow large eggs and then use specially adapted vertebrae to split the egg open in their throats, allowing them to consume the nutrients and regurgitate the shell. Other species such as watersnakes have exceptionally sharp teeth—a bonus when trying to hold on to slippery fish, frogs, and tadpoles. Their teeth structures are so varied that the differences between them play an important part in classifying species.

So, while it is true that a snake can consume prey proportionally larger than is possible for many other animals, these adaptations are, in large part, merely compensation for their lack of arms and legs. We should not take everything we hear or watch at face value and believe that there are no limits to their abilities. A snake with a head as big around as your wrist will not be out hunting German Shepherds, but rather seeking prey of a similar diameter. Unless you are reading this from an equatorial jungle, your local snakes see you as a threat and not a meal. They may try to bite in defense if you scare them, but they are not attacking you or out to get you.



Although snakes can consume surprisingly large meals, your backyard snakes are not hunting you or your pets.

This Florida Watersnake's glottis (left), visible in the front of the mouth, allows the snake to eat without suffocating.



“Sticky” Feet

You may have noticed that some lizards can walk up glass with apparent ease. While your first suspicion may be that their feet have some sort of natural “glue” on them, the reality is much more intricate.

Geckos and Anoles have structures on their feet that use what are called van der Waals forces. Without delving into an entire physics lesson, these are “weak, short-range electrostatic attractive forces between uncharged molecules, arising from the interaction of permanent or transient electric dipole moments,” or more simply—distance-dependent interactions between atoms or molecules.

The lizard’s interaction with vertical surfaces is not a result of “stickiness” as we normally think of the term (chemical or capillary adhesion), but rather a mechanical and electromagnetic combination of forces that allow the animal to grip various surfaces. In a lab setting, geckos can even adhere to “molecularly smooth” materials. This is made possible by millions of hair-like structures (called setae) on the pads of their toes. Below is a diagram showing how these setae continue to diverge into smaller structures (called spatulae). Each of these nanostructures creates a tiny individual bond to the climbing surface that is so strong in aggregate that geckos can hang from the ceiling by a single toe. Upon learning this, scientists became amazed that geckos were able to “un-stick” their feet at all!

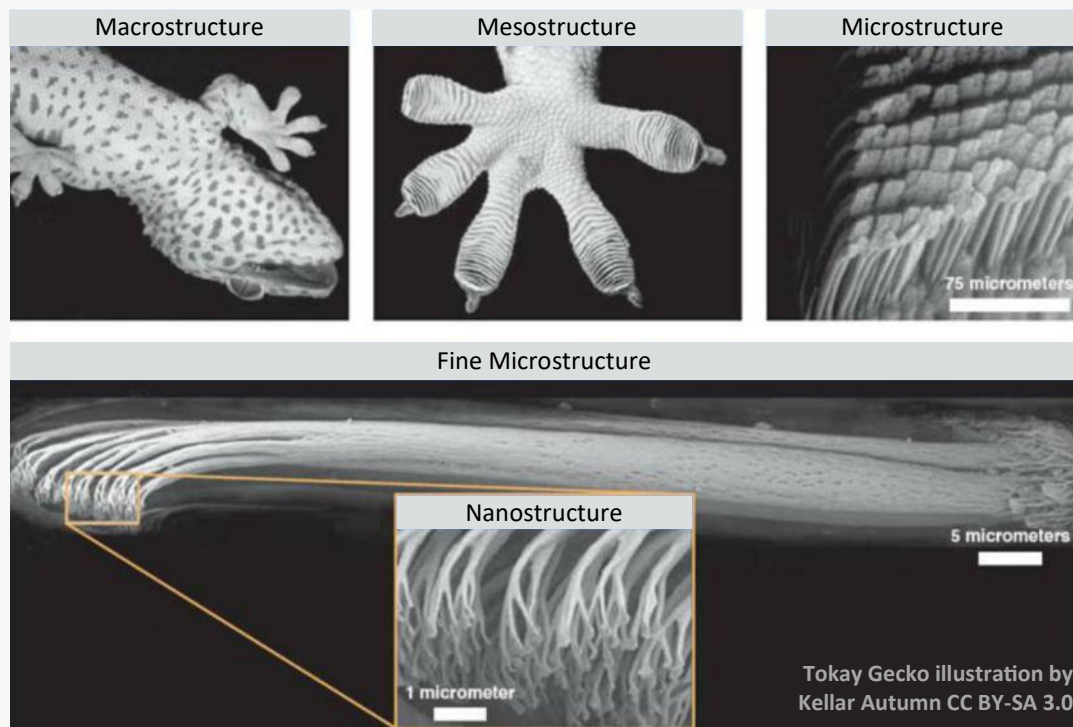
It turns out that the adhesive force of these spatulae depends critically on the exact angle of engagement. Geckos peel their foot up in a way that slightly changes the angle of the setae and breaks these mil-

lions of bonds a few at a time in a rolling motion. This is similar to how you would remove tape from glass by peeling it off rather than trying to pull it straight up all at once. This adaptation is so remarkable scientists are using gecko feet as a model for an array of various new



Wahlberg's Velvet Gecko photo by Bionerds

devices ranging from “tape” so strong that a piece the size of an index card can hold up to 700 lbs. (317 kg), yet detach with no residue, all the way to “Spider-Man gloves” that allow a person to scale sheer surfaces. These amazing creatures could keep research and development labs busy for decades to come!



Tokay Gecko illustration by Kellar Autumn CC BY-SA 3.0

Hibernation & Aestivation

Reptiles and amphibians are ectotherms, meaning they do not generate or regulate their body temperature internally, so what do they do when it is too hot or too cold? How do aquatic turtles manage life when the lakes and rivers freeze over?

California Mountain Kingsnake photo by Chad M. Lane



Herps do not hibernate exactly like mammals, which has led to some debate over the appropriate terminology. Some people call what reptiles do “brumation,” a term proposed in 1965, but other scientists consider that to be unnecessary jargon, as animals overwinter in various ways and “hibernation” sufficiently covers the spectrum. Regardless of what you call it, many animals are less active and use fewer calories in the winter than during other times of the year. However, since herps do not have to burn energy to keep themselves warm, their metabolism can safely slow way down, allowing them to burn very few calories and even use less oxygen. In fact, many aquatic turtles have adaptations that allow them to absorb sufficient oxygen through their pharynx (throat) and cloaca (vent), allowing them to stay submerged until springtime! Some frogs and hatchling turtles can even freeze solid in the winter and emerge unharmed in the spring!

Hibernation is not an extended sleep as is the case with some mammals—the herp is awake and may even venture out to get a drink of water from time to

time or move to a new location. However, they cannot have any meals immediately before or during hibernation, as their digestive system needs warmth to function. For required energy, herps may expend glycogen stored in their muscles.

Since reptiles and amphibians do not have the same ready means of dissipating excess heat that we do, they avoid fatally overheating during dangerously high temperatures by remaining inactive somewhere sheltered from the heat, such as in the shade, underground, or in the water. During extended periods of high temperatures, herps may enter a state of dormancy characterized by inactivity and a lowered metabolic rate. This is called aestivation.

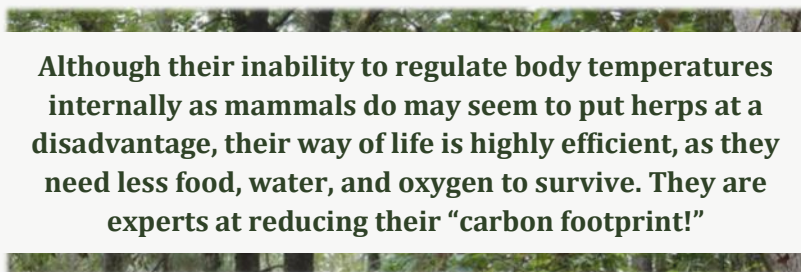
Many herps will retreat to the same hibernaculum year after year. This is one of the reasons it is crucial not to translocate (move) animals long distances. If you need to remove one from a house or help one cross a road, move them the shortest distance necessary for safety. A guideline many wildlife professionals use is a quarter-mile radius at most. Among other reasons, this is so that they do not have to face the challenges of finding new sources of food, water, and shelter. They may or may not be able to overcome the learning curve before those resources are desperately needed.

These methods of dealing with extreme temperatures are just more of the many adaptations that have enabled reptiles and amphibians to survive in so many different environments and fill so many niches. We humans may view ourselves as more advanced, but there is much to be learned from these creatures who are so adept at living on less. As our population continues to grow—these lessons may prove vital!

Southwestern Speckled Rattlesnake photo by Kameron Orr



Although their inability to regulate body temperatures internally as mammals do may seem to put herps at a disadvantage, their way of life is highly efficient, as they need less food, water, and oxygen to survive. They are experts at reducing their “carbon footprint!”





Tortoise Pee!

How do tortoises survive in the desert with so little water? Well, they have several tricks up their shells. We know that reptiles are ectotherms, which means they need much less food and water than comparably-sized mammals since they do not need to consume and burn so many calories to stay warm. That is the first thing they have going for them. Since they have such low requirements, the water already contained in the vegetation they eat goes a long way towards keeping them hydrated. Many can go incredible lengths of time away from any drinkable water by merely finding such vegetation. Their adaptations don't stop there, though.

Another trick of the trade they use is burrowing. Some tortoises are primary burrowers, digging tunnels slanted thirty feet or more into the ground. Even in the desert, the soil has trace moisture, and hunkering down in this humid microhabitat minimizes moisture loss. Furthermore, these tunnels offer safety and security, not only for the tortoises themselves but often dozens of other species, as well. Researchers with cameras routinely observe snakes, mice, and a variety of other critters sharing these shelters. In times of danger, such as a wildfire sweeping through the area, these burrows become community shelters, with all manner of creatures high-tailing it down these holes.

Possibly their most useful adaptation, however, would be how they handle the matter of liquid wastes. We humans must take in voluminous amounts of water every day (we're supposed to, anyway!) and we eliminate these fluids along with various unneeded byproducts of our metabolism. To keep the "furnace" going, we need lots of "coolant" circulating. Tortoises get their heat from the sunshine and often get their moisture from their diet. Instead of wasting the water they take in, they store it in their bodies. Uric acids that other animals continually flush out get crystalized by the tortoise, allowing them to expel only those actual waste products as a white, semi-solid concentrate (the white part of bird droppings are

similar in nature). The water itself is retained in case the tortoise doesn't come across a drink for a while and needs to reabsorb it!

In fact, tortoises will often wait to urinate until they find more fresh water to drink, or at least until they find some vegetation with high moisture content. They essentially "flush and refill" the tank by peeing and drinking as much as they can. They can then keep going for weeks (or longer, if necessary) on their fresh water supply.



Leopard Tortoise photo by Bionerds

Talk about Reduce-Reuse-Recycle! Humans spend huge amounts of money developing and refining methods of safely recycling water for vessels such as submarines and spaceships. Tortoises mastered that process ages ago, enabling them to spend their time on more important tasks, like napping. These majestic, armored survivors plod continually along, merrily digging burrows that preserve biodiversity and often asking little more than a patch of grass, some sunshine, and some shade. If ever there was an animal that deserved our respect and protection, tortoises are certainly top contenders. Quite a few organizations are working to preserve threatened tortoises—check out the links in the appendix to see how you can help!



Desert Tortoise photo by Kameron Orr

Did you know? Many animals, such as dogs, cats, birds, and lizards lap or scoop up water with their beaks or tongues. Tortoises can't do either of those things, so they just stick their whole face in the water and "pump" it in!

Bonus Section

Find the Herp!

See if you can find the reptiles and amphibians in this section.

Need help? Visit
LearnAboutCritters.org/connect

Alleged difficulty ratings appear
near the captions and range from
1 (easiest) to 5 (hardest).

Northern Pacific Rattlesnake photo by Chad M. Lane



1 Timber Rattlesnake photo by Armin Meier



3 Pygmy Rattlesnake photo by Luke Pearson



Red Cornsnake photo by Matt Moore

5



Eastern Copperhead photo by John Williams

5





Blanchard's Cricket Frog photo by Micha Petty 3



Northern Cottonmouth photo by Bronc Rice 1



4 Green Anole photo by Nick Barys



3 Northern Cottonmouth photo by Micha Petty



Blanchard's Cricket Frog photo by Micha Petty 2



Timber Rattlesnake photo by Ashley Tubbs 4



3 Blanchard's Cricket Frog photo by Micha Petty



1 Spring Peeper photo by Luke Smith



Broad-banded Copperhead photo by Rebecca Steele 3



Eastern Copperhead photo by John Williams 1



2

5

Stripe-necked Musk Turtles photo by Derek Wheaton



1

Green Anole photo by Micha Petty



Brown Anole photo by Micha Petty 2



Blanchard's Cricket Frog photo by Micha Petty 2



2 Broad-banded Copperhead photo by Alli Kirk

2 Northern Cottonmouth photo by Micha Petty



Canyon Treefrog photo by Daniel Hediger 2



Blanchard's Cricket Frog photo by Micha Petty 2



2 Smooth Snake photo by Daniel Hediger



2 Asp Viper photo by Daniel Hediger



Asp Viper photo by Daniel Hediger 2



Asp Viper photo by Daniel Hediger 2



2 Green Iguana photo by Micha Petty



3 Dusky Pygmy Rattlesnake photo by Nick Barys

Part IV

Natural History



American Alligator photo by Ashley Tubbs

THE ONLY *GOOD* HUMAN IS AN *EDUCATED* HUMAN



Eastern Copperhead photo by Justin Sokol



A Complex Web

Reptiles and amphibians are a part of an incredibly complex ecological web. In this modern age of information, it may feel as if all the secrets of the universe are just an internet search away, but the reality is that we are only just beginning to understand the nuances of the natural world. Biologists estimate that we have only described around 20% of the species on Earth, and researchers routinely make observations that turn the things we thought we knew upside-down. When we think of the “food chain,” many of us picture a neat circle where small organisms are eaten by progressively bigger animals until one day the top consumers pass on and decomposers start the process over again. Many may think of snakes as simple rodent-eaters or can only picture a frog catching a fly. There may be some truth there, but once you develop a passion for the natural world, your mind soon wonders at the dizzying array of relationships to be revealed among its secrets.

When we start to wrap our minds around this much biodiversity, we realize just how vital preserving it is. When we eradicate a native species from the environment, the unintended consequences can be dire. Whenever a void is created in nature, something steps in to fill it. For example, rodents may not seem like a significant human health concern now, but if snakes and other predators were not keeping them in check, you would soon feel like you were in a horror film. In large metro areas where people have decimated the snake populations, it takes traps, poisons, and pest control technicians to keep our food and perishables even relatively safe. Rodents chewing on electrical wires are already one of the leading causes of house fires and without snakes preying on them that would only get worse. Rodents are a primary source of agricultural destruction and facilitate the spread of many diseases. Snakes and other predators are a sign of a healthy ecosystem. People who fail to appreciate reptiles and amphibians enjoy that luxury because herps are quietly helping to keep life in balance.

If you happen to observe a snake on your property, your

first reaction should be one of appreciation. Either the animal is just passing through or is there to perform a valuable service. Our penchant for repaying these beneficial animals (who by the way were here before we were) with the business end of a shovel is a gross injustice. We ought to recognize the inherent value of biodiversity and concern ourselves with being stewards of the natural world. Failing that, we should want to preserve herps for selfish reasons, as they benefit our lives in

Eastern Copperhead photos by Sarah Phillips



countless ways. Sadly, our tendency instead is to alter and destroy habitat for herps and other wildlife, and then set out traps for anything that manages to survive.

A healthy ecosystem is a perpetual play enacted between predators and prey, producers and consumers, sunlight and microbes, and many organisms we have yet to discover. When we disrupt that balance, nature struggles to regain equilibrium, but that takes time, and we may not like the new status quo once we see it. Let us prioritize preserving the environment we have for our own sake and the sake of the critters we share it with. Inevitably, we ignore the plight of the species declining around us at our own peril. Our undoing may be that too many of us are waiting for someone else to come along and fix the mess we have made of our home.

When asked why the Earth needs venomous snakes, one wise educator likened the answer to an airplane. “You may take a part from an airplane,” she explained, “and yet it will still fly. You may take two or three or four without apparent ill effect. But sooner or later, you will have taken out too many parts, and that plane will fall out of the sky.”
...and so it is with our ecosystem.



When are Herps Active?

Reptiles and amphibians have a wide range of activity times. Herps can be diurnal (active during the day), nocturnal (active at night), or crepuscular (active around dawn and/or dusk). Many species will have peak times of activity within those categories, and many herps vary their activity seasonally. This is a wide range of options, but there are some general rules of thumb that we can learn and apply.



Brazilian Bush Anole photo by Bernard Dupont

Many amphibians do poorly in excessively dry conditions, so will not usually be seen in the heat of the day during warmer months. While some may venture out periodically, especially during wet or overcast days, crepuscular and nocturnal activity is the norm for these moist-skinned animals. Look for most frogs and salamanders to be especially active during evening rainfalls.

Chelonians (turtles and tortoises) are highly diurnal. Most aquatic turtles eat, swim, and bask during the day. Wading through a creek will often result in seeing a few turtles awake here and there, swimming underwater, but nighttime is generally a lull. Likewise, tortoises are sun lovers that often find and consume plants in the morning, if possible, then look for some shade or a burrow to avoid the overhead sun. If they get enough to eat in the morn-

ing, they will often call it a day. If they are still hungry, they might venture out later that afternoon, but tortoises are not known for doing much more than they have to.

Crocs, while diurnal, will not hesitate to hunt at night if that is when their quarry is active.

Lizards are predominately diurnal, but there are plenty of exceptions. Geckos are so overwhelmingly nocturnal that we call the few diurnal species Day Geckos. By and large, though, most lizards hunt by sight and bask for warmth during the day.

Snakes are the most variable. There are many diurnal species and many nocturnal ones. Furthermore, diurnal species in hotter climes often switch readily between the two when daytime temperatures get too hot for comfort.

One can typically ascertain a species' activity times based on their prey. For example, snakes that make their living finding nocturnal animals like bats and frogs are, of course, nighttime critters. Others that eat lizards or birds are creatures of the day (though a few hunt nocturnal species). The juveniles of some species will have longer active times until they learn to be more efficient hunters. There is also a tendency for primarily nocturnal herps to have elliptical pupils, allowing them to take in the most available light at night and contract to slits to reduce the glare when they need to face the day.

As you learn more about reptiles and amphibians, you will discover that various facets of their biology and natural history are intertwined with each other. For example, knowing an animal's preferred body temperature will tip you off to when they can be seen, as will knowing what it likes to eat. As you study them, your understanding will start to fit together like pieces of a puzzle—one that some find all the more enjoyable because it will never be finished. If you enjoy learning, herps provide the perfect subject matter!



Desert Banded Gecko photo by Kameron Orr

If you want to spot herps, it helps to know when they are moving about. While this varies with species, seasons, the changing abundance of prey, and other factors—this bulletin contains some tips that may make your search easier.

Where do Herps Live?

Reptiles and amphibians are all around us. Just because we may not see them every day does not mean that we are not passing by them every time we walk outside. Many herps are masters of camouflage and are thus able to hide in plain sight. Many others whose camouflage may be less than perfect still tend to blend in with their surroundings most of the time. Most have acute senses and are fully aware of our approach long before we notice them. Since they are smart enough to know that we are much bigger than they are and could easily be a threat, they often slip under the leaves, into the water, or down a hole, and we are none the wiser.

The fact that most humans are virtually oblivious to the world around them also works in their favor. If we just open our eyes and look around, they are almost always there. Even in our concrete jungles, there are usually lizards watching us walk by, whether it is the anoles of the Americas or the house geckos of the Old World or something else.

Slowing down also makes a dramatic difference. Just sit down and be still and quiet for fifteen minutes or so. Keep an eye out and you will likely soon discern skinks or earthsnakes carefully creeping back out from the cover they slipped under, checking to see that the coast is clear before resuming their business of basking or searching for insects.

Pretty much the only place herps do not live is in the sky. They can be found on volcanoes and mountains, in treetops and bushes, among the rocks and weeds, on fences and walls, in gardens and on roads, in puddles, creeks, rivers, and lakes, in the oceans and in the deserts, under boards or logs, in burrows, or buried in the soil. Unless you are in a frozen wasteland, there are probably herps within a stone's throw of you right this moment.

All of this is not to say that they are as commonplace as

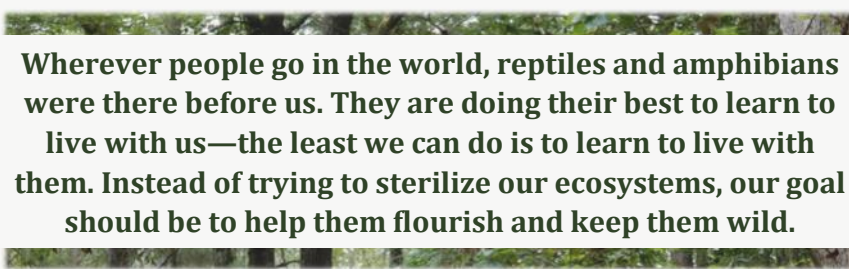
they once were or should still be. Every order of reptiles and amphibians are struggling against the habitat loss we incur. They are pressured by collection as food or pets or as ingredients in superstitious medicines. They suffer diseases that are likely made worse by our interferences into their environment. They struggle to adapt as we engineer and alter the ecosystems with which they are so in tune. Our pesticides and herbicides kill their food or render it unwholesome. We pol-



Blunt-nosed Leopard Lizard photo by Chad M. Lane

lute their groundwater. These and many other factors, both drastic and subtle, take their ominous toll. Preserving reptiles, amphibians, and biodiversity is critical in this modern age and requires a holistic approach.

We must change our attitudes and understanding of the world around us and learn to appreciate that we are not the only animals that live here. We need to start valuing biodiversity more than money. Now is the time and education is the key. Please give some serious thought to how you can reduce your impact on the environment and to how you might take part in conservation efforts that are already underway. Just because we may not notice the creeping things of the world does not mean that it is not a tragedy each time more disappear.



Wherever people go in the world, reptiles and amphibians were there before us. They are doing their best to learn to live with us—the least we can do is to learn to live with them. Instead of trying to sterilize our ecosystems, our goal should be to help them flourish and keep them wild.



Eastern Gartersnake photo by Marc Dubois

Adapting to Suburbia

Animals survive by being adaptable. Change is constant in the wild and animals that cannot adapt to changing environments typically perish. Unfortunately, humans are changing the environment much faster than many species are able to cope with. Fortunately, some species have been able to take our interference more or less in stride and even find ways to take advantage of the new opportunities created by disturbed habitats. For our part, there are ways we can make their lives a little easier.



American Alligator photo by Christopher Gillette

When tropical storms lead to flooding in the Florida Everglades, animals like this young American Alligator waste no time taking advantage of the opportunities created by manmade features of the landscape. This little fellow quickly discovered an easy meal as passing fish were exposed above the road surface. Sadly, while altered habitats do create opportunities for some adaptable animals, habitat loss, and fragmentation typically take a severe toll on wild populations.



FrogLog photo by Rich Mason



Desert Nightsnake photo by Chad M. Lane

It's time to make herp-friendly yards the norm. Just as you see bird feeders in many backyards, you can also do your part to help the herps in your community. There are many ways of doing this, such as:

- Installing a garden pond for amphibians and water-snakes.
- Leaving sections of your yard to grow naturally to provide cover for herps.
- Letting a spigot or hose drip during dry spells so thirsty critters can have a drink.
- Leaving natural or artificial debris in various locations to provide shelter for toads and other creatures during the daytime.
- Follow the instructions in the bulletin about creating treefrog tubes.
- Stop applying harmful pesticides and chemicals to your yard—healthy insects are an essential part of the food web!
- Supervise domestic animals when they are outside; wildlife rehabilitators take in animals attacked by pets all the time.
- Work to humanely eliminate feral cat populations—cats are a significant threat to urban wildlife.
- Consider making adaptations to your property that increase animal safety, like the device shown on the left, which allows animals to exit swimming pools.

Animals rarely miss opportunities that we create for them, such as toads hanging out under artificial lights. Unfortunately, they are often also affected by the pitfalls we put before them, such as getting tangled in plastic. Let us be continually mindful of the effects—good and bad—of what we do and leave outdoors.

Of course, making our yards eco-friendly is no substitute for preserving wild habitats. These tips are just examples of some small things we can do to help animals who have been adversely affected by human expansion. See if you can think of even more ways to help your backyard critters. Retaining *some* biodiversity is better than none!

Animals such as ratsnakes quickly learn that chicken coops mean eggs, barns mean mice, and attics can mean squirrels.

We should not fault them for trying to find a meal—every animal needs to eat. Instead of chasing them off, try to look at it as a small payment for them letting us live in their homes!

Hidden in Plain Sight

While camouflage is by no means exclusive to reptiles and amphibians, herps certainly display many striking examples of being practically invisible. You could be six inches away from a Leaf-tailed Gecko or Vietnamese Mossy Frog and probably not see them even if someone was pointing at them. A vast number of herps simply blend in with the surroundings as you walk through the trees; camouflage is a survival trait that has served these animals well.

Unless you live in a frozen wasteland, you are almost certainly surrounded by herps every day. They use a combination of blending in and sliding out of view to keep from getting noticed most of the time. There are greensnakes in the bushes that look like vines, tree-frogs on the oak trees, cricket frogs in the weeds, skinks in the leaf litter, and more. We pass blithely by these animals every day.

Many reptiles and amphibians can also change color. Some (e.g., Mediterranean Geckos) do so subtly; others (e.g., many chameleons) do so drastically. Species do this to blend in with their surroundings and for other reasons. Chameleons and many other species express emotion by changing color. If you were to watch two male Green Anoles get close to each other and know how to speak “lizard color” you could easily translate their entire exchange. If neither gives way, their heads will eventually turn black with apparent rage before they do battle.

Some herps also change color in response to temperatures. This handy adaptation allows them to assume a darker color to absorb more heat from the sunlight when they need to get going in the morning and then return to a more reflective color to avoid overheating.

For the most part, though, herps make their way in the world by the motto “*Act natural.*” They know that, for the most part, all they have to do is be still and quiet and we will tromp right by. They often also seem to know how fast they are and how slow we are. Even if we approach them, many critters will retreat just far enough to stay out of reach, seemingly with complete



Eastern Copperheads photo by Armin Meier

confidence that they can easily avoid us if we make any sudden moves. This is how some snakes got the ludicrous reputation for chasing people—they try to sit still until the last second and then dart (sometimes past us) toward cover or try to drop into the water after a fisherman’s boat is already underneath.

It really is not that difficult to understand the animals that share our ecosystems. If you study them, you will soon realize that, even though they may not debate politics or religion, they are sharp critters in their own rights. It would be a rare human indeed that took the time to get to know herps or other animals and did not then want to preserve their presence for future generations. Hopefully, this already describes how you feel now!

Learn to be alert to the (sometimes subtle) appearance of herps all around you. Not only will this help you avoid stepping on a venomous animal, but it can also increase your enjoyment of the outdoors as you make more observations.



Canyon Treefrog photo by Frank Portillo

Non-native Species

Non-native (introduced or invasive) species can be a very hot topic. In the U.S., for example, feral hogs tear up land and destroy crops, exotic plants clog many water bodies, pythons cause problems in the Everglades, domestic cats kill birds and reptiles, zebra mussels alter our waterways... the list goes on.

Burmese Python photo by Susan Jewell, USFWS CC0



Red Invasive Fire Ant photo by Alexander Wild CC0

It is never a good practice to introduce any non-native species into a new ecosystem, yet we humans seem to do so as a matter of course. We routinely spend substantial amounts of money to introduce supposedly beneficial species to the environment, such as bass into fishing wa-

ters. Many animals, such as Nutria and Red Imported Fire Ants, have been a fixture in the U.S. for so long that many people are not even aware that they are not natives. European Starlings are another example, having been brought to America and released in New York by a Shakespeare club that wanted any bird mentioned in his plays to live in the New World. Goats released by sailors in the Galapagos nearly wiped out native tortoises by out-competing with them for food. There is no shortage of proof that we frequently do this intentionally, and it really needs to stop.

From time to time, people get up in arms about certain introduced species, such as the Burmese Pythons in the Everglades. This has a lot to do with big snakes making for good television ratings. Some viewers now think that half the country could soon be covered in monster snakes. In all likelihood, however, there are only a couple of small swathes of southern Florida and Texas where the climate could support these large constrictors. In any event, as sensationalized as these pythons are, many other non-natives, such as domestic cats, have killed far more animals than introduced snakes ever have. In fact, herps are quite often some of the primary animals to suffer at the hands of invasive species. Fire ants raid box turtle and other nest sites, wild hogs decimate snake populations, introduced fish and crawfish prey on or compete with amphibians, really there are too many examples to list.

Introduced species are not in balance with their new ecosystem and often cause a considerable degree of upset. Once a new species gets established, it is typically here to stay, and the ecological and financial consequences can be quite severe. Please think twice about introducing a new species, be it plant or animal, anywhere that it is not already established.



Mediterranean Gecko CC0

While many introduced species that have hitched rides with people and become established in new locales seem relatively innocuous, others can wreak havoc. Try to avoid moving plants or animals around—an organism in balance in one area can become a destructive invader in another.



Red-cheeked Salamander photo by Todd Pierson

Part V Conservation

I appreciate your helping me across the road, but

Please Leave Me Nearby!

This is my home and I don't like new places.



Three-toed Box Turtle photo by Grover Brown

Herp Conservation

Reptiles and amphibians are in crisis. While there are still many species that are listed as “demonstrably secure” or of “least concern,” there are far too many that are in peril or endangered. It is well known that amphibians and Chelonians (turtles, tortoises, and sea turtles) have been in drastic decline for some time. The secretive and solitary nature of snakes has meant that their distribution

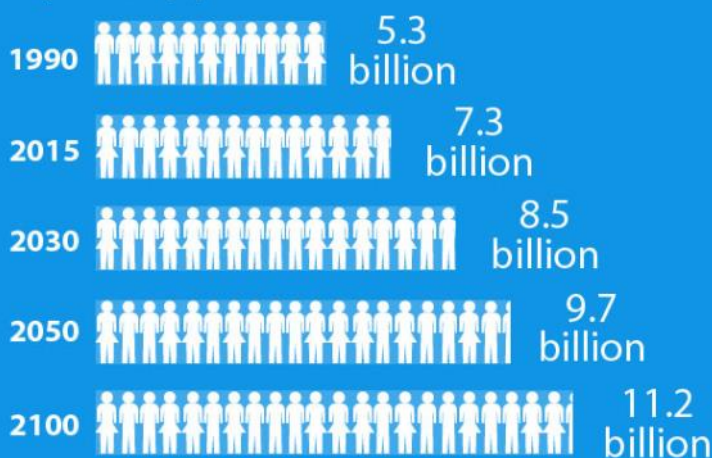
- **Collection for food and pet trade**
- **Climate change**
- **Pollution including pesticides, hormones, and altered pH levels**
- **Disease, e.g., Chytrid Fungi, Ranavirus, *Mycoplasma agassizii* in Gopher Tortoises, Snake Fungal Disease**
- **Incidental (collateral) mortality, such as sea turtles caught in commercial fishing nets**
- **Direct human interference, such as killing snakes on sight**
- **Introduced species, e.g., cats, rats, and goats**

Some of these may be difficult for the individual naturalist to see a way to change. However, although these are global issues, change typically begins locally. If our goal is, as the saying goes, to “be the change we wish to see,” our successful efforts will often spread and gain traction. Regardless of what the rest of the world does, many of these items must be addressed locally each place they occur. Mitigation of invasive species, for example, can and should be addressed at the state or local level. Curbing the wanton and needless killing of harmless and beneficial animals such as snakes is behavior we can confront when we encounter it. The collection of wild herps for food and the pet trade puts tremendous pressure on local populations, and each state should work to carefully regulate this activity. Not to be overlooked is the option also to get involved with various global conservation organizations. There are many that could certainly use all the help they can get.

Do not let being “just one person” deter you! The more we consider these issues, the more wisdom you will find in the adage, “**Think Globally—Act Locally.**”

World Population

Projected world population until 2100



Source: United Nations Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision*
Produced by: United Nations Department of Public Information



and population densities have been poorly understood, but studies continue to confirm suspicions that serpents are also becoming fewer. Lizards, while seemingly more secure than other kinds of herps, nonetheless face their own difficulties. This is a worldwide and alarming trend. There are many factors contributing to this decline.

Some major factors are:

- **Habitat destruction, degradation, and fragmentation (this is generally acknowledged to be the primary cause of wildlife decline)**

Little Brown Skink photo by Ashley Tubbs



At our current rate of growth, we are projected to have roughly twice the population on Earth in forty years than we had twenty years ago. Species lost during this expansion can never be recovered, so we should all be concerned with mitigating our impact.

Habitat Loss

The most severe threat to biodiversity worldwide is generally accepted to be the loss of habitat. Birth and death are a part of life. Up to the point of their habitat's carrying capacity (with some exceptions), species can regain equilibrium after disasters or other imbalances. Although many factors determine how many individuals a given area can support, the loss of habitat through alteration by humans reduces the carrying capacity of an ecosystem across the board. It is true that some animals may adapt to disturbed habitats—most of us have seen pigeons thriving in cities or toads waiting underneath lamps for falling insects. Nonetheless, the fact that a few species manage to survive our interference is no reason for complacency. Sustaining a natural level of biodiversity should undoubtedly be our goal and is a worthy end unto itself.

The onslaught of human expansion has meant more than just habitat loss. We have caused habitat degradation through pollution, the introduction of domestic species of plants and animals that compete with the native species for resources, the artificial re-routing of waterways for our own purposes, and countless other factors. Even where wilderness still exists, it is typically subjected to habitat fragmentation. This is the parceling out and dividing of land areas into smaller sections surrounded by altered habitat and bisected by roadways. Scientists estimate that while roads only cover 1% of the planet's land area, they affect up to 15% of the world's land habitat through the effects of fragmentation. If you have ever seen a dead animal on the road shoulder, you have witnessed this first-hand.

The minds of our generation should be engaged in innovation. Although it may not be possible to stem the tide of population growth in any politically correct manner, we should be looking for ways to mitigate this expansion. It seems unlikely that genuine and permanent solutions are going to originate from the world's governmental bodies. Change typically arises through small, devoted groups of committed, concerned individuals. It may be that you are one of these leaders, or maybe you choose to support others who are taking point on this charge. Whatever the role, more of us need to “unplug” from our distractions long enough to consider how we might curb

the rampant and virtually unbridled consumption of resources that is taking place worldwide.

There are things that you can do right now. If you own land, you can seek out private land biologists to help you learn how to improve its value as habitat. One example is habitat corridors. These are sections of undisturbed or naturalized land that wildlife can use in their movements, such as a swath of trees and understory around a creek



Painted Ensatina photo by Chad M. Lane

bed. In some areas, people volunteer to help animals like salamanders cross roadways during known migration times toward breeding waters. Many herp lovers purposely have garden ponds or cover-boards or PVC pipes hung up for treefrogs. Cutting down on the use of pesticides and plastics is always good. These are just examples to get you thinking—every little bit helps! Look into conservation efforts locally and globally and give some thought to how you might be of assistance. The world is in a precarious state in many respects. As the saying goes, “It is what it is.” However, a more encouraging phrase to focus on says, “Be the change you wish to see.” With enough people prioritizing habitat preserves, refuges, natural areas, and innovating solutions like turtle excluders along roadways, etc., there is hope, but we must act, and we must do so now. There is no time to wait for someone else to come along and take care of this the only planet we share with so many amazing creatures.



It may seem that there is little one person can do to halt the destruction of the Earth's habitat. Don't let that discourage you!

Change always starts with just one person. By sharing our knowledge and cooperating—there is always reason to hope!



Gila Monster by Chad M. Lane



Commercial Collection

Collection of native reptiles and amphibians for the food and pet trades is a widespread issue for wild populations. There are many areas where populations have been collected out of existence. This includes areas of functional extirpation where there are not enough individuals remaining for their numbers to recover from the removal of breeding adults. Even when biologists are consistently communicating that these animals cannot sustain virtually unbridled collection, enacting protections is a highly

theory is that animals will always recover as long as we don't collect all of the animals. In all fairness, there is a level at which the harvesting of certain wildlife is sustainable. For example, most states have down to a science the number of deer that can be harvested each year for the remaining animals to have better survival rates than if left unmanaged. When adequately administered and based on input from biologists, this practice seems beneficial to the wild populations. Sound science is the key to management.

Alligator Snapping Turtle photo by Peter Paplanus

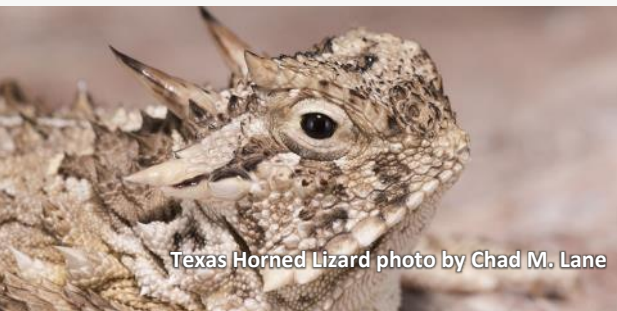


politicized undertaking, and the needs of wildlife often lose out to the "needs" of those making a living from them.

In nature, a species whose numbers are reduced will typically rebound back up to the carrying capacity of its habitat (although some species have low replacement rates, which can make rebounding an excruciatingly slow process). This means that if a population sustains losses by natural means that the number of individuals should regain equilibrium as a result of several factors such as a relative abundance of food, a decrease in predators due to the temporary lack of prey, and so forth. Some people feel that this cycle indicates that commercial collection should not be of any concern to conservationists. Their

However, humans have repeatedly demonstrated their disregard for sustainable practices on countless occasions. Southeast Asia is one currently well-publicized hot-spot where collection has decimated numerous species. Comedians may joke about certain cultures eating anything and everything, but drastically reducing biodiversity is no laughing matter. Asians are not the only guilty parties. There are plenty of accounts of systematic harvests across the globe, on land and at sea, that have wiped out populations of numerous species. Even in the U.S., hundreds of thousands of turtles are still being systematically harvested to this day to satisfy the demand of the Asian food markets, despite the availability of farmed turtles.

When a predator has found a meal it ceases the hunt. But when a human's livelihood depends on the collection of animals in the field, the collection continues as long as that person needs income. When you multiply this out by a multitude of skilled, focused individuals, it can quickly reach epidemic proportions. While it may seem easy to fault the individuals doing this commercial collection, the simple fact of the matter is that as long as people are willing to pay for these animals there will always be collection activity (even if it is illegal). Poverty is an effective motivator. The avenue that would seem to hold the most promise is Conservation Through Education. We need to teach people, starting when they are young, to value biodiversity. Only when we are unwilling to pay for wildlife to be killed on our behalf will the killing stop.



Texas Horned Lizard photo by Chad M. Lane

There are global efforts to eliminate unsustainable and illegal trade in wildlife, including reptiles and amphibians.

**For more information, visit traffic.org
TRAFFIC aims to ensure that trade in wild plants and animals is not a threat to the conservation of nature.**

Amphibian Diseases

There are several devastating infections affecting amphibians populations around the world. We've known this has been happening for decades. The two most common are chytridiomycosis and ranavirus infections, and more recently we have become aware of another deadly disease called Severe Perkinsea Infections.

- Researchers have documented mass die-offs of amphibians due to ranavirus in 25 U.S. States and 5 continents since the 1960s. Mortality, which can be as high as 90%, is highest among larval frogs and salamanders—thousands at a time have been found dead in affected areas.
- The US Geological Survey has been studying another disease and considers it the third most common among amphibians. Dubbed Severe Perkinsea Infections, or SPI, this one has mortality rates as high as 95%. So far, SPI has been detected in fewer locations than chytridiomycosis or ranavirus infections, but it demands attention, nonetheless. It has, for example, already affected the critically endangered dusky gopher frog at the frogs' few remaining breeding sites.
- The main culprit on scientists' radar is chytridiomycosis, affecting both frogs and salamanders. Frogs are affected by the chytrid fungus *Batrachochytrium dendrobatidis*, or simply Bd. There is a similar chytrid fungus affecting salamanders and caecilians called *Batrachochytrium salamandrivorans*, or Bsal. We don't fully understand Bd yet, but we have at least deciphered the mechanism of this illness. Amphibians take in water and absorb salts through their skin rather than their mouths, and this fungus thickens their skin. The resulting electrolyte imbalance eventually causes cardiac arrest.

Bd is a naturally occurring fungus that has been described as causing "the worst infectious disease ever recorded among vertebrates in terms of the number of species impacted and its propensity to drive them to extinction." (Gascon et al., 2007). Scientists are working hard to understand this disease and hopefully prevent further extinctions. However, the global nature of



this problem makes it likely that more species will disappear before we can find an effective and practical response. Although there have been some breakthroughs in the work to understand Bsal, we know even less about Bsal than we do Bd.

Many people are working to curb these disturbing outbreaks, and some potential remedies have been found, such as slightly increasing the salinity of small water bodies. However, it is clear that more resources need to be devoted to understanding and preventing these diseases. Visit some of the links in the appendices to learn more—there are ways you can help, even if it is just keeping an eye out for sick critters!

Frogs and salamanders are among the most threatened and vulnerable animals on Earth. In addition to pollution and habitat loss, several diseases are decimating populations. We are still struggling to understand these pathogens in the hopes that we might prevent further extinction events.



Snake Fungal Disease (SFD)

Multiple diseases threaten reptile and amphibian populations in our modern age. Several of these have risen to alarming proportions. One notable example is Snake Fungal Disease [SFD]. SFD is caused by the keratinophilic fungus *Ophidiomyces ophiodiicola* [Oo]. It is thought that this pathogen may have been present in the environment for some time, but changing climactic or other conditions may have allowed for the infections to become symptomatic.



SFD illustrations courtesy of The Royal Society, London.

Mortality among affected animals varies but can be very high in some instances. The long-term effects of this pathogen in the environment remain unclear, but the obvious concern is that of potential extinction events. Recent studies have shown that, due to a variety of factors, many snake populations in areas where SFD has been detected were already declining at a

higher rate than previously suspected. This makes the potential pressure from SFD all the more worrying.

SFD was first described in the northeastern United States in 2006, and its appearance has been documented in 20+ states as of 2016. Whether through expansion of the disease or merely a result of increased research and discovery, instances are now being recorded west of the Mississippi River. Although cases have been detected in captive or wild animals in Canada, Germany, Australia, and the U.K., the disease still appears to be most prevalent in the U.S.

Another concern has to do with the solitary and secretive nature of snakes. This disease may be much more commonplace than we yet realize. It is possible that, even with the rapidly growing list of documented cases, we are only seeing a small portion of the extent of this disease.

Although the layperson may feel there is little that they can do to combat such a widespread ecological issue as this, there are a couple things that you can be aware of and take action on. If you seek out and observe reptiles in the field for scientific study or recreation—please make a habit of sterilizing any equipment used after each encounter to avoid potential cross-contamination of populations. Also, bookmark and be aware of the Disease Reporting Task Force managed by Partners in Amphibian and Reptile Conservation (PARC), and report any appearance of diseases in reptiles and amphibians (not just SFD). This will help conservation groups understand and respond to these diseases much sooner than might otherwise be possible. The web page for this initiative is parcplace.org/parcplace/resources/disease-task-team.html

Ophidiomyces ophiodiicola photo by Sigler L, Gibas C CC BY-SA 4.0



Instances of this disease are being discovered so often that printed maps become obsolete almost before the ink dries. SFD is being found at more sites, in more states, and in more countries than ever before. This is one reason why it is so important to use caution and practice decontamination protocols when moving between natural areas.



Systematic Eradication

Appallingly, humans are still calloused enough that people intentionally and wantonly kill reptiles, particularly snakes. You probably know people who will kill a snake on sight, solely for the crime of being alive. Conservation Through Education seeks to overcome fear and ignorance and instill a sense of value and respect for all wildlife. Although each individual may only kill a small number of snakes, millions of people willing to do so equates to a considerable amount of senseless destruction. When combined with the many other pressures on wildlife, such as habitat loss, studies showing these animals in population decline come as no surprise.

In some areas, people actually make a public spectacle of such activity. Some communities host “Rattlesnake Roundups,” which have become a mainstay of these small-town economies. Leading up to these ghastly events, thousands of snakes are harvested from the wild, typically by flushing them from their retreats (hibernacula) with gasoline fumes. Any snake fortunate enough to escape the fumes is collected to be killed at the “festival.” These animals are then left to languish, starve, and sometimes suffocate in buckets and bins for weeks before being decapitated and skinned before the wide-eyed onlookers who arrive in droves to gawk at the carnage. In response to a rain of protests from biologists and naturalists, paltry excuses are put forth, such as the meat being used for food. Such transparent justifications ring hollow when one considers that these animals are not feeding destitute people, but rather are being inhumanely housed and killed to prop up townships that are either unable or unwilling to build a sustainable economy free from sensationalized cruelty. Apart from the pangs of conscience one should feel at such “festivals,” the past and present are replete with examples of species being decimated when harvesting them becomes a commercial activity. If we want to avoid that with these iconic and beneficial animals, it is ultimately up to the consumers to stop supporting these activities.

In an age where raising the next generation should have

a value for our natural heritage as a cornerstone, these events institutionalize destruction and disrespect. There is hope, however. Many of these festivals have voluntarily reformed their nature and have become (still profitable) wildlife festivals. At these, the public can learn about these fascinating members of their local ecosystem and gain a new appreciation for animals they may have previously feared. Biologists and naturalists contin-



Western Diamond-backed Rattlesnake photo by Mark Lotterhand

ue to entreat the remaining destructive communities to voluntarily reform and progress. Wildlife agencies in the states that have yet to ban the ecologically disastrous technique of gassing wild habitat are also being encouraged to do so. Unfortunately, when people are convinced that their livelihoods depend on a practice—humane or not—it can be difficult to enact change. Please contribute what you can to the organizations that are working toward the reform and transformation of the remaining destructive Roundups, even if your part is as simple as participating in a boycott. Optimally, naturalists should find ways to present sound natural history education to those willing to receive it in these areas in the hopes that they will voluntarily adopt humane and sustainable behaviors. However, thousands of animals are suffering every year as long as these barbaric events continue to take place, so we should seek reform by every available means until the killing stops.



Decapitated snakes photo by photo by Mark Lotterhand

For more information, read [Rattlesnake Roundups](#), [Rattlesnake Roundups Revisited](#), or join [Rise Against Rattlesnake Roundups](#) on Facebook.

Preservation Efforts

Learning about all the adverse pressures on herps and wildlife can undoubtedly be daunting and disheartening. We must accept that the current state of the environment “is what it is,” so to speak, and work towards improving it in whatever ways we are capable of. We should look backward for the lessons history provides but not let despair over diversity that is already lost keep us from preserving what is left. The good news is

Texas Indigo Snake photo by Armin Meier



that people and organizations are working to protect our environment and the organisms that surround us. Those of us entering the field need not begin from scratch or reinvent the wheel.

There are people trying to preserve our natural heritage on local, national, and global levels. All of these arenas need attention and there are opportunities for you to join in any or all of them. Each of us would do well to remember that what happens in other parts of the world affects us all. Ultimately, though, conservation begins at home. It is important to identify and rectify the waste in our own homes first and then build upon that footing. If everyone everywhere did that, we would be in *much* better shape than we are now.

A few ongoing efforts include:

- Development and refinement of public policies
- Establishment and management of habitat preserves
- Heightened protections for wetlands and other vulnerable and critical habitats
- Protections for vulnerable species
- Increased enforcement of existing regulations
- Professional study of environmental concerns
- Citizen science movements
- Captive management and repatriation of vulnerable animals
- Research and mitigation of wildlife diseases
- Innovations to reduce the impact of human interference with wild populations
- Programs improving and promoting the sustainable utilization of natural resources
- Raising awareness of environmental issues in the public consciousness, especially in developing nations
- Phylogenetic studies based on DNA sequences to increase our understanding of species and populations
- Increasing participation in responsible ecotourism to promote understanding of, and funding for, conservation efforts.
- Targeted educational campaigns to youth, landowners, regulators, recreational enthusiasts, etc.

Consider finding ways of supporting and contributing to existing conservation efforts—there are numerous opportunities available!



Green Sea Turtle photo by Wildlifepl CC BY-SA 3.0

Conservation begins with education.
We must keep in the forefront of our minds that people only protect what they care about and only care about what they understand. Educating both ourselves and others must become a commonplace activity for changes to really gain traction.



Habitat Management

What is needed to slow the decline of reptile and amphibian populations (and all the other critters on the planet) is straightforward enough. We need to leave as much habitat (land and water areas) undisturbed as possible in the largest contiguous tracts feasible for as long as possible. Unfortunately, just because this need is easy to describe does not mean it is easily accomplished. The human population on the planet is growing exponentially. We not only convert land for our dwellings and other facilities, but we are also hungry for the resources that undisturbed environments provide. We continue to alter and destroy the habitat of every other creature on Earth. To some degree this may be unavoidable, but we should be continually on the lookout for ways to mitigate this expansion and destruction.

Every place is a habitat for something, whether it is grassland, desert, waterbodies, mountains, forests, oceans, coasts—even, to an extent, cities, and towns. Anywhere you see animals living is a habitat. However, not all species manage to adapt to the altered habitats that we create during our expansion. Most of us are familiar with doves and squirrels and other such animals that can thrive in these new paradigms. Unfortunately, however, most animals affected by humans are in decline. It is critical that we find ways to preserve what natural areas we have left. Landowners and governments must ask themselves how they can leave natural areas undisturbed to the greatest extent possible. We must seek opportunities to convert altered habitat back to its natural state, or at least manage it in ways that are as naturalistic as practicable. When it does become necessary to develop plots of land, we must innovate techniques that have the least overall negative impact on the organisms that call that place home.

Fortunately, many are trying to pursue these critical goals. For example, in the U.S. there are millions of acres

of wildlife refuges that are funded in part by hunters' purchasing Federal Duck Stamps. The duck hunters recognize that their quarry must have habitat to survive, so they respond to that vested interest and protect natural areas across the country for that reason. Of course, hunting takes place on these refuges. Even if some people have mixed emotions about hunting, it is easy to view these large swaths of preserved and protected land as a net gain. In addition, these refuges often have rangers and volunteers that conduct conservation education throughout the year, further expanding their reach.



Redback Coffee Snake photo by Andres Novales

Sometimes it is not possible to leave large spaces entirely undisturbed, but we as a species (and as individuals) must prioritize biodiversity above thoughtless expansion and consumption. We must continue to find new ways to live and acquire the goods we need with minimal impact on the environment. We must confront the challenges of making these goals fiscally viable if they are to become widespread. These are complicated issues, but the cost of not prioritizing healthy habitats is too high for us to leave the challenge for the next generation. We must make biodiversity a part of our decision-making processes, and we must do it now—for the critters' sake and our own.

All animals need habitat to survive. No amount of conservation, preservation, or repatriation efforts will be successful if animals do not have enough space to live. This is more than just land area. This means adequate space and resources for a complex, functioning food web. Preserving these habitats must be our priority now and into the future.



Blue-spotted Salamander photo by Marc Dubois

Assurance Colonies

When *in situ* (wild management) programs are insufficient to safeguard against a species becoming extinct, one of the last-ditch efforts humans may try is to create assurance colonies and repatriation programs. This is done by establishing captive colonies and practicing husbandry to develop numbers of viable offspring with the intent of releasing them back into their natural habitat and range. Conservation workers have estab-

One impressive example of these efforts is the cooperative venture of the Myanmar Ministry of Environment, the Wildlife Conservation Society, and the Turtle Survival Alliance to save the critically endangered Burmese Starred Tortoise. Featured in *Herpetological Review* 48(3), this program established three captive breeding colonies consisting of around 175 individuals in 2004. Their colonies now number about 14,000 and produce over 2000 hatchlings a year, with over 1000 animals having already been released into the wild (known as repatriation). Their original stock was mostly seized from smugglers, which is fitting since poaching to satisfy the food and pet markets (coupled with habitat loss) caused this species' decline. The problem is ongoing, as hundreds of repatriated tortoises have already been stolen, and joint efforts between law enforcement and the community are hard-pressed to keep up. Nonetheless, this highly successful program now has the freedom to try various tactics such as burying clutches in suitable habitats and other innovative attempts to securely reestablish wild populations.

Assurance and repatriation efforts must have many facets working in sync to be successful. Plan administrators must take great pains to ensure the genetic viability of the colony. The facilities often must be carefully guarded against poaching. Suitable habitat must be identified which can support the species and which is reasonably protected against development and intentional harvesting. Released animals must be monitored to evaluate the success of the program. Reliable funding must be available to sustain the program. The list goes on. We are unable to identify when we may be able to begin repatriation efforts for some species, such as amphibians vulnerable to viral and fungal infections that persist in the environment, but at least we are preserving the hope that these species may once again be seen in their natural habitats.

Hopefully, humans will someday develop a more harmonious relationship with the environment and reduce the need for such efforts!

lished assurance colonies for a range of species which are often functionally extinct in the wild (meaning their numbers are so low because of disease, habitat loss, commercial collection, or other pressures that there are no longer enough breeding adults to assure the species' continued survival without intervention). Currently, the Association of Zoos and Aquariums cooperatively manages around 500 Species Survival Plan Programs which maintain captive populations of endangered species at member institutions worldwide. Global assurance efforts have included species such as Panamanian Golden Frogs, Big-headed Turtles, Burmese Roofed Tortoises, Asian Giant Tortoises, and Golden Mantella Frogs, as well as bison, wolves, and condors.

Assurance colonies are one of the ways concerned people and organizations have been working to preserve endangered species. Though laborious and costly, these programs have already shown promise.



Burmese Star Tortoise photo by ゆうき315 CC BY-SA 3.0



Panamanian Golden Frog photo by Ltshears CC BY-SA 3.0

Public Policy

Public policy is a tricky thing. Certainly there are instances when protections for a species are helpful. On the other hand, like the drug trade, there have been plenty of cases where we have seen that an animal being banned from trade causes the price to go up and attracts poachers from far and wide. A quick scroll down the Facebook feed of the group Illegal Trade in Amphibians and Reptiles shows post after post of thousands of turtles, frogs, lizards, snakes, and salamanders being confiscated by law enforcement. The numbers are shocking, especially when one realizes this is just a small portion of the stories that garnered media attention, which in turn is only a percentage of the arrests taking place, which is only a fraction of all the smuggling taking place. It is easy to see why so many sought-after species are being decimated.

The International Union for Conservation of Nature (IUCN) is a global organization that maintains a database on the vulnerability status of various species worldwide. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a regulatory tool that attempts to control the international wildlife trade. TRAFFIC is an international joint venture of the IUCN and the World Wildlife Fund (WWF), which operates as a monitoring network seeking to guide wildlife trade toward sustainability. These and other organizations work to try to keep wildlife trade not only within the law but also within what wild populations can support. This takes constant oversight, management, development, and implementation of several facets simultaneously to be even moderately successful. Regulation, therefore, should be viewed as only one piece of a complex puzzle and not a solution by itself.

What is usually needed is for policymakers to hold the opinions of biologists in higher regard. Frequently, biologists compile ample amounts of data regarding the vulnerability or decline of a species, but commercial interests have conflicting demands and commerce ends up holding the final sway. Commerce and prosperity are necessary if people are to live above the poverty line and become less likely to turn to poaching for subsistence, but we must stop swindling futurity to make a quick dollar today. We must demand that policymakers view the ecosystem that we all rely on not just as a means to today's ends, but as a continuous whole that we are merely temporary stewards of.

An old saying posits that you should never ascribe to malice that which can be ascribed to ignorance. Remember that pundits and politicians can only operate in what they

know, so it is up to us to prioritize Conservation Through Education on a societal level. Animals cannot vote, so they are counting on you to bring their concerns to the table for them!



American Bullfrog photo by Justin Sokol

According to the monitoring network TRAFFIC, achieving a sustainable level of global wildlife trade is a multifaceted undertaking that essentially boils down to carrots and sticks.

- *For trade to be sustainable and legal, we must increase the rewards for responsible trade, improve the systems that assure responsible trade, and increase market access for legal, sustainable producers.*
- *To reduce the illegal trade, we must increase the effort illegal traders need to make to ply their trade, increase the direct and indirect risks for illegal trade, and reduce the rewards for illegal trade.*
- *These goals require cooperation, regulation, sourcing, and purchasing interwoven with research, analysis, guidance, and engagement.*
- *Considering all this, we start to get an inkling of how there is no simple solution. Instead, we must develop processes, policies, and procedures that gradually guide our use of wildlife towards a sustainable level.*



Green Sea Turtle photo by Ashley Tubbs

Citizen Science

It is worth noting that you do not need to hold a doctorate to take part in conservation efforts. Formally educated people are often at the forefront, but there will never be enough Ph.D.'s or funding for them to carry the day alone. This is where you come in. There is a wide array of opportunities for ordinary citizens to record observations, collect data and report their findings on all manner of organisms. More good news is that many of these opportunities merely involve adding a few short steps to your existing routines.



Spotted Salamander photo by Justin Sokol

Using reptiles and amphibians as an example, you can create an account at [HerpMapper](#) or [iNaturalist](#), among other programs. You probably already have a camera with you when you are outdoors, even if it is just the one on your phone. These databases allow you to upload good, clear photos of an organism such as a lizard or frog using an app or directly through their websites. That record is then used by biologists, researchers, and conservation workers for a variety of purposes. This body of information is invaluable for correctly identifying current species' ranges, for gaining insight regarding population sizes, for establishing data on individual variation in appearance and habitat selection, and many other uses. Incorporating records from amateur and casual observers has the potential to multiply our available knowledgebase by

several orders of magnitude over relying purely on graduate students and professionals to compile this information by themselves.

It should be noted that HerpMapper hides exact location data of reptile and amphibian records from public view, thereby precluding data-mining by poachers. Currently, iNaturalist shows location data by default for most species. When uploading photos of any animal that may be subject to illegal collection to the latter database, please alter your settings to ensure viewable location data is too vague to be useful to poachers (more about this can be found in the Location bulletin).

There are many layers to the types of data citizen scientists may collect and the uses for this information. Obvious examples would be establishing the current ranges of various species and documenting their variation of appearance. A great but more subtle use would be phenological data. Phenology is the study of the seasonality of organic cycles. Recording what times of year organisms are active and engaged in various activities at various latitudes and in different habitats broadens our understanding of flora and fauna. It also allows us to create an accurate picture of the changing habits and cycles of ecosystems over time. It is one thing to say that changing climates affect the ecosystem, but it is vastly more useful to have a large body of data from which to draw to precisely articulate what effects we are observing.

It is important to grasp that you need not go out of your way or become embroiled in complex procedures to be useful in the field of citizen science. Do you like trees? Photograph and upload the ones you are already viewing and appreciating. Look up and make a note of their degree of foliage at various times of year and enter that information as you get the opportunity. Whatever you are already interested in is what you can contribute!

Create an account with both HerpMapper and iNaturalist today. There is really no reason to put off this easy way to contribute to conservation!



Sonoran Desert Tortoise photo by Chad M. Lane

You do not need to know what species of organisms you are recording when you take part in citizen science opportunities. Just upload a clear photo to existing databases and existing users can assist in identifying what you saw. This is a great way to learn more about the organisms in your area and take part in conservation simultaneously!

What Can You Do?

Let's face it—environmental conservation can be a daunting subject. The human population is increasing at an exponential rate. Habitat is being lost, altered, and fragmented at alarming rates. Species are in decline because of diseases, commercial collection, competition from non-native wildlife, etc. Where do we even begin? How can one person make a difference? Can we really do anything about all of this devastation anyway?

You may have heard the story of the man who, when asked why he was throwing starfish back in the ocean after a storm, replied as he threw another that, "Even though I can't save them all, I can save *this one*." There is some truth to that. On the one hand, all any of us can do is our little part, and we *should* help individual critters in need. On the other hand, the proper response to so many threats to the planet's biodiversity would seem to also mandate more concerted efforts. We should be finding ways to protect populations and preserve habitat. How can we do that? One way to do that is to take part in various local, regional, national and global initiatives already taking place. Whether you choose a cause based on some personal affinity, greatest need, or some other reasoning—there are many efforts to protect our planet's wildlife and habitat already in the works. Many are making a difference. Those of us without the practical option of leading such efforts can almost certainly find ways to support these efforts if we try. You may even find ways to do so from your own living room!

If you are able to support a cause financially, that is fantastic! Money is always needed for travel expenses, supplies, food for the crew, technology, etc. If you have the freedom to roll up your sleeves and get your hands dirty out in the field, that is fantastic as well! Very few efforts would not benefit from another pair of boots on

the ground. Understandably, not all of us have the resources to contribute in such tangible fashions. Whatever your situation, there are things we can all do, such as being discriminate in our use of plastics and pesticides. We can and should be aware of how our actions impact the environment and take responsibility for making our corner of the world better. But what about when these aren't enough?



Speckled Kingsnake photo by Justin Sokol

One thing that you will always have once you acquire it is education, and you can share it repeatedly without using it up. Knowledge can be distributed *en masse*, and the efforts of one person spent toward educating others can have a domino effect on thousands or millions. This same modern age that facilitates species decline is also one of instant global communication. We should each be using these available resources to educate ourselves and then share what we have learned. Even if you find yourself unable to volunteer every weekend or fund a research trip to the Amazon, when you take part in Conservation Through Education you may find yourself inspiring a new generation of wildlife defenders!



Eastern Newt photo by Todd Pierson

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has." —Margaret Mead (attribution unverified)

Become an Interpreter!

There is a great need for those who value the natural world to communicate that value to the public. If all people ever hear is that snakes want to bite them, they will have little reason to consider any other possibility. The idea that herps are cold-blooded and creepy animals is, in large part, the default perspective of the masses. We who know better must take an active role in changing hearts and minds. People only value what they understand, and it is all too easy to disregard the magnificence of nature while insulated by walls and electronics.

Eastern Coachwhip photo by Justin Sokol



If a person grows up with scant exposure to any creatures besides the family pet, they may never realize that other animals need protection (doubly so if any wildlife that makes it into the house gets poisoned or squished). Politicians seem to be especially oblivious to the importance of living in cooperation with the natural world, often putting even the smallest commercial interest above the needs of the environment unless a great deal of leverage is applied. For these and other reasons, it is critical that we find ways to infuse science and environmental ethics into mainstream consciousness. This may seem daunting, but change begins at the grassroots level.

There are programs and training that will help you become more effective, such as Master Naturalist Programs or becoming a Certified Interpretive Guide. You do not have to be a scientist to help others understand and enjoy the natural world. Many times, just seeing that you care may cause others to want to follow in your footsteps. The goal is to present correct biological information at the level your audience is willing and able to receive. If you are speaking to someone who kills snakes on sight, differentiating the fine points of terms like ven-

omous vs. poisonous may not be the best use of your time. You might instead focus on what excellent pest control services snakes offer. If you are speaking to primary school children, you might hone in on the fact that animals are living, feeling creatures and that they should be treated with respect. There is no shortage of fascinating and useful information that may be shared about herps or other organisms. At the end of the day, what really matters is that you hopefully leave others feeling a personal connection to the animals that share our ecosystem. People will go to great lengths to save their pet from harm, for example, but many don't give a second thought to the wildlife casualties they drive by on their way to work. Think of your mission as trying to move them along a continuum, bringing them from wherever they are now towards becoming naturalists themselves. Rather than get frustrated at how far they must go, revel in what progress they are able to make!

Children are always a worthwhile audience to focus on. For one thing, they are fascinated by animals—herps especially—and are very receptive to learning more about them. For another, they are generally much less argumentative and set in their ways than adults and are consequently easier to teach. Plus, presenting animals (or information about them) to kids is usually much more fun than dealing with adults. Children are typically the only group of people who will ask you what your fourth favorite reptile is. Perhaps most importantly, they will be taking up the reins of society soon, and no matter how meager a job of protecting the environment the current generation is doing—raising up young people who see the importance of wild places and the critters that live there may be the best insurance we could have against things getting any worse.

Although the daily activities of previous generations revolved heavily around the outdoors, the current generation is predominately cut off from the world around them. More so than ever before, we must actively engage young people with nature. Adopt the motto "No Child Left Indoors!" Whether it is with young or old listeners, though—don't be afraid to share your knowledge and passion for wildlife. The only way the world changes is one person at a time.

Yellow-eyed Ensatina photo by Ken-ichi Ueda



The National Association of Interpreters defines interpretation as "a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in the resource."

Innovative Solutions

Someone with a promising idea can really make a difference when that idea catches on. More and more, conservationists are coming up with new ways to achieve their goals. Examples include drones to monitor wildlife and habitat, live camera feeds to get the public invested in the rearing of eagle hatchlings, encouraging people to upload their wildlife photos into citizen science databases... the list goes on. New and better techniques arise all the time. Unfortunately, sometimes bad ideas also catch on, like Trap-Neuter-Return programs that perpetuate domestic cats' massive toll on wildlife.

One such innovation involves non-native species. It is L.E.A.R.N.'s position that it is ecologically irresponsible to release non-native animals into the ecosystem, even if they were collected from the wild (this includes cats). In all cases, though, non-native animals should be treated humanely. It is not their fault they are in the wrong place. Human interference is almost always behind the spread of invasive animals. Nonetheless, we must work to eliminate invasive populations whenever possible for the sake of native wildlife.

One promising business model for herps is the trapping and selling of unwanted invasives into the pet market. This model simultaneously helps the environment by reducing the non-native animals and the animals themselves by giving them a chance at life they would not have had with typical eradication methods—all no cost to taxpayers!

At least one business is already doing this in Florida. A licensed trapper there is collecting invasive tegus in south Dade County and listing them online as pets. Thought to be released by breeders about twenty years ago, the Argentine Tegus have now become well-established in southern Dade County. Highly intelligent and well-suited to thrive in the area, they have unfortunately had a considerable impact on the local ecosystem. Argentine Tegus are sought-after pets, however, so they are trapped and

sold to buyers in other areas where they would be unlikely to become established even if they escape captivity. Not only does this help curb the problem of an invasive species, but it also gives each animal a chance at a safe environment and a caring home.



Argentine Black and White Tegu photo by Bernard Dupont

It is a fact that people tend to do that which makes them money. By incentivizing the wild collection of native species worldwide, we have decimated many populations of vulnerable animals. However, if we can foster a new approach such as this one and incentivize the removal of non-natives, we cultivate jobs and the health of the ecosystem simultaneously! Free-market solutions are often superior to publicly-funded efforts, and helping the environment without draining the public coffer is undoubtedly an innovation worth supporting.

Similar approaches are emerging with other animals, such as the collection of feral hogs for the meat market. This is another business model which will hopefully expand—removing such a destructive species while employing and feeding people is a triple-win. There are probably quite a few more opportunities in the field of commercial collection of non-natives yet to be explored. Consider supporting and raising awareness of these solutions (provided they are performed humanely) and be on the lookout for new potential solutions to ecological problems. The next great idea could be yours!

There are plenty of reasons and opportunities for conservation-minded people to come up with new ways to promote healthy ecosystems. In circumstances where these solutions can also pay for themselves—everyone wins!



Argentine Black and White Tegu photo by Mike Baird CC BY 2.0

Exclusion Devices and Underpasses



Habitat fragmentation is the sectioning off of natural habitat into parcels separated by altered landscape and usually bisected by roadways, and it takes a significant toll on wildlife. Terrestrial animals naturally move about their home ranges in search of food, a mate, better habitat, etc. In the past century, these animals have become frequent casualties as automobiles have become ubiquitous. Animals getting crushed by cars is not “nature doing its thing.” Vehicle traffic is a man-made hazard; the solution must also be ours. It is worth noting that wildlife on roadways is also a human safety issue: people swerving or braking fast to miss them can be very dangerous, as can people stopping to help them.

Fortunately, research and development have been taking place (though more is required), and there are several solutions already in existence. Exclusion devices and underpasses (like those in the accompanying photos) have been installed in some areas and work by directing



Painted turtle using underpass and other photos by Peter A. Zani

small animals into culvert-like safe passages. This allows them to travel around their home ranges safely and also makes these roadways safer for humans. There are even a few underpasses in Africa designed for elephants! It is not that we don't know of any viable options. Working models are already in place, we just need many, many more!

It is more economical and efficient to incorporate various solutions early into the construction of new right of ways than it is to retrofit existing roads. For example, if a new road is crossing a wetland, it should be standard practice for an overpass to be built, rather than a levy and culvert. Trying to change a roadway already in existence to an overpass is liable to be a non-starter, but sufficient public outcry during development has a much better chance of success. Areas slated for major maintenance and upgrades are also good candidates for incorporating animal-friendly designs. If a road surface is already being removed and replaced, trenching in an underpass is a relatively minor upgrade—much cheaper than if it were a stand-alone project.

Of course, being armed with comprehensive data makes an enormous difference. Public resources are not unlimited, so engage with officials about specific areas of highest need, optimally with hard data in hand. Records of the numbers of species and individuals killed in specific locales (for existing roads) or at comparable sites (for new construction) will help the conversation go much further. Visit [Wildlife and Roads](#) to arm yourself with even more info!

Change often starts because a single person cared enough to gather support. If you aggregate and organize existing data, add some of your own, and get it in front of the decision-makers, you could be the reason why the next wildlife underpass is built!



What is needed is public pressure on policy and decision-makers to make animal-friendly roadway designs a much higher priority. Try to find respectful ways to insert wildlife exclusion into roadway planning discussions.



Special Protections for Special Places

Nestled in the Larue-Pine Hills Research Natural Area in southern Illinois there lies a rocky ribbon traversing the landscape called Snake Road. The LaRue-Pine Hills is an ecologically diverse part of the Shawnee National Forest that is home to at least fifty-six species of reptiles and amphibians. In the spring these herps emerge from their hibernacula in the hills and migrate toward the spring-fed swamps where they stay until the fall when it is time to move back to the cracks and burrows where they will overwinter. In the 1970s, the U.S. Forest Service began closing this road for three weeks out of the year to reduce wildlife casualties in this unique area. Those closures have expanded to provide protection from mid-March through mid-May and September through October, based mostly on information compiled by Scott Ballard with the Illinois Department of Natural Resources who documented the prominent level of biodiversity in the area and the need for more protection.

In addition to allowing animals to cross in safety, the Snake Road closures provide excellent opportunities for education and interpretation. Herp enthusiasts come from far and wide to photograph and observe the snakes and other herpetofauna. Those newer to enjoying these critters can go on interpretive hikes. Naturally, a scenario like this tends to draw poachers, but federal rangers and state employees are on hand to make sure that the animals are not collected or molested. Ballard still frequents the area and tries to foster awareness and appreciation for these fascinating animals as he keeps an eye out for those who may have the wrong intentions.

Situations like this need not be so unique. We have become desensitized to road-killed animals and seem to consider it a matter of course that animal populations will be continually thinned by our commutes, but this is not a sustainable attitude. When authorities identify sections of roads that repeatedly have high

human casualty rates, they make adjustments to reduce those tragic incidents. We need to extend that thinking to include wildlife. Protections like the closure of Snake Road need to become just one of countless examples of humans prioritizing the preservation of our natural heritage. While champions of nature like Scott Ballard are remarkable in their willingness to do

Picnicking with cottonmouth photo by Tasha Conley



the footwork and present data needed to enact protections, what is needed is for folks like Scott to be commonplace.

Our perception of the world around us must mature. Sadly, we are still at the point where one in twenty people will intentionally run over a reptile on the road. We must work towards the day when one in twenty responds to wildlife deaths by seeking a solution. If you identify a problem area, look for an answer. When you find it, try to make it happen. Once you finish—keep an eye out for the next one! Biodiversity is declining worldwide. We can not just leave these problems for our grandchildren to solve and hope that “not too many” species are extinct by then.

Northern Cottonmouth photo by Tim Spuckler



If you plan to visit Snake Road—plan to do so the right way. This is not a place to bring hooks and tongs or to tear up the landscape. Familiarize yourself with the information in the Observation section of this primer and commit to leaving no trace—every time you go herping!

Community Outreach

Reptiles and amphibians have undeserved poor reputations in many people's minds. This, of course, makes preserving these animals and their habitat more difficult and results in many being intentionally harmed because of human ignorance. It behooves those of us who know how valuable and fascinating these animals are to share that knowledge with others. The good news is that you don't have to have any specialized degrees to start taking part in Conservation Through Education. Among your other options, you could start by printing some of these bulletins and post them around or hand them out at events. There are many ways to do outreach. If you put

your mind to it, you will quickly see avenues that suit your personality and skillsets.

Wildlife education and community outreach should impart the value of biodiversity. The goal is to impart that the ecosystem and the animals that we share the world with are fascinating, worth protecting, and in need of more conservation efforts. At L.E.A.R.N., we try to convey that reptiles and amphibians are living, breathing, feeling creatures. It is disheartening how many people will, for example, intentionally run over a turtle or a snake on the road. Helping people to understand that these critters deserve the same consideration as any other animal is crucial. Successfully interpreting these concepts is about helping people to make a personal connection; always strive to present things in a way that seems interesting and relevant to your listeners.

While it is sometimes possible to change an adult's perspective about their relationship to the natural world, it is no secret that children are generally much more receptive to messages about animals and nature. Even if the pessimist in us wants to give up on the current generation, it won't be long before the young people of today become the decision-makers of tomorrow. For this reason, our efforts rarely wasted when directed at helping kids make an emotional connection to wildlife. It is imperative to be more than a petting zoo, though. We must combine exposure to these animals with messages about environmental stewardship. Kids love to help, so explaining to them that these fascinating animals need their assistance is often a message that sells itself.

You might ask around and find others already devoting their time to productive outreach in your area, but you needn't wait until you are surrounded by others to take part. There are probably schools, libraries, nature centers and other venues that would love someone to come by and provide educational nature-oriented messages and materials. This Primer is a free download and formatted as single-page bulletins to arm you with a diverse array of information. You may find that you need do little more than show up with some herps and a few flyers. The kids will find you and ask to see the herps (plus a hundred other questions) rather quickly. If you still feel unprepared after reading this Primer, reach out to us at LearnAboutCritters.org/connect for more resources, or order the cornerstone book *Interpreting Our Heritage* by Freeman Tilden. Don't worry too much, though. Sharing your passion for wildlife with those willing to listen is not difficult once you step out of your comfort zone. You will probably enjoy it as soon as you try it!



Photo by Diane Mastrodomenico



Photo by Larry Raymond



Photo by Diane Mastrodomenico



Master Naturalist Programs

There are so many conservation-oriented programs out there—how does one begin to decide which one is the right one to join? Often, the decision is affected by what organizations are active in your area, what organisms you have an affinity for, or even which programs your friends belong to. If you are open to suggestions, Master Naturalist Programs are worth consideration. Associations are often autonomous, so goals and procedures may vary; but the thrust of the Associations are the same.

Master Naturalist Programs are grassroots organizations that exist to assist the public to a better understanding of the natural world and to promote the conservation and preservation of native plant and animal life and habitats. Candidates attend workshops on an array of topics regarding the ecosystem with a focus on local indigenous flora and fauna. Once an applicant has completed the required training and any testing, they become Master Naturalists. They are then often tasked with continuing their education and logging a certain number of volunteer hours annually with organizations working to preserve natural heritage. In other words, Master Naturalist Programs help a variety of conservation efforts by training people to be more knowledgeable volunteers in their community. Those who have been through locally-oriented training are better prepared to be a part of Conservation Through Education efforts in their areas.

If there is already an Association near you, consider attending a meeting or just go ahead and sign up for the training. One evening you may learn about insects and spiders in a classroom environment, and then that weekend get outdoors and try to identify various insects you encounter. Another workshop may be about reptiles and amphibians, another about birds, and yet another about trees and shrubs or wildflowers or fungi. If you enjoy learning about the environment and the organisms in it, the program will likely be enjoyable for its own sake. The fellowship of others in your community who are also interested in nature is a good reason for many to look forward to each workshop as well.

If there is no Association where you live, then consider starting one! Every Association out there began by some-

one deciding to get a ball rolling. Your Association may (or may not) elect to partner with an entity who can offer guidance, instructors, or funding. Examples might be state universities or extension services, wildlife agencies, other conservation-oriented non-profits, etc. You could meet at a college or nature center classroom during off-hours. There are no hard and fast rules. The idea is to get experts and novices together for the sharing of knowledge and to inspire people in your community to



Three-toed Box Turtle photo by Charles Paxton

take a more active role in conserving and preserving their natural heritage. Make sure and design as comprehensive a program as you are able, drawing from local experts and gearing towards what makes your area unique. If you are in the U.S., reach out to the Alliance of Natural Resource Outreach and Service Programs (ANSROP) for assistance in locating or starting an Association. If you are in another country, still think about starting one! You're welcome to reach out to existing Associations in the U.S. for guidance.

Master Naturalist Programs are not the only thing you can get involved in. However, please consider getting involved with some organization that is working to preserve biodiversity. There is strength in numbers, and the critters we share this planet with need people to be taking part now. Don't wait until tomorrow; the situation is already serious enough.

Naturalists are students of natural history. Master Naturalists are ordinary citizens who have taken the time to go through a formal training program to learn about their ecosystem and then volunteer to pass that information along to others.



Eastern Gartersnake photo by Marc Dubois

Knowing is Not Enough

Maybe you have heard since childhood that there is an environmental crisis, or perhaps you realized this on your own. Either way, if you have been reading this Primer, you have been exposed to these concepts now. Reading conservation-oriented works like this one is certainly a step in the right direction, but what is needed is for more people to *take action*.

Most Americans report concern for the environment; one-in-five try to act on that concern all the time.

% of U.S. adults who say they are _____ about helping the environment as they go about their daily lives



% of U.S. adults who say they make an effort to live in ways that protect the environment...



“The Politics of Climate” survey conducted May 10-June 6th, 2016 by the Pew Research Center

A 2016 study by the Pew Research center indicates that, while approximately 3 in 4 Americans consider themselves to be “particularly concerned” with environmental issues, only 1 in 5 claim to make this knowledge a part of their everyday actions. To be fair, 2 out of 3 claimed to act on this knowledge “some of the time.” This probably translates to something along the lines of, “I will recycle some items if my city puts bins out and all I have to do is put it in there.” This stark disjointedness, while likely an inherent part of human nature to some degree, should be cause for self-reflection in each of us. While most of us would probably agree that it sounds silly to watch the environment decline while we pat ourselves on the back for noticing, that is essentially what we seem to be doing.

Similarly, a 2017 journal article in Biological Conservation

indicates an unfortunate similarity of unconcern among varied demographics. When compared to economists and medics in the U.S. and U.K., conservationists displayed only marginally more ecologically-friendly practices, and even then only in some areas. The conclusion is that increased exposure to environmental information does not necessarily equate to more environmentally responsible habits. These are not unique findings; similar studies have shown that many people in medical fields do not necessarily lead healthier lives than those less familiar with health data. Apparently, humans have a propensity for gathering knowledge without acting on that information.

Even though these studies only represent small sample sizes, these data are congruous with human behavior in general. This can be understandably demoralizing for those practicing Conservation Through Education, but we should face these facts and learn from them. We need to remember that education is not an end unto itself. How much you know about the environment does not benefit the ecosystem directly. What matters is how much you and your family individually *value* the environment, and what you commit to *doing about it*.

It is understandable that we might get overwhelmed and rationalize that, since the world is so big and we are so small, it doesn’t really matter much what we do. The fact is, though, that it *does* matter. We need to be a part of the forces shaping policy and global trends. We need to be stewards of nature at home. The good news is that people have been making some progress in recent decades regarding how we treat the environment, but the job is far from over.

Hypocrisy may be commonplace, but that is no excuse for us to give up. Knowing that not everyone will act is no reason to stop encouraging them. We cannot expect people to change overnight, but we also cannot give up the fight. The cost of surrender is unthinkable. No matter who or where you are, there is something you can be doing to pitch in. It is what you *do* that counts.

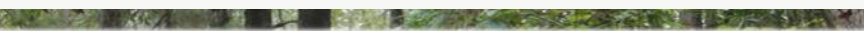
What are *you* doing? Could you be doing more?



Black Salamander photo by Chad M. Lane



Knowing that we need to act as stewards of the environment is excellent, but it is of little value unless that information shapes our habits. We must do more than know the planet is in crisis—we must act in order for the needed changes to take place.



The Fallacy of a Laissez-faire Approach

Sometimes even well-educated people say some pretty dumb things. Comedians, politicians, and rogue biologists have been known to put forth the idea that, since extinction is a natural occurrence, we should not concern ourselves with species disappearing across the globe. While laissez-faire (letting things take their own course without interference) might improve most public policies, it is reckless to view biodiversity in such a manner.

The argument from the “don’t worry about it” camp often goes something like this: “Extinctions happen. Species have been disappearing since the beginning of life on Earth. When one species disappears, another will fill the void. Besides, humans are essentially a part of nature anyway, so all the destruction we cause is ‘natural.’ Considering all this, we may as well just focus on what makes our own lives better.” The egotistical nature of such a stance may seem self-apparent, but the fact that this idea gets floated (whether through naivety or for personal gain) over mass media warrants a moment’s rebuttal.

Let’s consider these statements. Yes, it is no secret that species appear and disappear over time, regardless of whether we cause it or even know about it. Most of us can probably agree, however, that there is an ethical difference between the naturally dynamic ebb and flow of biodiversity on Earth and the proximate effects of humans laying waste to the ecosystem. Our degrading and destroying habitat to suit our own short-sighted agendas can scarcely be described as “nature taking its own course” by any reasonable person.

Granted, it is also true that nature continually works to gain equilibrium despite our wholesale destruction and meddling—if we don’t keep the cracks sealed, dandelions soon shoot up from our sidewalks. However, a complex ecosystem does not just rebound overnight. When we push plant and animal species out of existence, it is reasonable to feel some guilt about that.

Let us use the example of Lonesome George as a learning tool for a moment. George was considered the last surviving Pinta Island Tortoise until he passed away in 2012. He became “lonesome” because sailors made a habit of stopping off at the Galapagos and doing two things. First,

they would leave a few goats behind to breed, multiply and serve as a food source for future voyages. Over time, the goats did just that and ended up out-competing the native tortoises for food, as well as stripping the island bare of the vegetation they used for shade. Second, once the sailors learned that tortoises could live for weeks without food or water, they quickly began filling their holds with these animals to provide fresh meat at sea. As you might imagine, it did not take long at all before the



Lonesome George photo by Alan CC BY 2.0

tortoises were in grave peril. Conservation workers managed to intervene in time to save some of these remarkable creatures, but sadly, Lonesome George was the sole survivor of his kind. For over four decades researchers sought him a mate, but with his passing the Pinta Island Tortoises were apparently gone. What human with a conscience would seriously put forth that decimating these fascinating creatures was worth a few seamen’s preference for fresh meat instead of salted fare?

Yes, humans are native to this planet, and the message that we are part of the environment is one that naturalists have been trying to foster for generations. Yes, the destruction we cause could technically be construed as natural. It does not follow, however, that our wanton attitudes are justified. Recognizing and preserving the richness of our natural heritage should weigh so heavily in our decision-making processes that it would not even occur to us to trade an entire species for ephemeral gain.

Those who justify apathy toward the environment often conveniently overlook the fact that most modern pressures on wildlife are anthropogenic (of our own creation). For us to be cavalier about destroying habitat and polluting the environment is the epitome of egocentrism and can hardly be called moral.



Texas Indigo Snake photo by Ashley Tubbs

A close-up photograph of an Eastern Copperhead snake resting on a dark, textured asphalt surface. The snake's head is raised, showing its characteristic copper-colored head and neck with dark bands. The background is a blurred green landscape with sunlight filtering through the trees.

Part VI Observation

Eastern Copperhead photo by Derek Wheaton

**Get to know the critters in your own backyard.
Wi-Fi isn't the only "connection" that matters.**

A photograph of an American Bullfrog sitting in a shallow, muddy pond. The frog has a brown, bumpy back and a greenish-brown head with large, prominent eyes. It is surrounded by green grass and small yellow flowers.

American Bullfrog photo by Justin Sokol

Field Guides

In this age of high-speed internet, people sometimes overlook the value of printed materials. Field guides are certainly an example of this. While they do require effort to carry around and search through, many people consider them well worth it. Not all field guides are created equal and no one size fits all. Many naturalists find they can never have too many of these valuable resources. There are guides on the market today for everything from herps to trees to poisonous plants to seashells to birds to mollusks and so on—whatever your interest. You sometimes need to be careful with older guides, as names and ranges change over time, but quality guides often get updated and reprinted. Field guides have drawings or photos and descriptions of the animals in your region and diagrams on how to differentiate between similar species, as well as natural history information such as diet and preferred habitat. They make your field trips more rewarding by turning every trip into a learning experience.

The various guides all have their pros and cons. Some have a local focus, such as your home state. One benefit of these is that there is more space to go into greater detail, and you will typically save time by not having to sort through so many pages of animals that are not from your area. However, you may have to get one with a broader scope. One thing to consider is whether you want to be able to easily carry the book—guides like Audubon's and Peterson's are meant to fit inside a cargo pocket or a gear bag easily. This makes it more likely that you will have it handy when the time comes. Larger books can go into much more detail, but you probably won't want to carry those around. Buying several guides is the norm among avid herpers. Many tend to carry a pocket-sized guide with them in the field to confirm their identification of new or similar species and then read about those animals in more depth when they get back home to their reference versions.

Another factor to consider is the choice of photographs or color composite drawings. Your natural inclination may be to think that photos are better. While photos *are* pretty, herps exhibit so much individual variation in appearance that new herpers are often frustrated by futile attempts to find a photo that looks *exactly* like the animal in front of them. Composite drawings are purposely less specific, which can make an identification quicker and easier in many cases. Mostly you will want a guide with high-quality color range maps. An accurate identification often hinges on where the animal was found. Without a location to go with a range map, it may still be possible to get an identification, but it will be much more difficult.

If you acquire a few field guides, you will likely start learning your local animals faster and more intimately. That's well worth the price of a book and the time it takes to use it!



JEFF BOUNDY AND JOHN L. CARR

Amphibians & Reptiles *of Louisiana*

AN IDENTIFICATION AND REFERENCE GUIDE



Snakes

OF THE SOUTHEAST

BY WHIT GIBBONS AND MIKE DORCAS

Location, Location, Location!

Anyone who has learned to do their own herp or other animal identification (rather than just posting on the internet with the caption “What’s this?”) knows the importance of location in achieving an accurate identification. The obvious reason for this is that there are around ten and a half thousand reptile species and almost eight thousand amphibian species in the world, but there may be only several dozen or so species in your area. Trying to narrow down your options from 100 is *significantly* easier than narrowing them down from 18,700!

Another reason is that many species of herps appear quite similar to each other. Visually differentiating these species may involve counting very small scales or other subtle, specific differences. On top of that, individuals

may vary drastically in appearance, which can further confuse an identification. Without a location, proper identification can sometimes only be accomplished with the animal in hand and access to specific scientific resources. Location can make the difference between an identification taking seconds or hours or more.

For example, I recently received a photo of a North American watersnake from one of our social media followers, and I mistakenly assumed it was from her area of residence. I spent thirty minutes comparing photos on my hard drive of the various patterning of individual animals known to be from that area because the animal did not appear to fit any of the expected profiles. It was then that she sent a follow-up email mentioning that it was from an entirely different state! With that info, I was able to immediately tell her the species without even having to look at a map.

Some species literally cannot be accurately identified visually without the correct location, as their range is defined by location. There are animals whose genetic or morphological differences change so gradually over large areas that taxonomists have had to set somewhat arbitrary range limits. They will say, for example, that snakes east of the Mississippi River are one species, and those to the west are another species. You would obviously need to know where an animal was from in these instances.

Another case in point would be frogs who are externally identical to each other (e.g. Gray Treefrogs and Cope’s Gray Treefrogs). Without a location, one would have to either hear them call or run a test on their tissue to get an identification. The best you can say from a photo alone is that they are one of two or more options.

So, the next time you post a snake photo moderator nags you for a location, know they are not just trying to be difficult. They need this information to help you!



Black-masked Racer photo by Justin Sokol

Western Ratsnake photo by Ashley Tubbs



Indian Cobra photo by Ashley Tubbs

Location is often a critical factor in accurately identifying herp species. Always make a note of the location when saving a photo or asking for help with an ID. Don’t be too specific, though—not everyone out there has good intentions.

Exact Locations are Important (to Keep Secret!)

Most of us that spend time in the outdoors are trustworthy people who have nature's best interests at heart. As such, we tend to imagine that everyone else feels the same way. Alas, that is not the case, and naiveté will not help the wild critters. The sad truth is that there are people in every country who are unconcerned with the welfare of wild populations and who would be all too happy to follow your location information out to the same habitat to collect all the breeding adults they can find, all the while tearing apart animals' homes in the process. We don't want to believe that this is true, but too many researchers and naturalists have discovered this the hard way. Just because it would not occur to you to collect and sell the animals you see in the woods does not mean that the next person feels the same way. Even laws against collecting animals exist in your area, that doesn't automatically mean the animals are safe. In fact, poachers are more common in areas where wildlife is protected, as there are plenty of people who will pay a premium for an animal that they covet but are too scared to go collect for themselves.

Making a note of and sharing location information is essential for an accurate record and to assist with any questions about correct identification, but it is not necessary to share GPS coordinates publicly for these purposes. There are some citizen science databases that will allow you to share the exact location (possibly contained in the photo's metadata) with bona fide researchers yet display much more vague information to the general public. This is the optimal solution. As a general rule, county-level location information is more than sufficient for most identification purposes. When entering a record on a public map, consider inputting the data as a 40 or 50-mile (65-80 km) radius, rather than a pinpoint record.

As the scarcity or desirability of an animal approaches either end of the spectrum, you may want to alter these guidelines. In the case of particularly rare or vulnerable species, you may want to share no more than state-level information in a public forum. On the other hand, ubiquitous species that people can find by just looking around their backyard probably do not need these stringent protocols. You may, of course, use your best judgment regarding how you choose to share information or read more at bit.ly/locality-sharing



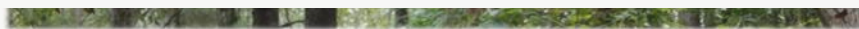
Florida Watersnake photo by Luke Smith

The salient point is that not everyone respects the environment and the critters in it the way you do. You don't want the little critter you were so excited to spot getting kidnapped the following week because you elected not to use discretion about where he lives. Before you post a location, stop and ask yourself whether you are giving out enough information for a collector to find that animal or that population. For many species, even the removal of a few breeding adults can have a negative impact. Think before you post!



It is important to note and share the general locale of an animal for an accurate record and identification, but be careful not to provide so much specificity that someone looking to collect the animals could find them again.

Also, be aware that your photos may have geotags!



Bog Turtle photo by Todd Pierson



Venomous Identification ~ *Forget The Rules!*

Some parts of the world may have simple rules that enable the novice to tell at a glance whether a snake is venomous. However, that is not the case in most areas, and certainly not in most of the U.S. You have probably heard several “tricks,” such as looking for “cat eyes” or “triangle heads.” *Please beware of resting in such simplicity!* While some guidelines may enable the studious observer to consider the totality of an unfamiliar reptile and make an educated guess as to its nature, the simplest and best course of action is to take the time to become familiar with the venomous serpents in your area. This is not a particularly challenging task—only ~20% percent of the world’s snake species are venomous (depending on your definition), with many areas having but a small handful. Here are some rules and why they so often don’t work.

Triangular head shape—While it is true that an observer can sometimes distinguish the bulge behind the eyes of snakes with venom glands, most snakes can flatten their heads or flare their necks. They often do this to appear larger or more menacing as a defensive mechanism. What’s more, without a sound basis of comparison, most snakes will appear to have a “triangular” head to the uninitiated. The combination of these facts results in possibly more needless animal deaths because of misidentification than any other “rule.” PLEASE DO NOT USE OR TEACH THIS “RULE.”

Elliptical pupils—Viperids such as rattlesnakes or adders do have elliptical pupils; however, many harmless snakes also possess this feature. Furthermore, many venomous snakes (elapids) have round pupils. As if that wasn’t enough—even elliptical pupils appear round in low light since they expand just like round pupils.

“I heard it rattle!”—Where rattlesnakes occur, many people assume that any snake making a rattling noise is automatically a rattlesnake. In fact, a great many harmless species will make a rattling sound with their tail against leaves or debris. Again, this is a defensive mechanism—the animal is trying to sound and look as imposing as possible in response to being approached by an unfamiliar animal many times their size. On the other hand, rattlesnakes often make no sound, or may even be mis-

ing their iconic rattle as a result of it getting hung and broken off. All things considered, this is another unreliable “rule” for identification.

Protruding brow—While it is true that viperids typically have pronounced brow lines that obscure their eyes from above, this trait occurs to varying degrees and is often less apparent than people might wish. Furthermore, some harmless species have brows that protrude somewhat. It may also be unwise to approach the animal close enough to discern this feature. Yet again, elapids do not share this trait, so even when this guideline is correctly applied, it does not assist with the identification of many venomous snakes.

Loreal (heat-sensing) pits—While it is true that pit vipers have sensitive thermoreceptors in pits between their eyes and nostrils, many harmless snakes around the world also have thermoreceptors, and many other venomous snakes do not possess them.

Red touches yellow, kill a fellow—Although the rhyme to differentiate coral snakes from their mimics *usually* works in some areas, it is fraught with exceptions. Instead of researching this rhyme, just become confidently familiar with all your local elapids.

Swimming on top of the water—While vipers of the genus *Agkistrodon* (copperheads, cottonmouths) often swim with their body at the water’s surface and their head raised and harmless watersnakes usually swim with their bodies submerged, individuals sometimes swim atypically. Other regions have similar behavioral rules—it should always be remembered that snakes cannot read books and not knowing the rules often results in animals deviating from them.

Consider how you recognize someone you are familiar with—you simply know them when you see them, and “rules” play no part in that process. There really is no substitute for learning the appearance, habitat, and behavior of the snakes in your area. Devote some time to this simple task. This should be grade school knowledge alongside not playing with fire. The needless death of any wildlife is tragic—let us commit to it never happening because of a mistaken ID.



Eastern Diamond-backed Rattlesnake photo by Kim Bell Mross

The pit viper on the left has elliptical pupils (“cat eyes”) that appear rounded in low light. This is just one example of why relying on overly simplistic rules for a correct identification is not recommended.

Get to Know Your Neighbors

Now that we have learned that the “rules” for identifying venomous snakes don’t work and just end up getting a lot of harmless snakes killed for no reason, what are we to do? The proper solution—both for human safety and the sake of the animals we share the ecosystem with—is to learn what venomous animals (not just snakes) live around us. While the overwhelming majority of snakes are harmless to humans, most areas do have one or more snakes with venom potent enough to cause a medical emergency (also true for spiders). Just as we learn and teach our children not to play with fire and to look both ways before crossing a road, learning to identify the handful of venomous species in your area accurately is a basic safety skill that anyone school age or above should master.

No one book or bulletin can cover every locale so you will need to do a little research. Maybe there is a nature park near you that has your local species on display. Perhaps there is a reptile club in your area or a helpful herpetologist at a nearby college. There are groups on social media that are devoted to snake education whose members would be happy to help. Regardless of what else you do, you should purchase a field guide specific to your region that has photos, illustrations, and identification aids for your local venomous species. Looking through a quality field guide will help to familiarize you with the animals as well as point out how to differentiate similar species. Considering the trouble and expense that becoming envenomated can entail, this is a task that is worth taking seriously. You might even download some photos of indigenous snakes and make some flash cards!

Besides human safety, another good reason to do this is to reduce the wanton killing of all snakes on sight. There is really no need to kill venomous snakes. If you know someone who insists on doing so, your being able to

quickly provide the identity of harmless animals should hopefully give them the confidence to let them go in peace. Whatever the reason, taking a little time to learn a handful of species is not a particularly arduous task. There is no good reason not to do this.



Northern Cottonmouth and Eastern Copperhead photo by Ashley Tubbs



Texas Gulf-coast Coralsnake photo by Ashley Tubbs



Timber Rattlesnake photo by Armin Meier



Northern Pacific Rattlesnake photo by Chad M. Lane

Consider taking some time learning to identify the venomous animals that live around you—even if you do not plan to approach them. You never know when you may find yourself facing a snake, and knowing at a glance whether an animal is harmless is a valuable safety skill.

Learning to Identify Herps

For some people, narrowing their identification down to “snake” or “frog” is as specific as they are interested in being. Hopefully, you set a much higher bar for yourself. There are over 18,000 species of reptiles and amphibians in the world, so you’re not likely to learn them all. The best approach is probably to start with your area and work outward on an as-needed basis. Learning the venomous animals near you would be a great first step and then focus on other commonly seen critters.

Eastern Coachwhip photo by Armin Meier



An excellent method for this is to have your field guide with you and just to get outdoors. As you see herps (or other organisms), take a moment to learn their names and a little about their natural history. Over time, this one-at-a-time approach will equate to your amassing quite a bit of knowledge about your local ecosystem.

As you flip through your field guide, you will notice several similar-looking species. Your guide should have helpful illustrations and descriptions in the species accounts section to help you sort them out. For example, several Toothy Skinks (*Plestiodon* spp.) are so visually similar that about the only way to know which one you’ve encountered is to count upper labial (lip), post-ocular (cheek), and subcaudal (tail) scales. Learning such subtle and specific differences like this takes an eye for detail. It is not unusual for an accurate identification to entail counting scale rows or looking closely at the shape of specific features. Just like anything else, there is a learning curve

starting out, but it quickly gets easier. Pay attention to the names of the various parts of herp anatomy to help future identification attempts go faster. Don’t worry! The various “tricks” for figuring out an identification tend to stick with you once you know them, and differences that once seemed imperceptible soon begin to look obvious.

One thing to remember is that it is not uncommon for juvenile herps to have colors or patterns unlike adults of the same species. Many herps start life looking one way and change as they age. Sometimes, the illustrations you find will be from a different life stage. This can be confusing to newcomers, but if you are aware of this, you can account for it and look more closely at the descriptions to determine what’s going on.

Some herps are also sexually dimorphic. For example, some male lizards will change color on their heads or bellies during mating season. This determines sex but may confuse identification attempts. Again, be aware of this possibility and read the descriptions carefully.

An advanced method for identifying species is the use of dichotomous keys such as [this one](#) for Virginia lizards. These are tools for scientifically arriving at an ID. They involve a series of Yes/No answers that systematically rule out species based on diagnostic features. These are not as readily available as field guides, but learning to use them is a skill that translates to being able to accurately identify any species covered by these keys. Do an internet search for dichotomous keys or check with a herpetologist in your area to familiarize yourself with these definitive resources.

Of course, another easy method is to seek guidance from groups of knowledgeable people, either locally or online. If you use a platform like HerpMapper or iNaturalist, you can get IDs from the community. However, it is worth learning identification skills on your own so that you do not remain reliant on others indefinitely.

Learning the names of the organisms around is a worthwhile endeavor that will almost certainly equate to a feeling of intimate familiarity with nature. This will make your time in the outdoors much more rewarding!

Five-lined Skink photo by Eddie Ledbetter



There are over 18,000 species of reptiles and amphibians in the world. Learning them all would be a bit unwieldy. What we *can* do is master techniques that enable us to identify new species quickly when we encounter them.

Take Nothing But Photos, Leave Nothing But Footprints

Each living being has an impact on the environment, be it human, plant, or animal. All who breathe are a part of a delicate and intricate balance affecting all the organisms in the ecosystem. Humans, however, while technically a part of nature, tend to have a disruptive and artificial effect on that balance, whether intentionally or inadvertently. Because we live on this planet in such masses now, it behooves us to strive to mitigate this interference. Getting outdoors is good, but we should consider that even seemingly minor activities can have a significant impact when many people are doing the same thing. Looking for a lizard by removing the bark of one fallen tree may seem low-impact, but it doesn't take many people doing so before the skinks in the area will have a challenging time finding shelter.

While something as fundamental as not littering would seem to go without saying, we have all seen refuse in otherwise pristine locales. In waterways, we often see copious amounts of discarded detritus. Wildlife rehabilitators are routinely called upon to disentangle animals from these items, many of which persist in the environment almost interminably. Resolve never to contribute to this issue and join in with community clean-up efforts when possible. Especially conscientious hikers even make a habit of tossing the refuse they encounter into their pack for carry-out, and they speak up if they see a litterbug (L.E.A.R.N. encourages politeness at such times).

When photographing herps and other wildlife, the best practice is to take photos of an animal *in situ* (in its original place). While it may not have a lasting effect on an animal to be caught for a wild selfie, you will almost certainly find that you will build a more impressive portfolio by learning to capture your images without disturbing your subject. Likewise, people are often tempted to bring wild herps home when they find them. This is under-

standable since many are quite endearing. While this is legal in some areas, and some people are capable of practicing adequate husbandry, these animals often live with sub-standard care until they expire or are finally re-



Eastern Hog-nosed Snake photos by Mike Tabb

leased into an unfamiliar environment. If you “capture” those herps on film instead of in a bag, you can enjoy and share them indefinitely with no further impact or effort!

Those of us who value nature and want to spend time immersed in it should take pains not to be detrimental to it. We should be examples to others on how to responsibly appreciate all that our environment still has to offer. Preserving habitat is a lifelong job, but degrading it can happen very quickly. Let us be on our guard and commit to developing more good habits for cooperating with the natural world around us. Preserving biodiversity for future generations of people, plants, and animals does require consideration and effort, but it is worth it!



Since it is not possible to have no effect at all on the world around us, some naturalists subscribe to the 1% rule. The rule is thus—if you see 100 flowers, pick no more than one. Engaging with nature is a good thing—if we are responsible stewards and minimize any negative impact.

Field Herping ~ Tips & Tricks

So you want to spot herps in the field. Well, the good news is that they are all around you. The bad news is that they can usually see you coming from a mile away. Just because they are there doesn't mean you will see them. The main thing I try to impart to new folks is to try to tone down our 21st-century habits of tromping. Plowing headlong through the brush or whisking down the path is great when you have an appointment to get to, but if that's how you are trying to experience nature, you're doing it wrong. Animals are accustomed to the ambient sights and sounds, and they stay alive by being alert. Learn to walk like you're wearing moccasins and remember to look around and not just straight ahead.

Aberrant Eastern Copperhead photo by Armin Meier



The next tip is to think like a herp and not an endotherm. Has the sun just started to warm things up? Reptiles are probably hanging out in their favorite little patch of sunshine—preferably a safe one that's not too exposed and just a moment's dash from cover. First rain after a dry spell? Amphibians are probably hopping for joy, looking for their own little spot by the water to start advertising. You will enjoy more success as you become more attuned to your quarry's habits. Herps want to eat, drink, warm up or cool off, and stay safe. Look for habitat that provides these things. Here are some other bullet points:

- Be aware of your surroundings at all times. It is your own fault if you end up in the hospital because you stepped on a viper or fell down a hill.
- Never approach a

- snake you cannot positively identify as harmless.
- If you are going to pick up a harmless herp, your hands are the easiest way to do it. Be careful not to make lizards autotomize their tails, or get too excited and squeeze any animal too hard.
- Looking under cover such as logs or rocks can be fruitful, but make sure not to squish anything in the process (lower the item back down without the animal underneath it if there is any doubt)
- Lift or roll cover items toward yourself to provide a barrier between you and the animals, and put everything back the way you found it.
- Wading through creeks at night is a sure-fire way to spot herps (often including venomous snakes, so watch out!).
- A field hook or potato rake is a more comfortable and safer way to flip things over than bending over and sticking your fingers somewhere you can't see.
- Do not disturb nesting animals or eggs.
- It should go without saying that you should never employ gasoline or other noxious agents to flush animals out of hiding, but some people actually do this.
- If you use turtle or minnow traps—make absolutely sure that they are not entirely submerged so captive herps can breathe.
- Do not get overly excited and pin an animal down too roughly. Better yet, observe or photograph the animal from a distance. You will probably discover that your photo collection is much more attractive if you are not in the shots.
- Resist the temptation to bring herps home as pets, even if legal in your area. This especially applies to vulnerable species such as box turtles.
- Do not relocate animals to a different area. This is a biosecurity issue and increases herp mortality.
- Many people like to herp the “easy way” by driving along rural roads after dark. This can be a great way to spot herps, but make sure not to hit any. Not only is driving more slowly safer for the critters, but you will also probably see more of them. Make sure you are not causing a hazard for other drivers.
- Be prepared for a cop not to believe that you were just looking for snakes.
- Make sure you are familiar with applicable laws. States and localities vary wildly on what you may do regarding wildlife.
- Don't forget your field guide to help identify new herps!

Stay safe, take care not to disturb habitats, and happy herping!

Mojave Desert Sidewinder photo by Chad M. Lane



Be a citizen scientist as you herp!

Don't forget to upload your records to [iNaturalist](https://www.iNaturalist.org) or [HerpMapper](https://www.herpMapper.org) when you get done with your field work! Report any sick herps to [PARC](https://www.parc.org) or another similar [project](#).

Field Herping ~ Tools

Naturally, what you bring into the field with you is going to depend a great deal on where you are going and what you are doing, plus a large measure of personal preference. It is perfectly enjoyable to walk a trail with empty pockets and just observe what you encounter. Others enjoy an assortment of items that may come in handy. You should practice whatever level of preparedness you are most comfortable with (though a proper snakebite treatment kit means having at least a cell phone and car keys).

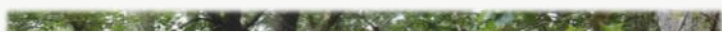
If you are looking for terrestrial herps, a field hook will almost certainly come in handy. Also called a snake hook and designed to facilitate lifting or handling snakes, the most frequent use will be to peek under fallen wood or other debris without having to bend over or stick your fingers somewhere you cannot see. A camera is an excellent addition to your gear, which can be combined with a monopod or tripod to make getting clear shots easier. There are other tools, such as snake tongs and gloves that some like to have with them. Since wading in a creek at night is a fantastic way to see herps, a set of waders might be worth the investment for some, as might a dip net.

Other items that some people might bring include:

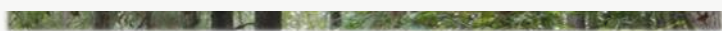
Polarized sunglasses • Hand trowel • Water bottle • Trail mix • Insect repellent/sunscreen (natural formulas) • Sweatband • Wide-brimmed hat • Collection bag (depending on purpose) • Inspection camera • Flashlight or headlamp • Compass • Whistle (in case of separation) • Notepad (to record observations) • Binoculars • Infrared thermometer • First aid kit

A field guide is always a great item to have. After you learn your herps, you could grab a guide to birds or insects or trees. Learning what the things around you are called and reading a bit about their natural history is one of the most direct means of getting more “plugged in” to the world around you. Besides which, many organisms are difficult to identify if you take a photo from the wrong angle so there are times when looking at your guide when you get home may be a missed opportunity.

Carry whatever makes *you* feel comfortable and prepared. If others around you bring more or less gear than you—



A camera and a field guide are two great things to have in your pockets when you head outdoors. Use your guide to confirm identifications and upload your photos to a citizen science database!



don't sweat it. You have your own personal relationship with the outdoors. The more you enjoy your time in the woods, fields, or mountains is the more often you will want to go there. The important part is just making sure to get out there!



Snake hook photo by Brendon Wilson

Biosecurity Note: Please wash and/or sterilize any items you bring into the field. There are several diseases affecting reptiles and amphibians in the environment, and human activity is a potential vector for these diseases to be introduced in new areas.

Remember, when heading out to the woods, tell someone where you're going and when you'll be back!

Decontamination Protocols

Over the past few decades, emerging infectious diseases have caused population declines and extinctions of amphibian and reptile species worldwide. Examples of pathogens that pose a potential threat to herp populations include Chytrid Disease (Bd and Bsal), Ranaviruses, and Snake Fungal Disease (SFD). Field research activities can negatively affect wild animal populations through the accidental spread of pathogens. Proper decontamination of boots, waders, nets, boats, and other field equipment

Speckled Kingsnake photo by Justin Sokol



helps keep wildlife populations healthy by ensuring that pathogens are not transported between sites. Specialized equipment like calipers or spring scales can also transmit pathogens from site to site or from one individual to another at the same site.

Materials needed:

- Household bleach (4-6% sodium hypochlorite)
- Biodegradable soap
- Large bucket or tote (about 8 gallons [25 L])
- Bucket or container with a water-tight lid
- Container with tap water
- Spray bottles
- Scrub brushes
- Dishwashing gloves and safety glasses

Steps for decontamination:

1. Before you travel to your research site, ensure that all

your equipment has been decontaminated.

2. When you first arrive at the research site, identify a sunny location away from surface water (ponds, streams, ditches, etc.) that has an asphalt or hard-packed surface (e.g., a parking lot). This location will be your decontamination area after you finish your work. The direct sunlight will help break down the bleach before it can enter surface waters.

3. After you complete your work, return to your decontamination area and clean all equipment with tap water (do not rise with water from a local pond, lake, etc.). Use a scrub brush to remove organic material (mud or vegetation) from your boots and other equipment. If done for the day, thoroughly wash equipment with soapy water and rinse with clean tap water.

4. Put on safety glasses and make your decontamination solution in a large bucket / tote by adding 1 part bleach to 19 parts water (e.g., 100 ml of bleach to 1900 ml of water).

5. Immerse equipment (including scrub brushes) in the bleach solution. Use a spray bottle to soak larger items thoroughly. Soak equipment for five minutes.

6. For sensitive equipment like calipers, cameras, electronic scales, etc., rinse or wipe with 70% ethanol.

7. Rinse the bleached items with clean tap water to prevent exposing the next site to residual bleach and to minimize damage to the equipment. If clean tap water is not available, rinse the bleached items with water from the next site (away from aquatic habitats). Do not rinse with water from the current site. If you are done for the day, allow the equipment to dry completely.

8. Whenever possible, remove the bleach solution and soapy water from the site using a bucket with a water-tight lid and dispose of them appropriately. Otherwise, dispose of them at the decontamination site (note: these solutions should not be disposed of in the field if it is raining or if a suitable decontamination area is not available). Ensure full compliance with local laws and safe disposal regulations.

9. Once home, wash clothing in hot water.

Please incorporate these measures into your field routines—you don't want your activities to negatively impact the animals you go to observe!

Spring Peeper photo by Justin Sokol



Bulletin adapted by permission from *Canadian Herpetofauna Health Working Group. 2017. Decontamination Protocol for Field Work with Amphibians and Reptiles in Canada. 7 pp + ii. [Link](#)*

What is *That* Thing?

As you spend time in the field observing herps, you will encounter a host of other organisms. Plants, fungi, birds, mammals, insects, spiders, crustaceans, and the like are all around you. This is an excellent opportunity to become familiar with more of the organisms in your ecosystem. Take a good, clear photo of the plant or critter if you can, and try to identify it when you're done with your field trip. One way to do this is by having a range of different field guides available at home. Another way is by joining various Facebook groups that focus on the types of species you recorded. For some animals such as birds, you can install any of several applications on your smartphone for quick identifications in the field.

Possibly the best practice to get into is to upload your photos to iNaturalist or another citizen science web site. Narrow the classification down as far as you can, even if that is only to describe it as a "Plant," and see if the community can provide an ID. Taking a moment to add your observations to a database like this not only benefits you by facilitating an ID, it also benefits biologists, researchers, and other naturalists by helping confirm range maps and other research data. If you do this often enough, it is likely only a matter of time before you become the first person to record some obscure species in your area—a useful and exciting happenstance!

As you document and learn to identify more species, you will probably soon surprise yourself with how much more comprehensive your understanding of biodiversity and ecological relationships becomes in a rather short period. This also has the benefit of guaranteeing that every venture out is a fruitful one. You may go on field-herping trips where you spot few or no herps, but you cannot go outside without encountering any organisms.

It is also likely that as you slow down and take in more of your surroundings, the frequency with which you see the

animals you were looking for will also increase. Many herps have good auditory and visual acuity. If you are plodding headlong through the brush, they often disappear long before you get near. In short—try to avoid tunnel vision in the field for a more rewarding experience!

Southern Black Widow Spider photo by Micha Petty



Guinea Paper Wasp photo by Isaac Neely



Giant Stag Beetle photo by Charles Paxton



Eastern Eyed Click Beetle photo by Micha Petty



There are always a host of organisms surrounding you in the field. Learning to identify and study the natural history of plants and animals from multiple orders will add a rewarding breadth to your time outdoors!

Field Herping ~ The Law and You

Legalities can be an annoying and confusing hassle, but this primer would be remiss if it did not advise you to research and follow all applicable laws regarding wildlife. By and large, these laws are in place for a reason, and you will not be doing yourself or the animals you encounter any favors by ignoring them.

Common Chuckwalla photo by Chad M. Lane



Even if this bulletin were written specifically for your area, it could not contain all the laws that might apply to your activities. What it can do is give you an idea of how to go about researching the rules for yourself. These examples are geared toward U.S. readers, but international readers can hopefully extrapolate the gist and use what may apply to their country or province.

Local Laws: Be aware of the basics. Be respectful of others and don't overlook simple local or county laws like parking legally and not trespassing.

State Laws: This is usually the main set of laws regarding field herping. Observing or interacting with reptiles and amphibians typically falls under the purview of your state's wildlife agency, which may be called Wildlife and Fisheries or the Department of Natural Resources or another similar name. Find out what agency issues fish-

ing licenses in your area and start there. Their website will (hopefully) have applicable laws posted (these may also be included in the hunting or fishing regulation pamphlets available at many bait shops).

State Regulations: Regulations get their authority from state statutes but can be a little more subtle and difficult to find. They may be posted on your state or agency's website. If your local library has access to any legal sites such as Westlaw, you should be able to look them up that way. Legal sites will also contain case law, which will shed light on how your state laws have been interpreted. Some regulations are so stringent that you may, for example, be required to have a fishing or hunting license merely to photograph wild herps.

Federal Laws and Regulations: In the U.S., this is mostly applicable to interstate transport or commercial activities. Some law enforcement agencies will also interpret wildlife crimes to be a violation of the Lacey Act. This may seem extreme, but many wildlife enforcement agents take their jobs very seriously, so it pays to exercise an abundance of caution in this area. There are other statutes to consider, such as endangered species listings or USDA regulations regarding commerce in animals. One regulation that frequently affects reptile sales is the four-inch carapace rule for turtles. More information may be found at animallaw.info.

It is worth looking up the actual laws and regulations and reading them for yourself. Many people (including law enforcement) often rely on word of mouth for legal knowledge. This is much less reliable than becoming familiar with the laws yourself. It may be confusing, but there really is no substitute for taking the time to work through the learning curve and becoming properly educated about the laws that apply to your activities.



California Red-sided Gartersnake photo by Chad M. Lane

One database that may be of assistance in the U.S. with local laws is the Municode Law Library. For state laws, go to your state's legislative website and try search terms such as "reptiles" or "wildlife" until you find the sections that deal with keeping, observing, or interacting with animals in the wild.

Field Herping ~ Make it Count!

So you've decided you enjoy observing and identifying reptiles and amphibians in the wild. Great! Herps certainly need all the help they can get. Hopefully, you have already developed good habits for your field trips, including not destroying habitat, not littering, leaving the critters in the wild, and properly sterilizing equipment. You're following all applicable laws, you're not handling any venomous critters, and you are taking quality photographs to upload to a citizen science database. Excellent job! Now it's time to advance to the next level.

Herp blogger Sean Graham recently wrote about herping for the most impact in his [viral post](#), "Nobody Cares About Your Lifers: How to Make Herping Count." He talks about the propensity of veteran herpers to go out specifically looking for species they have never seen before, or "lifers." He points out that, while this is understandable, we should consider making better use than this of our limited resources. Those of us who value reptiles and amphibians are relatively few and far between, so leaving all the "important work" to the even fewer biologists who manage to get a grant to go looking for vulnerable species means there will always be a backlog. If, on the other hand, we were to adopt a targeted approach to our field time, every one of us could be making valuable contributions to science and conservation as a routine matter.

Specifically, his advice is to identify and seek out "species of special concern." These are species that we do not know to be common but are not known to be so rare that special permits are needed to work with them. Your goal would be to either confirm that these animals are more common than we realized or confirm just how rare they are through a consistent absence of sightings. In either case, your records of where and in what situations

they were found contribute to our knowledge of their natural history. This is important because funding and research time for protecting herps are limited. Determining the current extent of various species' ranges and population densities allows scientists to direct these resources more efficiently. Enough birdwatchers have already caught on to citizen science to the point where avian conservation efforts now have the luxury of being



Yellow-eyed Ensatina photo by Chad M. Lane

well-targeted. We are nowhere near that point with herps. We need to be—they are declining fast.

Herps are in crisis not only because of all the pressures they face but also because not enough people are taking their plight seriously enough. At a minimum, you should record your observations and publish your findings, even if it is just by uploading photos to a citizen science website like iNaturalist or HerpMapper. Optimally, though, you should be carefully planning a targeted approach to your time in the field that maximizes the scientific return on all the time, sweat, and money you expend.

Consider herping for a cause!

You do not have to be a Ph.D. to contribute to conservation efforts—just put some thought into how you spend time in the field. Instead of looking for the same species over and over—ask a biologist what species would be helpful to look for. Herping with a purpose is sure to feel even better!

Northern Gray-cheeked Salamander photo by Todd Pierson



Herpetoculture is the keeping or breeding of reptiles and amphibians (akin to horticulture for plants). It should be noted that, as a rescue and rehab center, L.E.A.R.N. cannot in good conscience indiscriminately encourage people to purchase or collect herps. This is because we deal with the aftermath of the all-too-common keeper who acquires an animal on a whim, spends about 15 minutes on the internet “learning” how to care for it, and then somehow thinks it is not their fault when the animal starts to deteriorate. On the other hand, L.E.A.R.N. also believes in personal freedom, and many people do have the capacity to practice proper husbandry.

Regardless, sound husbandry information needs to be propagated. Consequently, included here are bulletins on some foundational topics. It is up to each keeper to do their own due diligence in researching husbandry practices.

Valley Gartersnake photo by Chad M. Lane



Part VII

Herpetoculture

with Sabina Squires, DVM, CVA

ALWAYS DO YOUR RESEARCH *BEFORE*
BRINGING AN ANIMAL HOME!

LEARN
Louisiana Exotic Animal Resource Network



Ornate Box Turtle photo by Peter Paplanus



Read a Book!

It is always the responsibility of the owner to become intimately familiar with the needs of every animal in their care. At L.E.A.R.N. and probably every other facility in the world that rescues reptiles or amphibians, it is a routine matter to take in surrendered pets that are ill or injured in ways that would not have happened if their keeper had taken better care of them. In this age of readily available information on virtually any topic, it is quite frankly difficult to sympathize with those owners, especially when looking at an animal who can't walk or eat.

In many ways, herps are not like the domestic animals that many people are used to. Being ectotherms (animals who do not produce their own body heat), they need carefully constructed gradients of temperature, light, and humidity throughout their enclosures. Ultimately, the animal knows what it needs. It is up to us to offer a variety of parameters from which the animal is free to select throughout the day or night. Likewise, the animal cannot go out to forage for its own food. Its keeper must know what food it needs, spanning what variety, in what quantities, and at what frequency to offer that food. In situations where other animals are present, particularly cats or dogs, it is up to the keeper to keep animals safe from each other.

When a reptile or amphibian is sick, it will typically hide any symptoms for as long as it possibly can. This stems from the fact that, in the wild, sick animals are typically the first to get eaten, so there is a distinct advantage to appearing healthy at all times. These animals cannot speak your language to tell you to turn up the thermostat or that they different food items. It is always up to the owner to be sensitive, educated, and aware of their animals needs without being told.

Let's face it—this description of a well-attuned keeper matches relatively few people. Be honest with yourself. If you are the type of person who cannot boil water without burning it, you may not have the delicate touch needed to create and maintain a habitat in which an animal with a metabolism so different than your own

will be able to thrive. Make no mistake—there is a difference between surviving and thriving. Your goal should, of course, be the latter.

Granted, many people have managed to keep herps without buying and reading books on the subject. Of those people, though, how many were just meeting the bare requirements for the animal's survival? How many were providing the animal the things it needed to live a



Chinese Alligator photo by Andrew Austin

full life? There are many facets to successful herpetoculture, but it is our firm belief that buying an actual book—and reading it as many times as needed—is a necessity. A book is going to give you a much more comprehensive knowledge of what your animal needs than a conversation with a pet store employee or a random collection of people on social media. Arguably, every sick pet that L.E.A.R.N. has ever accepted would not have been sick if their owner had taken their research and follow-through more seriously.

It's no secret that some people view reading as a hassle. If this describes you, stop and take an honest assessment as to whether you are ready for the hassle of caring for an animal that may live for decades and will need precise parameters that entire time. It is better not to take on the responsibility of a pet than to get one and take care of it poorly.

Although proper animal husbandry is a complex subject that takes time to master, reading books on the subject will invariably contribute to your success and your animal's health. Husbandry and technology have come a long way in recent years, so make sure to buy an up-to-date volume.



Gray Ratsnake photo by Jennifer French



Consider the Cost

I could never run a pet store. People would come in all day wanting to buy an animal with a cage that was too small, the wrong lighting, or the cheapest food, and I would have to tell them that is a “hard nope.” I would soon have internet reviews overflowing with 1-star ratings from all the people I offended. This is one reason L.E.A.R.N. doesn’t charge adoption fees for our rescue pets. We want it to be clear that we are not selling animals—we are trusting an adoptive home with the animal only under certain conditions, such as providing a safe

learning and implementing proper husbandry is vital with herps.

It is beyond the scope of this primer to supply care sheets for every animal in the pet trade, but we will use an Inland Bearded Dragon as an example of a typical cost of a proper setup (prices may vary):

An adult will need at least a 48” L x 24” W x 24” H (122 cm x 61 cm x 61 cm) enclosure, so if you start with that, you won’t have to keep buying bigger tanks. If available, an enclosure with front-opening doors makes maintenance easier. **\$229.99**

Your lizard will need visible light, heat, UVA, and UVB rays. L.E.A.R.N.’s method is to buy one bulb and fixture to produce all four of these, so as not to buy, maintain, and replace multiple items. Mercury vapor bulb and fixture: **\$74.98**

Cage furniture: hides, climbing structures, water and food dishes, substrate, etc. This varies, but could be around **\$134.00**

2 thermometers and hygrometers (to monitor temps and humidity in the enclosure), digital units are nice: **\$29.98**

Miscellaneous accoutrements: a book about the species, tank stand, tongs for grabbing insects, a container to house uneaten insects, reptile-safe cleaning supplies, water treatment additive, food supplements, a timer for a heat lamp, etc.: **\$216.00**

So, for quality items, and not including sales tax or the cost of the animal or ongoing food costs, we are up to around **\$700!** One might reduce that by buying items on sale or carefully selecting less expensive (but still suitable) elements, so we might round that down to a low-end figure in the range of \$450.00. If you do not supply the proper equipment and environment, your animal is going to suffer—that is a fact. Do not buy an animal on a whim and then discover you don’t have more than \$99 to devote towards their set-up. L.E.A.R.N. takes in sick animals every week from people who tried that.

If you are going to own a herp, be a humane and responsible owner. Make sure to supply your animal with what it needs!



Green Iguana photo by Bernard Dupont

and proper habitat. We do not consider appropriate equipment, gradients, or care to be in any way optional.

If you are considering a herp as a pet, you should give some serious thought to the cost of creating an adequate enclosure for the animal. Herps are a hardy lot. Almost all of the problems captives develop are a direct result of being kept improperly. Once you research and set up a proper environment for the animal, maintaining it is easy. Herps generally consume less and produce fewer wastes than mammals and typically do not need constant attention like many mammals or birds. However, if you do not create the right environment, your animal will suffer and deteriorate and develop illnesses that may be expensive to treat. It cannot be over-emphasized that



Brazilian Bush Anole photo by Bernard Dupont

Proper husbandry is of the utmost importance for reptiles and amphibians. The necessary equipment can be quite costly. Do your research BEFORE bringing an animal home to be sure you have the resources to set him or her up in a way that will keep them healthy and happy!



Consider Size and Longevity

Exotic animals really are not the type of purchase that should be made on a whim. Unfortunately, that is precisely how they are often obtained. It is understandable to want to bring a cute baby turtle or iguana home when you see one in the pet store, but many questions should be asked and answered before deciding if that choice is right for you and the animal. In other bulletins, we discuss that the best practice is to read a book about the care of any species you are considering owning beforehand and to consider the initial and ongoing costs of care. Two more distinct factors to consider are how large an animal will grow to be and how long it will live.

As hard as it may be to believe in this modern age of ready information, it is unfortunately still true that some salespersons continue to tell customers that an animal will “only grow to the size of its tank.” This is, of course, ludicrous and totally false. Whether this is done from ignorance or intentional deceit may vary, but the lesson to be learned is that you should not be relying on pet store employees for husbandry information, regardless of how nice or helpful they may seem. Many lizards, turtles, and snakes—and even some frogs and salamanders—will get quite large as they age. While many herps in the pet trade stay small (e.g., Musk Turtles, Fire-bellied Toads, Green Anoles), there are many more that will get much too big to be housed in any sort of “starter tank.” Examples of animals that are routinely surrendered to rescues because they have gotten too large include Sulcata Tortoises, Boa Constrictors, Red-eared Slider turtles, Green Iguanas, Savannah Monitors, tegus, and more. Iguanas, for example, really need a 4' by 8' (1.2 m x 2.4 m) enclosure at a minimum as adults, and few of the people that buy them as cute tiny \$35 lizards are prepared to devote that type of expense or space. It is critical that you research the adult requirements of any animal before acquiring it as a youngster.

Another aspect that people often overlook is longevity. Many animals commonly sold as pets have the capability (if properly cared for, which is not the norm) to live much longer than cats or dogs. In fact, many herps should easily outlive you! Examples include many aquatic turtles (30

-50 years or more), many medium-to-large constrictor snakes (20-30 years or more), and iguanas at 20+ years. Several amphibians can live 15 years or more. Many tortoises and box turtles can live to be over a hundred years old—meaning you may need to plan for their care after you are gone! Such a commitment should be entered into very carefully, as it is difficult for any of us to know where our lives will be in a decade or two or three. If you are taking your commitment to the animal seriously, you



Gold Tegu photo by Bernard Dupont

will need to take your animal's needs into consideration when making a range of life choices, such as where to live or what job to take. Similarly, it can be difficult to weather some life events like a new baby or the loss of a loved one with the added responsibility of a pet. Another common reason for surrenders is teens going off to college and parents not wanting to take on the responsibility. Wouldn't it be best to consider these aspects before the purchase of an animal?

At L.E.A.R.N., we take in animals weekly that have grown much larger or lived much longer than expected. We always have several turtles, snakes, parrots, and other animals that were surrendered by caring owners who had simply grown too old to care for them anymore. While we prefer that reason to the more common “lack of interest” surrenders, we would like to encourage everyone to consider all the factors of exotic ownership ahead of time so that these animals are less likely to become neglected in the future.



Three-toed Box Turtle photo by Jason Wall

Caring for an animal should be viewed as a long-term commitment and should be entered into thoughtfully. Please ask yourself if you are willing to make sacrifices years down the road before purchasing an animal today.



Demand Responsibly-sourced Animals

The sad fact is that commercial collection of animals for the food and pet trades is taking an enormous toll on wild populations. There is also a thriving black-market trade in protected species in many parts of the world. In some instances, collection efforts actually increase when species are granted protection because of the increased black-market value (similar to what is observed in drug, weapon, and other illegal trades). Enforcement agents

African Bush Viper photo by Alexander England



and conservation workers do what they can to curb this practice, but there are unfortunately many more people willing to smuggle animals to make some quick cash than there is funding for enforcement efforts. Worldwide, the result of all this is that a great many species are becoming vulnerable or threatened as a direct result of these intentional human activities.

When you see a strikingly beautiful, personable, or otherwise fascinating species of herp in a magazine or online, it can be tempting to want to own one. Even if there are established data indicating that the species is under pressure already, it can be easy to tell yourself that you “only want *one*.” You might think that just one animal can’t have much of an impact either way on wild populations. Such thinking has multiple flaws.

For one thing, commercial collection happens on a differ-

ent scale than personal collection. There are a host of factors to consider (legality and cost of care being two examples) before collecting any animal from the wild, even if it as seemingly innocent as allowing a child to keep a pet lizard they found in the yard. Even if you feel small-scale personal collection is generally harmless, however, we must consider that involving money with collection activity opens animals up to countless people scouring the countryside, often removing every animal they find and having an enormous impact. Once people start collecting animals as a livelihood, they often continue until the animals are so scarce that collectors are no longer able to profit from the activity. By that time, the population has likely been so severely decimated that it can no longer recover from these losses. In other words—it is not “just one animal” being affected.

Another reason is that, if you want a pet and can provide the proper care, there are countless surrendered and unwanted herps needing better homes right now. Regardless of your feelings on breeding herps for sale, captive breeding reduces the impact on wild populations, as those animals have already been counted out of wild breeding populations and are meeting customer demand. Captive-bred animals are preferable to wild-caught animals both for ecological reasons and because they are often healthier than those that have been caught and shipped around the world in questionable conditions.

Collection for the food trade is an additional layer of activity that is also causing considerable pressures on herps worldwide. This ranges from the shipment of thousands of animals across borders down to small “bush-meat” markets in less developed countries. You may not feel like you can do much about the numerous examples of ecologically unsustainable practices, but one thing you can do is to resolve that your household will not contribute to the issue. Make that decision today!

*(In contrast to these cautions about commercial collection, it should be noted that the capture and sale of **non-native** herps may provide an economical and eco-friendly solution to problems of invasive species.)*



Beaded Lizard photo by Shane Smith

Commercial collection will continue as long as people are willing to buy wild animals. Legal protections often do little more than encourage poaching. The best hope is that Conservation Through Education can convince consumers to demand that all animals are sourced sustainably.



Code of Conduct and Ethics

L.E.A.R.N. does not presume to instruct anyone on how they should live, but we will suggest some principles that we think are sound. You are invited to consider these statements regarding the keeping of reptiles or amphibians and commit to those that align with your own conscience.

- I understand that it is my personal responsibility to research the needs of all animals in my care thoroughly and to provide all needed items for them to thrive and not just survive.
- I will provide my animal with an appropriately-sized, well-constructed, secure enclosure that is free from hazards and inaccessible to other animals.
- I will provide accessories that allow my animal suitable opportunities for exercise and enrichment, as well as hiding places for its comfort.
- If the animal needs to be transported, I will do so in a manner that ensures the safety of the animal and my fellow drivers and that causes the least possible stress on the animal.
- I will maintain a high degree of sanitation and biosecurity in the animal's enclosure to foster its health and prevent disease transmission (both to and from my animal, including zoonotic diseases).
- I will provide this animal with species-appropriate levels and gradients of temperature and humidity at all times.
- I will provide a nutritious variety of foods, as appropriate, in the appropriate amounts, and at a proper frequency.
- I will commit to keeping the animal for the duration of its life, and will not discard or neglect it due to lack of interest.
- I will provide the animal with lighting which includes ultraviolet wavelengths, particularly for diurnal species.
- If minors are involved in the care of this animal, I as an adult assume full and final responsibility for this animal's care.
- I will supervise the animal's interaction with other people or animals to ensure its safety. I will at all times act in a manner that ensures the safety of myself and others and portrays responsible ownership to any observers.
- I will not recklessly allow my animals to breed and reproduce, which could potentially put further strain on the resources of the limited number of rescues that accept reptiles and amphibian pet surrenders.
- If I sell or transfer an animal, I will base my decision primarily on the suitability of the placement, rather than monetary incentives.
- I will provide this animal with timely access to veterinary care as needed and will be solely responsible for the payment of same.
- If I become unable to provide for the needs of this animal, I will immediately seek out assistance or seek a placement or rescue facility that can provide suitable care. I will include the enclosure and accessories that my animal is accustomed to and make a donation, if possible, to defray the cost of the animal's continuing care needs.
- I will ensure the security of the animal's enclosure and under NO circumstances will I allow my captive animal to be released into the environment, for its own health and safety and to prevent harm to the environment from a non-native species.
- I will commit to sharing accurate knowledge about the species in my care whenever possible, and will never intentionally contribute to the fears that others may have regarding these animals.
- I will look for ways that I might contribute to the wild conservation of these and other reptiles and amphibian species.

L.E.A.R.N. considers it essential to optimal husbandry that there is one person who takes individual responsibility for the administration of animal care. In our experience, scenarios where responsibility is shared or poorly defined often result in a reduced standard of care resulting from overlooked or postponed tasks.



Northern Cat-eyed Snake photo by Ashley Tubbs



We're Not Disposable!

Caution—this bulletin is a little franker than the others in this Primer. It would be wonderful if this bulletin went without saying. Unfortunately, many people are so obtuse that they view people as disposable and animals even more so. Sometimes people bring animals to L.E.A.R.N. for understandable reasons, such as family members being concerned about their owning a 10' Boa Constrictor now that they have a newborn baby in the house. Sure, they could have kept the animal and the

I think many feeling people would be hard-pressed not to raise their voice at an owner like this, but they are everywhere. We have had people bring us animals that they had owned for years without even knowing what species it was. How anyone can not take the time to so much as research what kind of animal they have puts one at a loss for words. This bulletin could be filled with stories like this.

What is arguably worse are the people who bring wildlife home and just let it die. Sure, taking one Green Anole out of the yard or one Red-eared Slider home may not (for common species like those) have any more environmental impact than if a bird had eaten them, but if you are going to do that—*do your research and buy the proper equipment*. Do not make it live in a jar because it was “a free pet.”

Possibly one missing piece of the puzzle is understanding that these are living, breathing, feeling animals. Reptiles are not plastic toys that can be lost or discarded, whether they are pets or encountered in the wild. Appallingly, it has happened more than once that we have been called about animals that were intentionally abused, and we have certainly taken in plenty that have been neglected. If you are not entirely sure you can commit to everything an animal needs for the rest of its life, do not get a pet. If you have already done so, do not just turn the animal loose, even if it did come from the wild. Also, do not wait until the animal is about to expire before bringing it to a rescue. Bring the animal to a vet or, if you cannot manage that, surrender it to a rescue or find a better home before it is too late to be saved. Even if you don't believe the animal has feelings, the people at the rescue are saddened when they spare no effort or expense in a last-ditch attempt to rehabilitate a severely neglected animal only to have it be in vain.

In short, if you are going to neglect something, please make sure it is an inanimate object or a task and not a living creature.



Three-toed Box Turtle photo by Branuen Cary

baby safe, but the concern is understandable. Often, elderly owners surrender pets they have had for decades because their own health is becoming a concern. That is much better than times when an owner passes with ten birds still in the house. Sadly, these types of surrenders are not the norm. More often, people are just tired of cleaning their turtle's tank or their kid (who should never have been the primary caretaker of the animal in the first place) is not taking care of their pet. Don't take this to mean we would rather they keep it; we would rather try to find a better home for the animal than have it languish, of course. We just wish people would BE better homes in the first place.

Believe it or not, some people actually think, “I only spent \$29.99 on that iguana, I'm certainly not going to spend \$100 taking it to the vet. I'll just buy another one.”



Cornsnake photo by Armin Meier

L.E.A.R.N. does not advocate for a ban on pet ownership, as that would cause them to be hidden away and receive worse care. What is needed is education. Share this primer with others, especially those with children. It is not too late to raise the next generation to be responsible stewards of their pets and ecosystem!



Never Release Captives Into the Wild!

So you bought a reptile. You care about it to some degree. Maybe you managed to keep it alive for years, but you didn't realize it would live so long or get so big. Now you have to move for work and you can't figure out how to take it with you, or you have a new spouse that won't live with "that animal," or you realized you "have been meaning to get it a properly sized cage for years and still haven't done that." Whatever the reason, you have decided not to keep it anymore. Setting aside the relative morality of considering pets disposable, what do you do? Maybe you asked around to see if friends or family wanted it, with no takers. Perhaps you placed an ad online and no one responded, or the people replied didn't seem like good homes. Maybe someone recommended euthanizing the animal, but you can't bring yourself to do that. Maybe it never occurred to you to look for an exotic rescue, or maybe you searched and couldn't find one or they were all full up. Now your time is up and you still have it.

You think to yourself, "I know a place in the woods with lots of a critter to eat, and there are not many people around, and I've never seen any predators there..." You remember the sign at the pet store that said, "Never release captive animals into the wild!" You think to yourself, "I tried to find a home and failed, what else can I do?" So, you bring your pet somewhere that "seems like a good place" and let it go, hoping it will be ok.

**I have news for you.
It will NOT be ok.**

Even if it were ok, it is not a natural part of that ecosystem and the risks you expose your pet and the resident animals to can be severe. If your pet is lucky, something will kill it and eat it. If your pet is unlucky, it will last the season and still be around when winter comes. At best, the likely options your animal faces are a fast death or a slow death. At worst, your pet just

introduced microbes into the environment that the native animals have no immunity to, and you just wiped out an entire population. You may be able to put your pet's future out of your mind, but it will still be suffering.



Boa Constrictor photo by Armin Meier

It happens all too often that L.E.A.R.N. goes on rescue calls for non-native animals. It also happens that veterinarians call asking for guidance because someone brought in a tropical herp that they found almost dead on their back porch the morning after a cold snap. You may not see what a slow death to a hardy animal looks like, but that doesn't mean it is not taking place.

Trust me, if your only choices are release or euthanasia—the answer is obvious. Being humanely euthanized is infinitely preferable to the rigors of the wild for an animal that is accustomed to being provided for. You may feel bad or sad, but the proper response is to learn from the experience and resolve not to enter into commitments lightly in the future. The right answer is never to dump your pet out in the woods and forget about it.

**It may be hard to find a different solution.
Find one anyway.**

Unfortunately, herps are not the only animals that get introduced to the environment, whether intentionally or by accident. It is imperative that you secure your pet and protect it and the wild from each other. Non-natives can cause local ecosystems a great deal of trouble—don't make it worse!



Midland Painted Turtle photo by Tim Spuckler



Gradients are Key

Reptiles and amphibians are physiologically different from mammals. Being ectotherms, they regulate their body temperature externally through their behavior. They cannot sweat to cool off or do jumping jacks to warm up. Many people know that without really understanding what that means in practice. We are used to our body acclimating to a narrow temperature range and most of us are used to adjusting a thermostat if things are not just right. We can put on or take off clothes to make ourselves comfortable. We are so used

when they feel too cold or too hot. If you create a gradient for them to select from, they can take it from there. It is worth noting that gradients need not always be side to side. Heat from above and safe climbing structures, for example, create vertical gradients that work just as well or better for some animals.

This also holds true with humidity for most species. If you've ever been in the desert heat or biting cold and experienced the discomfort of your sinuses feeling like sandpaper, you can imagine what it must be like for an animal adapted to the rainforest to be stuck in our homes with the air conditioner working to remove all the moisture from the air. Yet again, the solution is not to make their home a swamp. Try solutions such as plants, misting one side, or a soaking dish to make sure they have a way to select their own comfort zone.

Though often overlooked, gradients hold true for visible light and UVB rays as well. If you've ever felt the need to don sunglasses, you can probably understand an animal being uncomfortable if they are unable to escape a blazing light 8" from their face for 12 hours a day.

This short bulletin is not enough to impart all the subtle aspects of creating, monitoring, and adjusting these gradients. Hopefully, it gets you thinking about how to provide your animals options to choose from. Naturally, you will need to adjust the high and low ends of these ranges to meet the various needs of different species.

L.E.A.R.N. recommends reading a printed book on the species you are considering caring for, developing a relationship with an appropriate veterinarian, and researching the animal's native habitat with the goals of understanding and duplicating that environment as much as possible. If you follow these guidelines and provide an appropriate diet for your animals, you will likely have years of enjoyment ahead with your healthy and happy pet. Speaking as an animal rescuer and rehabber, I can tell you from experience that most of the animals I have treated over the years would not have been in such poor condition if their owners had followed this advice. Hopefully, you can learn from their mistakes!



Green Anole photo by Eddie Ledbetter

to being comfortable that it may not be easy to perceive that an animal in our care might not feel the same way. A great many herps in the pet trade are tropical animals. They do not usually come from a land where it is a constant 72°F and 30% humidity like our houses. They often either come from hot and dry areas (e.g., Bearded Dragons, Leopard Geckos) or hot and humid ones (e.g., Ball Pythons, Green Iguanas). Forcing them to accept the same temperatures as us is akin to you sitting in a house that is 20° too cool and not having a coat or even long sleeves. That would get old pretty fast for most of us.

Simply cranking up the heat is not the solution. Ectotherms must be able to move closer to or further from their heat source as needed for their metabolic processes to function correctly. This includes digestion, energy levels, immune function, and more. Like you, they know



Black-necked Gartersnake photo by Ashley Tubbs

Gradients of temperature, humidity, light, and ultraviolet rays are essential for your animal's health and happiness. Your animal is an expert on what it needs—learn to make sure it always has options to choose from! Accurately monitor the temperature and humidity levels regularly.



Replicate Nature

For those responsible keepers who are doing their best to provide their animals with everything they need, it can be understandably difficult to sort through all the information available nowadays. For example, some people might suggest one type of substrate, but then others say not to use that; some people will say not to feed this or that to your animal, whereas someone else will assure you it is okay. How does one sort through all these conflicting reports? Well, as mentioned in a previous bulletin, L.E.A.R.N. recommends that books be your primary source of husbandry information. Add to that the advice of a veterinarian competent with herps, if available. There is another prime tenet to adhere to besides these—seek to mimic nature in as much as possible.

Let's be honest, even with solutions such as full-spectrum lighting, bioactive substrates, and carefully sourced food items, it is not possible to create a microenvironment that perfectly recreates any natural habitat. Wild ecosystems are just too complex. The interplay between microorganisms and plants and animals in nature is far too varied and subtle for us humans to fully comprehend, much less duplicate in a bottle. Nonetheless, we should hold up nature as our guiding principle and put effort into understanding natural habitats.

Study what successful keepers are doing, but don't stop there. Study where the animal in your care comes from and ask yourself questions accordingly. What is the climate there? Would the animal utilize microenvironments, such as a desert creature that spends its time in burrows during the heat of the day? What species of plants or animals does it feed on in the wild? Does the animal utilize the UVB in sunlight for vitamin D synthesis? How intense is that light where the animal would live? How would the animal naturally be getting water—dew? Rain? Standing pools? How humid is the air where they are found? How moist is the soil there? What hiding spots would it naturally utilize?

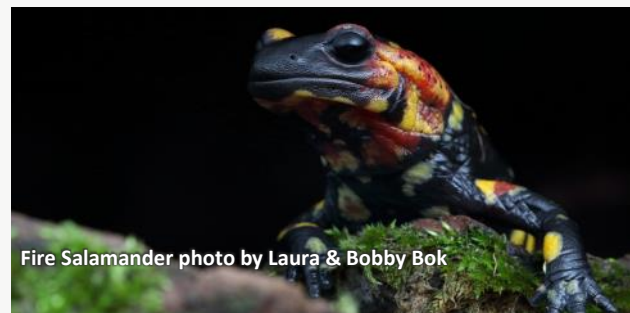
Thinking in terms such as these should reveal many answers worth incorporating into your husbandry. The idea is to form habits that are based on what the animal is naturally adapted to, rather than expecting the animal to adjust to what is convenient for you the keeper. It may be possible (and even common practice) to keep animals in ways that run contrary to their wild habitat. However, the best practice is not to ask whether the animal can



survive if kept a certain way, but rather how might one help it *thrive*? A big part of determining success is being attuned to the animal's behavior. For example—a lizard that rarely comes out from under a heat light is probably in too cold of an enclosure, and one that rarely comes near the light is probably too hot. Even if the animal cannot speak your language, it is still imparting feedback. It is your job to pay attention and learn to interpret your animal's behavior correctly.

Thinking like a lizard or a turtle or a salamander may not come naturally to you right away, but it is vital that you make an effort. The good news is that these animals are not coy—all their behaviors are perfectly understandable once you become adept at seeing things from their perspective. Resolve to start thinking this way today!

It is L.E.A.R.N.'s position that every animal in captivity should be provided a lifestyle that meets or exceeds what it would have in the wild in every way possible. While we cannot truly recreate nature indoors, we can and should learn to take our cues from the animal's natural habitat.





Even Herps Need Enrichment

It is important to provide stimulation for your animal, also called enrichment. It may not occur to most people that herps need enrichment, but all animals have a great deal more awareness of their surroundings than many people realize. While keeping your critter in a bare plastic bin may make *your* life easier, it does nothing to improve the animal's psychological well-being. Just because an animal appears physically healthy does not mean that it is thriving. Fortunately, the idea of naturalistic enclosures

ings so that they have a chance to feel more like a wild critter. Enrichment is not one single thing. It is taking the time to break the monotony. Sometimes this may be as simple as going outside and getting some sunshine in a secure and supervised setting. For some critters, it might be bringing in a pile of leaves and letting them root around in it. For others, it might be hiding some food underneath or on top of something. The point is to try to tailor as many activities and surroundings as you can to the animal's natural behavior. This does take a little thought and research, but it is not difficult. If you were locked in the same room every day, imagine how exalted any new experience would become. You are trying to alleviate that same boredom in your animal.

If you really want to step up your game, you can use enrichment as a dual-purpose activity and incorporate training into this time. Trained reptiles? Yes. Like other animals, herps learn and adapt to information. We have whiptail lizards (racerunners) at L.E.A.R.N. that will walk up onto their keeper's hand and ask for treats (waxworms). This may not seem like a big deal, but these same lizards are so flighty in the wild that many people call them "field streaks," and they can run up to 18 mph (13 km/h). Even a little 7" lizard can learn new behaviors. Do you have a large monitor or tegu? Try teaching them that, for example, when they are on a fuzzy pillow that means it is time to sit still. Think how handy that will be when it comes time to visit the veterinarian!

Take some time to seek out as much knowledge as you can about your animal's natural history. How do they interact with their environment? How do their activities vary throughout the year? Do they dig for food, climb for it, chase it, or something else? Do they like to wedge themselves into tiny spaces or hide underneath flat objects? Try to provide opportunities for your animal to exhibit some of the behaviors they are adapted to. It will alleviate boredom for them, it will be fascinating for you, and you will both get to know each other better!

King Cobra photo by Micha Petty



is gaining traction, and more people are getting away from empty-box-and-paper-towel housing. However, any small enclosure gets boring over time without periodic changes, even if it is well decorated.

The Association of Zoos and Aquariums defines enrichment as "a process for improving or enhancing animal environments and care within the context of their inhabitant's behavioral biology and natural history. It is a dynamic process in which changes to structures and husbandry practices are made with the goal of increasing behavioral choices available to animals and drawing out their species-appropriate behaviors and abilities, thus enhancing animal welfare." (AZA/Behavior Scientific Advisory Group, 1999). In other words, making periodic changes and offering a variety of experiences and opportunities for your animal to engage with their surround-

It is important to provide small periodic changes to alleviate the monotony of captivity. Pay attention to your animal's responses and be cautious about drastic change, as this can also cause stress. As you get to know your animal, you should be able to interpret their responses and gauge their well-being.

Red Tegu photo by Savage Leigh





Lighting for Herps

Proper lighting is essential to sound herpetoculture. Visible light is so integral to herps' circadian rhythms (daily cycles) that many lizards, frogs, and tuatara have a parietal eye on top of their head that senses light. Salamanders possess a similar, though less developed, parapineal gland. As such, visible light in herp enclosures should be regular, timed, and incorporate astronomic adjustments to keep the photoperiod similar to the changing length of daylight times throughout the year.

We also know that many herps can see the next shorter set of light wavelengths than are visible to our eyes, called ultraviolet A [UVA]. In the wild, this ability probably provides a variety of benefits such as being able to quickly identify conspecifics (others of the same species) from a distance. The iconic dewlaps that anoles display appear pretty to us, but other anoles see them more vividly as if someone was turning a neon light on and off. In captivity, UVA rays have been shown to promote healthy feeding responses and foster other desired behaviors.

When purchasing lighting equipment, be aware that lamps claiming to produce "UV light" or be "full-spectrum" may only refer to UVA. You will need one that also generates ultraviolet B [UVB] radiation, as that is an even shorter wavelength that serves another vital purpose. Verify that UVB is specified on the packaging.

Vitamin D is sometimes called the "sunshine vitamin." Without getting overly technical, that is because UVB rays, available from the sun, foster the production of vitamin D in many animals. Reptiles need vitamin D3 in their diet to effectively absorb dietary calcium. The best source is, of course, natural sunlight. While offering D3 as a dietary supplement has also shown some efficacy, serious herpetoculturalists provide UVB light to their animals to facilitate this critical natural process.

UV light (both UVA and UVB) can be produced in a variety of ways. Most commonly, herp keepers provide indoor reptiles with commercially available bulbs with wavelengths optimized for use with herps. These come in a dizzying array of options, but it mostly comes down to high or low output (for desert or tropical animals) produced by fluorescent or incandescent bulbs. If a fluores-

cent lamp is used, a separate light fixture must also be used to generate a temperature gradient, as the heat output of fluorescents is negligible. While there are enclosure configurations that make multiple light and heat sources desirable, many keepers prefer to produce light, heat, UVA, and UVB all with one lamp. Fortunately, this is available in the form of self-ballasted mercury vapor bulbs, which are sold in a variety of wattages to provide the desired output to meet the needs of the animal and enclosure.

Brown Anole photo by Ianaré CC BY-SA 3.0



If you are going to keep herps—especially if you are going to keep a turtle, tortoise, or diurnal (daytime active) lizard—it is *mandatory* that you become familiar with these products and follow the manufacturer's instructions regarding useful life and replacement timeframes. Bulbs will produce visible light even after they have stopped producing ultraviolet light, so you must replace them periodically (typically 6 or 12 months). Some keepers also purchase UV meters so they can periodically measure their lamps.

While some herps seem to survive without special lighting, many will develop life-threatening illnesses if not provided with vitamin D3 or the means to produce it. This is a critical part of keeping these animals and should never be overlooked.

Parietal Eye (Green Anole) photo by Wesley Shoop



While UV light is commonly thought of as being for turtles and diurnal lizards (and should be provided to them daily), further research indicates that many, if not all, herps may benefit from both UVA and UVB wavelengths.



Proper Enclosures

Reptiles and amphibians are incredibly diverse. Their caging should reflect this diversity. Glass enclosures are popular because of their ready availability, ease of maintenance, reasonable cost, and the ability to view the animal. When correctly set up, these can be quite suitable for smaller species. Some species need larger spaces than stock aquaria can accommodate. For these, there are several screened-in enclosures available from various manufacturers or custom options ranging from durable plastic to fine furniture type enclosures made to be the centerpiece of your living room.



Honduran Milksnake photo by Tim Spuckler

Many keepers build their own when it comes time for a larger setup, but one must be very careful not to incorporate potential dangers into the project (e.g., bare bulbs, electrical connections near water, gaps that could trap toes or limbs, sharp edges, etc.). It should be noted that wood is more difficult to clean and sterilize than non-porous products such as glass or plastic. Many people put off buying larger enclosures because of budgetary concerns, but there are always affordable options for those willing to think outside the box. Examples of these include ready-to-assemble chicken coops that could be made suitable for many lizards or plastic horse troughs for aquatic turtles. Some of these may not seem as presentable as fancy custom caging, but they can serve their purpose without breaking the bank. Some people even

make tortoise pens by buying bookcases at an office supply store, and then laying them on their back (sans shelving) and adding substrate.

Many reptiles will benefit from outdoor enclosures where they can receive natural sunlight. Depending on your climate zone, this may be feasible only during the day or during certain seasons. Even if a permanent enclosure is not an option, it is nice to have some way for them to at least go outside occasionally. The most significant danger in the outdoors is, ironically, the sun you are bringing them out to absorb. Never leave an animal in a glass or clear plastic enclosure outdoors, and make sure that they always have shade available or fatal hyperthermia is sure to result. The next big concern is predators, both large and small. When predator-proofing enclosures, you'll have to consider everything from domestic animals, birds of prey, and carnivorous mammals, all the way down to insects such as ants or hornets. An outdoor enclosure should essentially either be "bomb-proof" or continually supervised. Challenges aside, natural sunlight and being outdoors provide many benefits, so if you cannot provide an outdoor enclosure, you might at least consider sitting outside with your animal for an hour or so each week to give them a chance to be in the sun.

Although minimum cage requirements vary by species, the idea is that the animal needs space to move around, thermoregulate, and use multiple hiding places. It is much easier to provide all these things—particularly the necessary gradients of heat, light, humidity—in a larger enclosure. For all but the smallest species, 48" L x 24" W x 24" H (122 cm x 61 cm x 61 cm) should be considered the minimum practical size to provide the necessary space for the animal, furniture, and gradients. Many species will need even bigger enclosures. For arboreal species, height is usually more important than floor space, and gradients can be vertical as well as horizontal.

Don't forget to buy a book about your species, as it will contain in-depth information about housing requirements. Do not just choose a setup because of what a pet store employee or someone on the internet tells you. It is essential to do your own research!



Russian Tortoise photo by Savage Leigh

A surprising number of herps, particularly tortoises, will take advantage of a snuggly spot, such as a cat bed, if offered. Try making diverse types of sleeping and basking sites available and watch to see what your animal prefers.



Community Enclosures (Cohabitation)

Having more than one animal in a single enclosure (cohabiting) should not be done thoughtlessly. It is possible to find plenty of examples of exhibits and private collections where multiple animals of the same species (and sometimes mixed species) live in harmony. On the other hand, at L.E.A.R.N., we have taken in numerous animals over the years that have been injured by tankmates.

Cohabitation is a very controversial topic in the herp community, and there does not seem to be one clear answer. Some people vehemently protest that housing multiple animals together is a risk without benefit and should never be done. Others seem to feel like it is rarely a big deal and advise not to worry about it. As with most things, the truth is somewhere in the middle, but knowing where to draw the line takes research and an intimate familiarity with the individual animals in question.

The risks of cohabitation include injury or death of the animals, subordinate animals being denied access to resources such as food and basking sites, and overall stress that can weaken the immune system and invite illnesses. The potential benefit held out by proponents of cohabitation is the possibility of the enrichment provided by having another animal to interact with. Although studies are scant in this area of natural history, we know that some species do socialize to different extents in the wild. This could mean that offering these interactions in captivity may be of psychological benefit. Regardless, cohabiting should not be done merely to save the expense or labor of maintaining multiple enclosures, and the decision to do so should be based on more than a pet store employee telling you that “they should be fine.”

Many or most species found in the pet trade make poor candidates for cohabitation, including any species known to eat other herps in the wild. Furthermore, there have been numerous observations of species that rarely interact in the wild developing problems with each other in captivity, particularly when there is competition for re-

sources and during feeding times. It should also be noted that even among species that seem to interact safely under some circumstances, there are pairings that are best avoided. These include housing a single male and female together (often resulting in the female being pursued continuously and possibly bred too often), housing differently-sized animals together (larger specimens are much



more likely to kill or injure smaller animals), housing two territorial males together (males of many species, such as anoles, are known to respond to presence of other males as an intrusion). Even herbivores may attack each other if they feel another animal is invading their space.

Although there are groupings that typically take place without issue (e.g., ribbonsnakes, many small frogs and geckos, mixed species enclosures of similarly-sized insectivores, many aquatic turtles, etc.), mishaps can occur in any community. It is best to enter into any cohabitation very carefully and thoughtfully after diligent research. Managing communities requires attentive observation, and it is essential that excellent husbandry is being practiced to mitigate issues from competition. Especially if you have never kept herps before, it may be better to start by erring on the side of caution until you gain more experience or have the guidance of an accomplished keeper.

Only certain carefully selected animals may be suitable for living in an enclosure with other animals. Maintaining a community enclosure should only be done with great care and a thorough knowledge of good husbandry.



Eastern Copperheads photo by Chris Inns



The Importance of Hiding Places

Although often overlooked, hides are an integral part of herp husbandry. In the wild, being able to hide from predators is extremely important. In captivity, our job is to provide the animal with the things it needs to feel as comfortable as possible. A very few species may seem unconcerned with them, quite a few species will use them almost all the time, and others will use them periodically when they feel the need (such as when sleeping, or if there are new and unexpected sights and sounds

individuals may use hiding places extensively until they become accustomed to their new surroundings. It is important to give them as much time as they need to feel comfortable coming out on their own. Try to resist the temptation to repeatedly lift their hide to view them, as this can undermine the animal's sense of security.

As to type and location—your animal should have the ability to hide on the warm or cool side of her enclosure. Some animals will prioritize hiding over health and will stay in a hide even if they are too hot or too cold. Having multiple hides will enable them to feel secure and still maintain the proper temperature regulation that is so integral to their metabolism. Another option that should be available to many species is moist hides. In nature, animals from arid climes typically utilize humid microhabitats to minimize moisture loss, facilitate shedding, and for other reasons. This is so important that some species (e.g., Leopard Geckos) will have bad sheds and even lose claws or toes without a humid place to retreat to. Corn snakes, ball pythons, and many other common captives benefit significantly from moist hides. Unless you have an animal known to have health issues caused by high humidity (e.g., Trans-pecos Ratsnakes), it may be wise to offer a moist hide. This can be as utilitarian as a plastic food storage container with a hole cut in the lid, or you can purchase decorative cage furnishings designed for this purpose. Either way, you simply put material in it that is safe for the animal and retains moisture. Some people use paper towels, but these dry out very quickly. At L.E.A.R.N., we use New Zealand Long Fiber Sphagnum Moss (available at pet stores or online), which holds 21 times its weight in water and has natural antimicrobial properties. Hides with this moss (soaked and then gently wrung out until it is not dripping) can retain humidity throughout the week without being tended to daily.

Research the various products and methods for providing your animal places to hide, and offer them multiple options!



Spotted Tree Monitor photo by Chad M. Lane

around). Your animal should have multiple hides that serve different purposes and are easy to get in and out of, but that are not overly roomy, as many animals feel more secure in a hide that does not have a lot of empty space.

As with temperature and humidity gradients, having hides available in multiple zones is important for your animal's well-being. Particularly when an animal first arrives in an unfamiliar environment, she is likely to be afraid of all the new sights and sounds. She may feel in danger of getting eaten at any moment, and particularly so if in a glass enclosure. Having an escape from all that stimulation will profoundly improve her feelings of safety and security. This is important because stress weakens the immune system and can cause problems such as not eating, exhibiting defensive behavior, and other issues, such as abrasions from repetitive escape attempts. Some



Storr's Monitor photo by Chad M. Lane

Being able to view an animal should never take precedence over an animal feeling secure. Even in nature centers, animals should be provided hiding places. If an animals' hiding is an issue for visitors, another species should be sought that is more comfortable being exposed.



Variety is the Spice of Life!

Most reptiles and amphibians eat a variety of food in the wild. Although some herps have specialized diets, such as Northern Scarletsnakes which eat primarily reptile eggs or Western Mudsnakes which may only usually eat one or two types of salamanders, many more are opportunistic and may eat hundreds of different plants or animal species throughout the year. Consuming such a variety serves to prevent vitamin and mineral deficiencies, as elements that may be lacking from one food are often found in others. The host of dietary illnesses seen with captive herps, such as hyper- or hypo-calcemia (MBD), hypovitaminosis A, and others are virtually unheard of in their wild counterparts.

How does one prevent these issues? First, by following the advice of your herp veterinarian, the book (I trust) you purchased about your animal's care, and the tips in other bulletins in this section! If your animal is a specialist feeder, the natural solution is to provide it the diet it is adapted to in the wild. While some keepers propagate information about how to transition captive animals over to food that are easier for keepers to provide (e.g., scenting mice with other animal smells), this practice should be recognized as suboptimal.

It seems almost self-apparent that species which are adapted to specific diets in the wild should be provided those diets in captivity. Conversely, animals which would naturally consume a wide variety of plants and animals in the wild should be provided with a wide variety of foods in captivity, and those foods should approximate the types of organisms that would be available to the animal in the wild.

If your animal is a generalist, it is hardly feasible to offer the same range of items that the animal would have encountered if foraging naturally, but variety should be the watchword, nonetheless. It can be easy to get into

"feeding ruts," such as feeding only kale to your tortoise or crickets to your insectivore. Furthermore, if you have adopted an animal that has only ever been fed one or two items, it may be challenging to broaden their horizons. In either event, it is worth the effort to experiment around with different suitable foods and provide as many of them as your herp will consume.



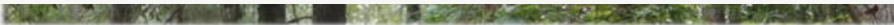
Western Hog-nosed Snake photo by Chad M. Lane

This doesn't have to be difficult. For herbivores and omnivores, If you usually shop at the same store, you could drop by a local grocer or a farmer's market from time to time. For omnivores and carnivores, it is easy to shop online for more types of vertebrates and insects than can be found in local pet stores.

Some people even collect wild food items. This can be a great way to offer variety if you do your research first. Bear in mind that some plants are toxic and be extremely careful not to introduce pesticides or other toxins to your animal.

Once you make providing variety a habit, you'll likely find that it is as easy to do as your previous routine, and it will feel rewarding to know you are going that extra step to ensure your animal's health and happiness!

Most captive herps will benefit from dietary supplementation in the form of trace vitamins and minerals added to their diet. Supplements are readily available from pet suppliers. Be careful to do your research and talk to your vet, though—it is just as bad to overdose on some vitamins as it is not to have enough!



Spiny Soft-shelled Turtle photo by Daniel Thompson





Invertebrate Feeders

Considering how many reptiles and amphibians are either strict insectivores or consume insects as a portion of their diet, it is probably wise to know a bit about sourcing, raising, and caring for a variety of invertebrates. For those with neither the time nor desire to raise insects themselves, numerous suppliers can ship several species of great feeders. Others raise some or all of their feeders, either from a desire to produce readily-available, nutritious food or simply from an enjoyment of entomology.

Green Anole photo by Eddie Ledbetter



Each has its pros and cons, and what you choose to do will be based on your personal situation. Even if you do not breed your feeders, you should research their care to ensure you are offering healthy food to your animals.

The insects most commonly sold and bred in herpetoculture are crickets, various darkling beetles (mealworms, superworms, mini-mealworms), various roaches (Dubias, Hissing Cockroaches), Black Soldier Fly larvae (also called Phoenix Worms, Calciworms, Reptiworms), earthworms (not red wigglers, which can be mildly toxic), fruit flies (usually flightless), and Wax Moth larvae (waxworms). Less commonly seen are silkworms, Chilean Moth larvae (butter worms), and Five-spotted Hawk Moth larvae (hornworms). Of these, the roaches, beetles, and earth-

worms are generally the easiest to culture. It is possible to raise crickets, fruit flies, or other feeders, but many shy away from those for reasons such as smell or complexity. Many devoted keepers also wild-harvest various insects, although some choose not to out of concern over pesticides, internal parasites, or because some insects are toxic. Although there are more risks with wild feeders than with captive-raised, they do offer variety for those willing to do some research and exercise caution.

If you have the time and interest, raising your own feeders can be a rewarding undertaking. Although the colonies may take some maintenance, you'll have fewer trips to the store for insects and have healthy food readily available for your animals. As you might expect from their prolific presence in the world, roaches are easy to raise. Many people raise Dubia roaches because they readily reproduce in captivity and they are unable to climb slick surfaces, which makes keeping them in glass aquaria convenient. Some people also keep "cleaner" insects, such as isopods (pillbugs), springtails, and mini-mealworms in their vivariums or their roach bins. These critters can function as a cleaning crew and also serve as an occasional food source. Look into ways of culturing various insects to decide whether this do-it-yourself option is right for you.

If you have an amphibian or an insectivorous reptile, take some time to familiarize yourself with the variety of food insects available. A diet consisting of only one type of insect can lead to nutritional deficiencies. This is often seen when crickets, which do not sequester calcium, are offered as a staple food with no supplementation. Many insects may be "gut-loaded" by being offered high-quality food or dusted with supplements before being offered to your animal to convey as much nutrition as possible. Whether you choose to order, raise, or collect your feeders—providing your herp with a variety of nutritious food is an integral part of keeping them healthy and happy!

Five-lined Skink photo by Daniel Thompson



Whatever insects you feed your animals, make sure they are healthy and have been fed a nutritious diet. Many keepers "dust" feeder insects (especially crickets) with calcium or other supplements before feeding them to their animals. Ask your veterinarian what vitamins or minerals are best for your pet.



Transporting Animals

Transporting your animal is potentially one of the most dangerous activities you and your pet will engage in. Assuming you have your enclosure safe, your husbandry right, and take care not to let your cat and lizard get into a fight—transportation may top the list of ways things can go horribly wrong. We at L.E.A.R.N. have been transporting rescued animals for many years and have had to develop several guidelines during that time. Hopefully, these will benefit you, as well.

Probably the first thing to remember is that even if your animal is calm and laid back when you have her out of her enclosure at home, this does not mean that she will be calm when she is going over bumps and seeing the world whiz by. Maybe she will be calm and maybe she won't. What you don't want to do is have her loose with you in the car and find out that she is terrified as she scrambles under your brake pedal. Play it safe ahead of time and transport your animal in a secure enclosure, preferably in a dark or covered container to reduce the chance of stressful visual over-stimulation.

When transporting reptiles or invertebrates, we use an appropriately-sized opaque or translucent plastic bin with air holes and a securely-closing lid. We line the bottom of the bin with paper towels or shredded aspen, depending on the species, which acts not only as litter but also something to hide under. For amphibians, we use moistened towels or sphagnum moss so the animal does not get too dry. For animals with claws, do not use terrycloth or other materials that could catch on a claw and cause injury. We find a place in the vehicle for the container somewhere that the animal will not be thrown about in the event of a sudden stop (e.g., the back floor-board). For birds, we use a small cage with a fabric cover. While in motion, it is best not to have any items in the container with the animal, as these might become projectiles in the event of an accident or sudden stop. A water dish may not seem to weigh much, but if it bounces up and down on your lizard's foot, it could easily break a bone. If an extended trip makes food or water necessary, we offer these items while parked.

This should go without saying, but do not leave an animal in a vehicle during the daytime. Even when the air temperature outside is moderate, the inside of a car or truck can reach dangerous temperatures quickly, and ectotherms will die immediately upon reaching certain critical temps. Likewise, if transporting multiple animals, make a list and go over it once you reach your destination to make sure everyone is accounted for and not forgotten in the back seat.



Alligator Snapping Turtle photo by Micha Petty

If your animal should get out of your control, use an abundance of caution while trying to locate them. You would not want to discover that you squished your animal as you slid furniture around in your search. In vehicles, do not slide seats back and forth to get a better view unless you are positive the animal is not in the mechanism. If you must transfer an animal to a different container for any reason while on your journey, do so inside the vehicle with the doors and windows closed to eliminate any chance of the animal becoming loose in the environment.

Expect the unexpected if you need to travel with an animal. Bring your health records with you, especially if the trip is to the veterinarian. Most injuries (and illnesses) are preventable—an abundance of caution should keep things from going awry.

Living with our animals every day and knowing their behavior can cause us to not foresee how they will react to a new environment. Plan ahead with the idea that they will act stressed or scared so that you are not caught unawares.

The goal is to get everyone back home safely!

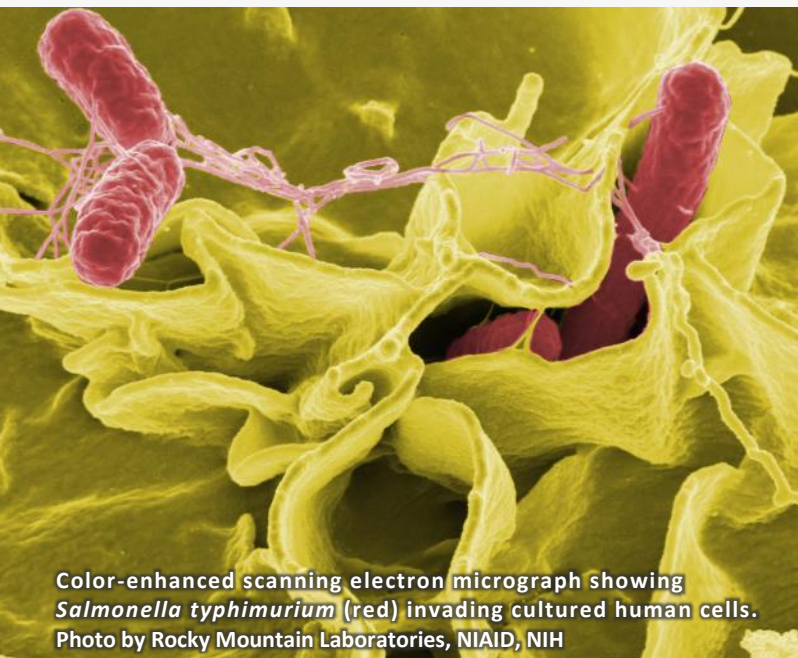


Bearded Dragons photo by Steve Jurvetson CC BY 2.0



Cleanliness is Crucial

Washing your hands after handling any animal is very important. According to the [Centers for Disease Control](#), “Every year, tens of thousands of Americans will get sick from diseases spread between animals and people. These are known as zoonotic diseases. Zoonotic means infectious diseases that are spread between animals and people.” Animals may carry many zoonotic diseases without appearing ill and your hands may have germs on them



Color-enhanced scanning electron micrograph showing *Salmonella typhimurium* (red) invading cultured human cells. Photo by Rocky Mountain Laboratories, NIAID, NIH

even if they look clean. Whether you touch a family pet, livestock, or wildlife—washing with soap and water afterward is always the best practice. Also according to the CDC, “Keeping hands clean is one of the most important steps we can take to avoid getting sick and spreading germs to others. Many diseases and conditions are spread by not washing hands with soap and clean, running water.” This should be done as often as necessary. I wash my hands after every task when working at the rescue facility. This not only helps prevent any zoonotic disease transference, but it also helps prevent the spread of microorganisms from animal to animal. I used to wonder if I washed my hands too frequently until one time when

I brought a tortoise that I had been working with for months to see a veterinarian, and she missed work for several days afterward because of salmonella-like symptoms. That was enough to confirm to me that all the soap I had been using was well worth it.

It is also vital to keep your animals’ enclosures as clean as possible. In the wild, animals may harbor various germs or internal parasites that do not appear to be causing them harm. One factor that may contribute to this is that when they eat or eliminate waste, they may move away from the area. Another factor may be that natural processes, such as ultraviolet light from sunshine, play a part in neutralizing germs. In captivity, these organisms may build up and become a “super-infestation”—even if you cannot see them. This is because an enclosed environment, especially one containing uneaten food or animal waste, may allow these pathogens and parasites to multiply to the point where your animal’s health may be put at risk. Clean enclosures are essential for more than just the sake of appearances.

Make a habit of keeping your hands and your animals’ enclosures clean. This is one of the best ways to prevent the spread or worsening of disease for you, your guests, and your animals. While this may not be new information, many people overlook the importance of tasks like handwashing or do it infrequently or improperly.

How should you wash your hands? (Source: [CDC](#))

- **Wet your hands with clean, running water (warm or cold), turn off the tap, and apply soap.**
- **Lather your hands by rubbing them together with the soap. Be sure to lather the backs of your hands, between your fingers, and under your nails.**
- **Scrub your hands for at least 20 seconds. Need a timer? Hum the “Happy Birthday” song from beginning to end twice.**
- **Rinse your hands well under clean, running water.**
- **Dry your hands using a clean towel or air dry them.**



Clean hands photo by Arlington County CC BY-SA 2.0

Pay attention to cleanliness and make it part of your everyday routine. This is a critical part of keeping everyone healthy—including yourself!



Choosing the Right Veterinarian

Herps should receive veterinary examinations just like any other animal, and it is worth the effort to select a veterinarian that has experience with their unique needs. Although it is legal for your neighborhood veterinarian to treat reptiles or amphibians, the decision regarding which provider to use should be based on much more than proximity.

Unfortunately, it may be difficult to locate a vet that is willing to see exotic animals, and finding one that is familiar with their husbandry, maladies, and medications is even harder. This is understandable, as zoological medicine is not core curriculum for veterinary students. L.E.A.R.N. presents herps for labs at a nearby veterinary college, but an hour-long presentation cannot begin to prepare these students to treat these animals, and many vets may become licensed with no exposure to herps.

More than a few times, well meaning dog-and-cat vets have attempted to help herps and ended up unintentionally doing them harm, due to their very different physiology and metabolisms. This is just one of the reasons why it is important to seek out the right practitioner. One way to do this is to search for a provider on the Association of Reptilian and Amphibian Veterinarians' website at arav.org. Even if the nearest one is a considerable distance, it is worth the trip. These practitioners have devoted a substantial amount of time to become proficient in the diagnosis and treatment of herps and will be familiar with recent advances in this field.

If an ARAV vet is not accessible, at least seek out a provider who has practical experience with their treatment. Many things we believed about these animals not long ago have been discovered to be in error, and you want someone familiar with recent research and practices. You may be able to ask your nearest ARAV vet for a referral.

Providers also need a familiarity with the appropriate formularies; when to (and not to) use medications is very important. Reptile medicine has come a long way from the "give them antibiotics and hope for the best" line of thinking that used to be commonplace.

Additionally, many (if not most) herp maladies are rooted in improper husbandry, so your animal deserves to see someone who knows what to look for and how to advise you on improving your animal's care at home.

At a minimum or in an emergency, if the only vet you can reach is one with no herpetological knowledge, at



Red-eared Slider photo by Micha Petty

least inquire whether they have access to appropriate resources for consultation (e.g., VIN.com). Tell them you are willing to pay for the additional time this may entail and that you want the best care possible for your animal.

Start seeking an appropriate provider now. Don't wait for an emergency. It may take time to locate the best provider, so it is never too soon to identify one (or two!) and develop a relationship. The old saying that "an ounce of prevention is worth a pound of cure" may never have been more accurate than it is for zoological medicine.

Tragically, we still live in a world where people may buy a reptile or amphibian on a whim and then be unwilling to pay more for its care than the cost of a replacement animal. Such thinking is, of course, inhumane and unacceptable. Medical services cost money, so plan for these routine and emergency expenses. Resolve to get your animal the examinations and care that it deserves.

When selecting a care provider for reptiles and amphibians, it is important to seek out a practitioner with training and experience with their unique husbandry and treatment requirements. Such providers may require some effort to locate or time to get to, but it is time well spent!



Leopard Gecko photo by FL Fish and Wildlife CC BY-ND 2.0



Consider Rescue!

It occurs to many people that they should find a rescue dog or cat when they decide they want a furry pet. Unfortunately, that same thinking rarely extends to reptiles. There may or may not be an exotic pet rescue in your area. If there is, the chances are that they are very much in need of good adoptive homes. At L.E.A.R.N., our biggest challenge after funding is getting animals adopted out to good homes, for several reasons.

Leopard Gecko CC0



First, it is a challenge getting people to think about a rescue pet instead of buying a herp on a whim. Generally, we must continually campaign to raise awareness of adoption as an option. Once we do receive an application, setting even minimum standards for adoption homes weeds out most applicants. Many people have neither the willingness nor resources to set up a proper habitat for an exotic pet. We do not hesitate to advise those folks against adopting or buying a reptile or amphibian. However, since pet stores typically sell herps to anyone with a few bucks, regardless of their skill level or abilities, that advice often goes unheeded.

Other people sound like they already have more animals than they can adequately care for. Still others make it pretty apparent that they are just looking for a free pet and are likely to sell it as soon as it becomes a hassle. Many fill out an application in the same way they would

type a text—with no capitalization or punctuation and with multiple misspelled words and abbreviations. While that is not proof by itself that a home is unsuitable, lacking the ability to write coherent sentences is cause for concern that the applicant may also have poor reading comprehension: a definite handicap when one wishes to care for an ectothermic animal.

Admittedly, sometimes the fault belongs in part to the rescue. At L.E.A.R.N., we sometimes get caught up in all the things we have to do to keep the shelter running and funded. What little time we find to catch up on emails can get eaten up with business matters that cannot be delayed. Consequently, applicants that may have been otherwise suitable may fall through the cracks. It is okay to politely follow-up on an application. We consider someone willing to follow-up as a sign of a responsible person and encourage it. Rescues near you may feel differently; you might ask to find out whether they also appreciate reminders when you submit your application.

If you have done your research, are still interested in an exotic pet, and are kind enough to consider giving a home to one in need, the next challenge is locating a rescue. One way to do that is to browse RescueMe! for posts in the appropriate state and category, or you can browse through the listings of rescues in your state. You can also do an internet search for reptile rescues, which should either point you to one or at least turn up more lists of rescues to sort through.

It pays to do a little research on the organization before deciding to adopt. Unfortunately, there have been occasions where some individuals have had a “side business” of “rescuing” animals and then turning around and listing them for a “re-homing fee” without providing any needed care in the interim. You don’t want to facilitate that. However, rescues are usually kind people trying to help. You can assist them with their work by being willing to adopt, by being patient with them if they are slow to respond, and by hopefully leaving a donation, even if they didn’t ask for one. Not only will you “save” the animal you bring home—the enclosure you free up at the rescue can then be used to save another!

Green Tree Python CC0



Herp rescues are not government funded and rely entirely on the funds of the people involved, combined with whatever donations they are fortunate enough to receive. Even if you can’t adopt a pet—donate to a local rescue!

Part VIII

Lagniappe

(a little something extra)

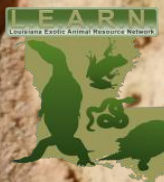


Saltwater Crocodile photo by Bernard Dupont

**YOU SHARE YOUR HOME WITH
SOME PRETTY COOL CRITTERS.
STOP AND GET TO KNOW THEM!**



Green Anole photo by Micha Petty



Becoming a Herp Vet with Sean M. Perry, DVM

Becoming a reptile veterinarian is an arduous process, but for those who love scaly critters, it can be well-worth the effort! The first hurdle is gaining admission to a veterinary school, which is no easy task, as it is one of the most difficult professional educational programs in which to be allowed entry. Earning admission to a veterinary school usually entails completing prerequisite coursework (such as Biology, Chemistry, Biochemistry, Physics, Genetics, etc.); sitting for the graduate record examination; gaining extensive, diverse animal experience; supplying letters of reference; and other various supplementals. Find out more about admission requirements at aavmc.org.



Snake examination photo by Holmes Palacios CC BY 2.0

Imagine drinking from a fire hydrant that's gushing water—this is how a veterinary school can feel. Curricula vary, but if you gain admission, you will most likely spend your first three years focusing on four major groups: canine, feline, bovine, and equid (dogs, cats, cows, and horses, respectively). You will learn a lot about these animals, studying disciplines such as anatomy, physiology, pathology, immunology, nutrition, toxicology, microbiology, etc. Traditionally, year four focuses on the clinical application of your learned skills. While on clinics, you are required to sit for a national board examination to demonstrate the knowledge you have gained, and this allows you to become eligible to obtain your veterinary license after graduating (each state may also administer additional testing). Once you graduate and pass boards, you are eligible to begin practicing on every species other than humans.

Are most veterinarians ready to practice on herps at this point? Not really, because little is taught about the world's nearly 18,000 species of reptiles and amphibians in veterinary school and their anatomy and physiology are drastically different than that of the mammals you

just spent years studying. As a recently graduated veterinarian, now is your chance to really follow your passion for these other thousands of animals.

So how does a veterinarian become more educated in reptile and amphibian medicine? Many successful veterinarians never undergo any specific specialty training other than continuing education. Many vets that see exotics learn from textbooks that they purchase themselves, and they combine that with the guidance of their peers and hands-on experience. However, it became apparent that more formal training offerings were needed, so the Association of Reptile and Amphibian Veterinarians was founded. The ARAV is the first herpetological medical society, and it allows veterinarians to be involved in furthering the veterinary care of captive and wild reptiles and amphibians. Additionally, the organization offers a yearly conference for all veterinarians to attend with hands-on wet labs, masterclasses, and original research presentations, so veterinarians can receive continuing education credit and develop new skills.

Currently, there are three organizations that certify or test expertise in reptile and amphibian medicine where you can be called a specialist: the American Board of Veterinary Practitioners with their Reptile and Amphibian specialty (ABVP R/A), the European College of Zoological Medicine specialty in Herpetological Medicine (Herpetology), and the American College of Zoological Medicine (ACZM). Each organization allows you to become a specialist either by enduring a residency training program or through an experiential route. Both options allow you to sit for a specialty examination to demonstrate your knowledge (the ACZM tests more than just reptiles) and become eligible for your credentials.

As a reptile and amphibian specialist, you become the point person for organizations seeking expertise, which may open new doors professionally with increased job opportunities and the potential to collaborate with individuals around the world. You may even find yourself in far-flung lands getting your hands dirty treating animals that most people have never seen! Becoming a herp vet is not for the faint of heart, but for a special kind of person, it can be a rewarding journey like none other.

For more information about reptile veterinarians, including how to locate a herp vet near you, visit the Association of Reptile and Amphibian Veterinarians' website at arav.org.

Becoming a Herpetologist with Dr. Andrew M. Durso & Dr. Lori Neuman-Lee

Job Requirements, Opportunities, and Roles in the Field of Herpetology											
Job	Examples	Degree			What the Job Entails						
		BS	MS	Ph.D.	Data Collection, Analysis, Publication	Classroom Teaching	Public Outreach	Writing Grants	Mentoring Students	Field Surveys	Land Management
College/University	Professor, Researcher, Instructor/Lecturer, Technician	Required	Optional ¹	Required ²	Almost always the leading role	Common	Common	Common	Common	Depends on the type of research	Very Rare to Never
Government or Private Company	Environmental Assessment, Park Ranger, Land Manager	Required	Recommended	Not Required	Common (often in a supporting role)	Rare	Common	Depends	Rare	Depends	Common
Zoo or Museum	Curator, Technician	Required	Recommended	Not Required	Depends (often in a supporting role)	Rare	Common	Uncommon	Rare	Rare	Rare
Non-Profit	The Nature Conservancy, The Orianne Society	Required	Recommended	Not Required	Depends (often in a supporting role)	Rare	Depends	Common	Rare	Depends	Common

1. Some people go straight from a BS to a PhD. 2. Many community college professors, university instructors, and research technicians have BS + MS but no PhD; they do not run their own research labs or directly mentor graduate students.

There are several fields of interest regarding reptiles and amphibians. Someone who manages or breeds captive herps is called a *herpetoculturist*. Those who casually observe or photograph herps in the field are called *field-herpers* (or just herpers). Someone who studies reptiles and amphibians and contributes to our scientific understanding of these creatures is a *herpetologist*. Many herpetoculturists and herpers become herpetologists when they collect and share original data that contribute to our understanding of the biology of these animals.

Not every person working as a herpetologist has formal training, although most do. In the past, it was easier to get a job based solely on practical experience or familiarity with a particular group of organisms. Today, you don't necessarily need formal training to contribute meaningfully to herpetology, but if you want to have a paid career working with reptiles and amphibians then you'll need at least a college degree in biology or a related field.

Herpetology is a sub-field of biology. It's rare to find a job that considers someone to be a herpetologist first, and you won't find someone who's only a herpetologist. All herpetologists are also biologists; a herpetological emphasis comes from the specific interest of the biologist. So, you won't find any place that offers a degree in herpetology. Instead, most herpetologists have a bachelor's degree in biology or a related field (e.g., wildlife, ecology), which requires coursework in biology, chemis-

try, physics, calculus, statistics, and increasingly in writing and computer programming. Upper-level electives specific to your interests might include specific herpetology classes, as well as ecology, anatomy, physiology, behavior, geography, biochemistry, genetics, or systematics.

To be paid to teach or do research, you also need a graduate degree (Masters or Ph.D.). The emphasis is less on the coursework and more on your original thesis or dissertation research project, the subject of which you decide. You gain skills as you need them and have a close, personal working relationship with a committee of advisors who help with your project. You may teach courses, and you will probably be paid a stipend or get a tuition waiver for doing so.

Ways to prepare for a career in herpetology:

- Join, attend meetings, and develop relationships with the members of state herpetological societies or Partners in Amphibian and Reptile Conservation (PARC).
- Take science courses whenever possible.
- Read books and scientific journal articles, especially herpetological journals such as *Journal of Herpetology*, *Herpetological Review*, *Copeia*, or *Herpetologica*.
- Volunteer to help care for a collection of captive herps at a museum, zoo, or nature center.
- Volunteer to do educational outreach programs about herps in the community.
- Volunteer to help a college faculty member with research interests in herpetology.
- Submit observations of herps you see in the wild to HerpMapper.org and iNaturalist.

For more in-depth information, visit
bit.ly/herpetologist

Conducting Scientific Research with Dr. Andrew M. Durso

Although all of us interact with our environment and form opinions about the natural world, biologists take this a step further by using the scientific method to separate fact from fiction. Questions about the natural world continually arise during fieldwork or laboratory observations, as well as from existing publications and discussions with the public or other scientists. When these questions appear to warrant further investigation, biologists follow specific steps to seek answers.



Research in progress photo by Sandy Durso

The first step, once a question has been identified, is to form suppositions as to the likely answer (hypotheses). Scientists then envision what tests might be performed to disprove these suppositions. If completed tests fail to disprove a hypothesis, the results are considered supporting evidence, but scientists are careful not to refer to hypotheses as “proven” because future experiments might find another way to disprove their suppositions. They perform these tests and, depending on the results, adapt their approach to delve further with additional testing. Once they have results, they draw conclusions, identify further needed research, and share their findings with their peers. Other scientists then review the methods used and conclusions drawn, and their research is (hopefully) published in a journal. This process is how we develop trustworthy information about the world around us.

Research often begins by examining what others have done to gain more understanding and to verify that someone else has not already found the answer. What data already exist? What methods were used to gather this information? What tests were performed and what results were produced? This information typically comes from previous publications and discussions with other scientists. If questions remain, the next best step

is usually to collect a small amount of data or perform an initial trial (known as a pilot study) to determine better whether investing resources into additional research is warranted and feasible. This may be done in conjunction with experiments already underway, through computer models, through further analysis of existing data, or other methods. This pilot study then becomes the basis for a grant proposal to conduct a full study.

The next step—securing the funding for more thorough experimentation—can be tricky. Science generally doesn’t pay for itself; grants normally come from governments, universities, or private foundations. Scientific grants vary in size from a few hundred dollars to more than a million dollars. They are always awarded for specific projects, and the money goes to an institution (such as a university) rather than to an individual. These funds are necessary for items such as paying students and technicians to carry out the work, buying equipment and supplies, and paying for travel, food, and lodging while conducting fieldwork. Finding funding often requires several attempts over months or years, and most grant proposals are rejected. Once funding is approved, the next challenge is getting permits to perform your field or lab work from any applicable governing entities.

The actual research and experimentation may take months, years, or decades. Longer projects may need several rounds of funding. During this time, the grant proposal is the roadmap and should be adhered to unless new data indicate that changes are warranted. Research often takes longer than anticipated, either because it is difficult to predict what one might find, or simply because life happens: harsh weather, political changes, personal difficulties, etc.

Once collected, data are formatted, organized, summarized, graphed, and analyzed to make them easily accessible. Do the data rule out or support the original hypothesis? What conclusions do any unexpected results lead to? What uncertainties remain? Scientists often repeat and expand their research once the data are analyzed. These steps must all be performed before submitting the research for review (which we will discuss in the next bulletin). As you can see, this is a thorough, repeatable process that reliably expands our knowledge of the natural world and all of this is what separates science from anecdotal evidence and opinion.

Publishing Scientific Research with Dr. Andrew M. Durso

Once the lengthy process of researching scientific questions has been performed, the next step is to share the findings with the scientific community and the world at large. This always takes the form of a scientific research paper: a narrative of what question has been answered, what methods were used to collect the data, what experiments were performed, and what conclusions were drawn. This is placed in the context of what work had been completed previously and what future research might now be needed. This narrative is coupled with graphic representations of the data and is all summarized in an abstract. Together, this forms a research paper which is submitted to a scientific journal for review.

Scientific journals are peer-reviewed, making them more rigorous than non-peer-reviewed publications. At a peer-reviewed scientific journal, authors submit papers that contain original data that they have collected themselves, and the editors ask at least two independent scientists who are experts in that subject matter to review the paper and make any suggestions or criticisms they want. The editor, reviewers, and authors may go back and forth many times over the course of months making changes to a paper. Many papers are rejected, normally because the conclusions are weak or not novel, the authors and reviewers cannot agree, or the paper requires significant rewriting or condensing. Sometimes, the paper is simply a better fit at a different journal.

Examples of herp-oriented and peer-reviewed journals include *Herpetological Review*, *Copeia*, *Herpetologica*, and *Journal of Herpetology*. Most people have never heard of these journals, and you will not see them in a magazine rack at the grocery store. Their subscribers are typically biologists and universities who pay annual dues to receive each issue. More and more, scientific papers may be found online on sites like Google Scholar or JSTOR, which may allow full or limited access to the articles, but many are still inaccessible without a subscription. Regardless, these journals are the source of all published scientific findings.

The other category is non-peer-reviewed publications: traditionally meaning magazines such as *National Geographic*, *Scientific American*, or *Discover*. At these outlets, journalists write summaries of peer-reviewed articles and the editor usually reads and makes suggestions on the articles to improve appeal or readability. Television, newspapers, radio, and websites may redistribute scientific findings if they feel it will appeal to their audience. It

is a good idea to be cautious when someone with no scientific background attempts to interpret others' findings, though, as it is easy (some would say routine) for a great deal of accuracy to get lost in translation. If you look, you will often see a citation referencing the original paper, and those who understand the importance of peer-review are likely to be wary if such a citation is absent. Opinions and policies are best based on the actual research rather than someone else's presentation of those



Western Hog-nosed Snake photo by Sandy Durso

findings. Nonetheless, researchers generally consider themselves lucky if their work garners this type of interest; and it is certainly better for the public to be presented with plain-English renditions of noteworthy research than it is for papers to stay hidden among university bookshelves.

Research does not take place in a void. Scientific papers are part of a broader conversation wherein a researcher builds on what has come before and identifies what further work is needed, and this is much of their significance. "Facts" that do not stem from this slow, painstaking, established process should generally be viewed with skepticism, as they could be put forth to serve someone's interest rather than edify the world at large. In fact, many scientists and naturalists believe that policymakers' (and the public's) lack of familiarity with factual scientific data may be a large part of why civilization still exhibits so many unsound laws and practices. If you are intrigued by science, please consider either subscribing to a peer-reviewed journal in your field of interest or at least browsing the many papers that are already online. Though they may take a little getting used to, they are a fascinating source of trustworthy information that will help you develop a more intimate knowledge of the natural world.

Antivenom with Spencer Greene, MD, MS, FACEP, FACMT

The definitive treatment for snake envenomations is antivenom. Each snakebite victim should be assessed individually to determine if its use is indicated. First developed in the late 1800s, antivenom did not come into regular use until the mid-20th century. Antivenom is made by immunizing a host animal, e.g., sheep or horse, with venom components from one or more snake species. The antibodies produced by the host animal are then processed and made available for clinical use.

Many of the older antivenoms consisted of whole immunoglobulin molecules. Although these were capable of binding and neutralizing snake venom, side effects, including immediate and delayed hypersensitivity, were common. Wyeth Antivenin Crotalidae Polyvalent (ACP), an equine-derived product, was associated with acute reactions in up to 50% of patients, and serum sickness was observed in nearly every patient treated with 10 or more vials. Some physicians and snakebite victims often chose to withhold treatment, which they believed was worse than the bite itself.

Newer antivenoms are often processed in ways that decrease the incidence of adverse effects. The only FDA-approved antivenom for all U.S. pit vipers, Crotalidae Polyvalent Immune Fab Ovine (CroFab®), has been commercially available since 2000. It is made by immunizing different flocks of sheep with the venom of one of four crotalid species: Western Diamond-backed Rattlesnake (*Crotalus atrox*), Eastern Diamond-backed Rattlesnake (*C. adamanteus*), Mohave Rattlesnake (*C. scutulatus*) and the Northern Cottonmouth (*Agkistrodon piscivorus*). The antibodies collected from the sheep are then treated with papain to liberate the individual Fab fragments of the immunoglobulin molecule. Adverse reactions, which may include urticaria, bronchospasm, anaphylaxis, and serum sickness, are infrequent. In a meta-analysis of 11 studies, Schaeffer et al. (2012) reported an 8% incidence of acute adverse reac-

tions and 13% incidence of delayed effects, (e.g., serum sickness) following CroFab® use. Data from the North American Snakebite Registry indicated that only 2.3% of adults and 2.7% of children who received CroFab® had acute adverse reactions, including rash (0.9%), hypotension (0.9%) and bronchospasm (0.9%).

Another antivenom, Crotalidae Immune F(ab')₂ Equine (Anavip®) is indicated for the treatment of North American rattlesnake bites but is not currently on the market. It is made by immunizing horses with *Bothrops asper* and *Crotalus durissus* venom. The resultant antibodies are then treated with pepsin, yielding F(ab')₂ fragments. Worldwide, there are many other available antivenoms, including some that are specific for a single species and others that can be used for snakes from different genera or even different snake families. The composition, safety, price, and availability of these products may vary significantly.

Multiple factors determine when antivenom should be used. It is typically recommended if there is evidence of systemic toxicity (e.g., coagulopathy, thrombocytopenia, neurotoxicity), or if there is progressive local tissue damage. When there is no apparent systemic toxicity, and the tissue damage is mild and localized, it may be reasonable to withhold antivenom. Some antivenoms are expensive, and some victims and healthcare providers may choose to withhold treatment. Patients and their physicians should engage in shared decision making when the decision to treat or not treat is unclear.

Some patients and physicians mistakenly believe that once a patient is treated with antivenom, he or she may never receive it again because of the high likelihood of inducing an immune response. This is patently untrue. The decision to use or withhold antivenom should be made based on the current situation rather than on previous use or likelihood of sustaining another envenomation in the future.



Fer-de-lance photo by Armin Meier

Snakes, snakebite, and antivenom are all frequently-misunderstood topics, even among professionals. As such, it would be wise to identify a medical facility in your area with a knowledgeable toxicologist *before* the onset of an emergency.

Nature Photography with Sarah Phillips

Photography is an essential tool in reptile and amphibian education and conservation. Photographs can instantly provide a record of an animal's presence, appearance, coloration, and indications of its state of health. Photographic vouchers (sometimes combined with small tissue samples) provide some of the data that researchers would otherwise collect by capturing and preserving entire animals. Photographs are fantastic tools for teaching identification and as illustrations for works such as this primer. With herps facing so many pressures, documenting ranges and densities of wild species is more important than ever. Fortunately, the ready availability of cameras and citizen science databases now enables us to record and organize this information on a scale not feasible a generation ago.

You don't have to be a professional photographer or own the most expensive camera to take decent wildlife photos. You can increase your enjoyment of nature and contribute to scientific research with any decent camera phone. Honestly, most of the cameras out there can take pictures above the skill level of their users. Learning to use what you have is much more important than buying a device you aren't ready for. For most people, reading a book or taking a class on photography will be cheaper, more rewarding, and more productive than spending a lot of money on a high-end camera.

Since photography is essentially the capturing and recording of light waves as they reflect off matter, learning to utilize light is a key component to good shots. Taking pictures from a well-lit angle and keeping your shadow out of the shots will dramatically improve your efforts, as will paying attention to reducing glare (particularly with artificial lights such as headlamps or flashlights, which are useful at night). Remember that good photos are well-lit photos.

The next step is putting some thought into framing your shot by finding more engaging angles than merely standing over an animal and pointing your lens at the ground. Most herps appear far more interesting from a

"critter's eye view." Crouching or laying down is one way to do this. You could also try carrying a small tripod or simply placing your camera on the ground. Make sure you and the camera are correctly focused on the subject. Consider the surroundings and how they might contribute to (or detract from) the image as a whole. Remember that shots often look better if the subject is not right in the center every time. Instead of zooming in on your subject (which may cause distort-



American Crocodile photo by Marc Dubois

tion) try to get the camera closer if you can do so safely. Be aware that digital zoom is essentially just a way of cropping photos and generally does not increase the quality or clarity of the photo.

While there are times when handling an animal may be necessary for an accurate scientific identification, nature photos are usually not improved by having the animal in hand. Whenever possible, the best practice is to photograph animals *in situ* (as they are discovered). It is important to have your camera at the ready when you are outdoors, as you may only have a moment to capture a photo or video of interesting behaviors. Whenever possible, take several photos from multiple angles at the highest resolution your phone is capable of. You can cull and crop the images later—removing pixels is much easier than adding them back in!



Never compromise human or animal safety when viewing wildlife. Never approach an animal you cannot positively identify as harmless. Remember that moving with calm confidence will result in more cooperative subjects.



California Red-sided Gartersnake photo by Chad M Lane

Herp Education Through Social Media with Mike Van Valen

Despite some bad press and a few bad apples, social media is becoming an ever-more valuable tool to disseminate amphibian and reptile information. With the rise of formats such as Facebook groups, educators now can engage with local and global audiences from the comfort of their home. Professional herpetologists, zookeepers, educators, experienced field herpers, TV personalities, naturalists, and thousands of fascinated laypeople from all over the map log in daily to find education at their fingertips.



Gray Ratsnake photo by Nick Barys

Photo sharing websites such as Flickr and Photobucket expose us to species we would otherwise never see in our lifetime. Social media has raised awareness of conservation efforts close to home. Video hosting sites such as YouTube and Vimeo have become additional platforms for herp education. There are now hundreds, if not thousands, of herp-related channels covering everything from field herping to captive care. Herp conservation organizations are finding it easier than ever to promote their cause, raise money through crowdfunding or other platforms, and reach out to people in their local community through Twitter, Facebook, and a host of other websites.

Citizen science has also seen a rise in popularity. There

now exist several herpetological and wildlife databases where the average person can collect data on wild amphibians and reptiles, submit their observations, and have those data become available to professional biologists who use this information for study and conservation efforts. This form of social media is getting people outside, eager to explore and learn about the natural world around them. These efforts are of significant value to researchers, as they simply don't have the resources to perform the amount of data collection, analysis, or reporting made possible by millions of people with smartphones.

It is crucial for those using social media for herp education to maintain high-quality information. Just as with other forms of mass communication, sensational (often inaccurate) information spreads like wildfire, whereas educators must deliberately propagate sound offerings. This is especially true with animals such as snakes, as it seems everyone is quick to believe that they are sinister and aggressive. Try to focus on the groups that are well-moderated and have knowledgeable people taking part on a regular basis. Just because a group has the word reptile in the title does **not** mean that it contains accurate information.

The world's population is growing exponentially, and many ecosystems are already in decline. It behooves those of us who value our natural heritage to focus on "getting ahead of the curve" by identifying and participating in methods of mass communication that effectively change attitudes and behaviors regarding the environment. By all means, browse the web for fun sometimes, but also try to spend some time doing more. Seek out sound education for yourself, and then look for opportunities to share that newfound knowledge with others. The future of individual animals, populations, and entire species may depend on our gaining mastery of these digital tools. Decide today to be a part of the solution!



Eastern Copperhead photo by Justin Sokol

Joining educational groups is an excellent way to learn more about reptiles and amphibians. For example, as you see identification requests in your feed, you can pay attention to the answers and know for next time. Check out the "Additional Resources" bulletin in the appendix of this primer for links.

Herp-friendly Roadway Design & Maintenance

Roadside Maintenance: Gravel shoulders and in-slopes near lakes and wetlands are favorable nesting sites for some turtle species. Avoid grading road shoulders near lakes and wetlands during the spring and summer. • Turtles which are in imminent danger should be moved out of harm's way. Turtles which are not in danger should be left undisturbed. • Spot mow or spot spray invasive species instead of broadcasting herbicides. • Roadside mowing should be done infrequently. • Remove brush in the fall through early spring. • Install 'Turtle Crossing' signs. • Record casualties to indicate needed improvements.

Design & Construction: New road alignments should avoid bisecting wetlands or be bridged. • Poll maintenance personnel to identify wildlife hotspots for use in planning projects. • Roads should be kept to minimum standards on widths and lanes (this reduces road kills by slowing traffic and shortening exposure time). • Expect wildlife activity near wetlands and waterways. • Wildlife can get tangled in welded plastic mesh—use woven or non-welded mesh. • Exclusion fencing to prevent turtles from reaching the roadway may be the best option in areas where turtles have been known to cause traffic problems. • Culverts between wetland areas, or between wetlands and nesting areas, should be sized accordingly, with a minimum diameter of 36 inches for dry culverts and full bank-width diameter for culverts in perennially flowing waters. A flat-bottomed or arched culvert with the shortest possible length is preferred. • Silt fencing should be set up around construction areas to keep turtles out, especially during the nesting season. • Use biodegradable material in all components of erosion control blanket and fiber rolls that are to be left on site.

Fencing: Exclusionary fencing should be installed as needed on existing roads and incorporated into new construction. • Fencing should lead turtles to a nearby underpass, culvert or bridge. • Standard right-of-way chain-link fencing installed tight to the ground should be used at a minimum. • In areas where high wildlife casualties

are expected or observed, a tight-mesh, coated chain-link should be used to exclude the maximum number of species. • It is critical that the fence end-posts fit tightly to abutments or railings. • Fencing works best if it does not deflect animal movements by more than 60°. • Methods to allow animals off the roadway should be incorporated into exclusion designs. • For seasonal or temporary situations, install and maintain tightly-woven silt fencing, replace with permanent fencing when able.



Desert Box Turtle photo by Chad M. Lane

Passage Structures: Turtles use rivers and streams as travel corridors as well as for core habitat. • Many aquatic animals can pass under bridges while in the water; however, there are designs which can aid other species' movement along waterways. Incorporating a passage bench into riprap design is one cost-effective solution. • Where needed, an underpass of a proven design should be installed to allow animals to migrate past roads in safety. • Existing structures may be improved by economical modifications, such as filling in riprap with gravel, so turtles and other wildlife can pass safely.

Curbs & Gutters: Traditional curbs and gutters should be avoided, as these can trap wildlife such as turtles on the road or direct them into storm sewers, often with fatal results. • Areas near waterways and wetlands should have rural shoulders and vegetated swale road ditches. • If a curb and gutter storm-water system must be installed, it should be of a slanted type. • Where traditional curb and gutter must be installed, a design without the side box inlet gives the animals a better chance of moving past the storm sewer as they search for an exit route. A slanted gutter should be employed several feet on either side of the storm drain to allow animals to exit safely. • Storm-water ponds that discharge to natural areas should not have outlets that block turtle movement.

Governments have made great strides in reducing human fatalities on the road. Let's extend this consideration to wildlife. These are some tips to reduce the impact of habitat fragmentation.

Wildlife Rehabilitation

I'll be upfront with you—wildlife rehabilitation is not a gig any sane person would seek out. While there are a few centers that manage to get sufficient private grants or donations to keep the doors open, the vast majority of rehabbers are simply people wanting to help animals and that are willing to jump through a bunch of hurdles to do so legally. They spend time getting trained and spend their own money for supplies, medicines, and veterinary

fledglings that didn't need to be rescued. Now the mother can't be found, and the youngster is old enough to know not to take food from you and dies. You will have people tell you it is a waste of time and just to let nature take its course; people don't seem to grasp that animals being hit by cars or tangled in fishing line or attacked by cats is our fault and not natural. You'll want to get booster shots and carry a card in your wallet that instructs medical personnel to check you for rare zoonotic diseases. Even if everything is going well—wildlife rehabilitation is a lot of work and expense.

All you can do is spend whatever time and money you can spare and help as many as you can as best as you can. If you are soft-hearted (or soft-headed!) enough for this to sound appealing, you are certainly needed! L.E.A.R.N. is the only non-profit rescue in our state focused on herps, and one of only a handful of places with a licensed reptile or amphibian rehabilitator. Your area probably has a similar scarcity of resources for herps. There is no shortage of wildlife being affected by mankind's actions, but there is a shortage of people with the skills and willingness to help. You do not need to be a veterinarian (in fact, very few rehabbers are vets). You do need to have space and resources to devote to their care, and you will need to sweet-talk a vet into being willing to help you, and probably more than one.

If you've read all this and helping animals still sounds worthwhile to you—bless you! Please contact your state wildlife agency for an application, or contact the [IWRC](#) or the [NWRA](#) for more information. You can also contact L.E.A.R.N. if you need further guidance. For those special folks who just can't stand to see animals suffer, being a part of healing them up and seeing them head back out into their home in the wild is worth more than money or words. *Consider joining us!*



Micha treating a Three-toed Box Turtle photo by Joe Armstrong

care. The government does not pay rehabilitators. Most people want you to drive to come get animals and don't think to donate to help with gas or the costs you are taking on. You end up with animals that cannot be saved and need to be euthanized, which is emotional. You end up trying to save some with guarded prognoses that don't make it. When you are successful and manage to get an animal healthy and ready to be released, you don't know if they will make it out there in the wild. People will feed orphaned animals while the animal is too cold to digest anything and then bring you an animal that can't be saved. You will have people bring you animals that can't be released because they waited too long to bring it in and now bones have remodeled in unusable ways. You will have people bring you perfectly healthy



Three-toed Box Turtle photo by Micha Petty

It is important not to attempt to rehabilitate wildlife without the proper training and licenses. Such activity is illegal, bad for the animal, and dangerous for you. Read more about why you shouldn't feed injured or orphaned wildlife at bit.ly/rehabbers

Feline Trap-Neuter-Release Programs

The ecologically unsound practice of neutering feral cats and returning them to the environment has unfortunately been gaining traction in the U.S. and other areas. Trap, Neuter, Release (TNR) is a program by which feral cats are trapped, spayed or neutered, and then released into the environment. Rather than immediately reducing numbers through removal, TNR practitioners hope to reduce populations over time slowly. The scientific evidence clearly indicates that TNR is not an effective tool to reduce feral cat populations. Rather than slowly disappearing, studies have shown that feral cat colonies persist or increase in size.

TNR programs fail because they do not operate in an enclosed system and cannot spay or neuter a sufficient number of cats to affect feral cat numbers at the population level. Despite the good intentions of many involved in TNR programs, TNR has been found to be a waste of time, money, and resources. For example, one evaluation of two long-term TNR programs in California and Florida indicated that “any population-level effects were minimal.” The team of researchers concluded that “no plausible combination of [conditions] would likely allow for TNR to succeed in reducing population size.” Once feral cats are spayed or neutered, they are then abandoned back into the environment to continue a feral existence. Not only is this systematic abandonment inhumane to the cats, but it also perpetuates numerous problems such as wildlife predation, transmission of disease, and property destruction.

While the people conducting these operations may be generally well-meaning, TNR programs contribute to the destruction of wildlife and perpetuate hardships to their feline subjects. These programs should be vehemently opposed by anyone concerned with the health of the environment, as domestic cats are a man-made species and are not in harmony with any ecosystem.

Fact Sheets:

- [Feral Cats: Consequences for Humans and Wildlife](#)
- [The Evidence Against TNR](#)
- [TNR: The Wrong Solution to a Tragic Problem](#)

Reports:

- [The Science of Feral Cats: A Report to Pompano Beach, Florida](#)

Letters:

- [2014 ABC and 200 Conservation Groups to U.S. Department of the Interior](#)
- [2014 Society for Conservation Biology & The Wildlife Society to U.S. Department of the Interior](#)
- [2014 U.S. Fish and Wildlife Service to Escambia County, FL](#)
- [2011 ABC to U.S. Department of the Interior](#)
- [2009 U.S. Fish and Wildlife Service to New Jersey Department of Environmental Protection](#)
- [2006 U.S. Fish and Wildlife Service to Seacoast Area Feline Education and Rescue \(NH\)](#)
- [2003 American Society of Mammologists to Florida Fish and Wildlife Conservation Commission](#)

Video: [TNR: Bad for Cats, Disaster for Birds](#)

Position Statements:

- [American Association of Wildlife Veterinarians](#)
- [American Ornithologists' Union](#)
- [Association of Avian Veterinarians](#)
- [Chicago Wilderness](#)
- [Cooper Ornithological Society](#)
- [Florida Veterinary Medical Association](#)
- [Georgia Ornithological Society](#)
- [International Wildlife Rehabilitation Council](#)
- [National Association of State Public Health Veterinarians](#)
- [National Wildlife Rehabilitators Association](#)
- [Texas Parks and Wildlife Department](#)
- [The Wildlife Society](#)

Scientific Literature:

- [Barrows 2004: Professional, ethical, and legal dilemmas of trap-neuter-release](#)
- [Castillo and Clarke 2003: TNR ineffective in controlling cat colonies](#)
- [Foley et al. 2005: Impacts of TNR programs on populations of feral cats](#)
- [Jessup 2004: Welfare of feral cats and wildlife](#)
- [Longcore et al. 2009: Critical assessment of TNR claims](#)
- [Roebeling et al. 2013: Rabies prevention and management of cats in TNVR programs](#)

Information adapted by permission from the American Bird Conservancy [TNR Fact Page](#).

Municipal Shelter Exotic Intake Quick Reference

It does not occur to most animal shelters to have an enclosure prepared for small exotics until the need arises. All too often, no one has any idea what to do with these animals when they arrive. Here is some info to get you through the first few hours.

If you take in an ill or injured animal, please try to have it seen by a veterinarian familiar with the species. Exotic pets need different medicine and care than cats and dogs, and several products that are safe for dogs or cats are lethal to them. It may take some footwork to locate the right provider, but it is necessary.

Reptiles and amphibians are generally hardy animals and can withstand sub-optimal conditions much longer than standard pets. While we always want to provide optimal husbandry, try not to panic about being unprepared. A healthy animal will survive while you calmly figure out what to do.

Generally, the two fastest killers are too much heat or drying out (in the case of many amphibians). Most other husbandry issues (temperature, humidity, lighting, food, water, hiding places) will cause stress and a weakened immune response but are not immediately lethal. Exotics should not be allowed contact with cats or dogs, as severe injuries become likely.

Try to house the animal somewhere quiet and provide something for the animal to hide in to reduce stress.

House the animal in something secure, as many reptiles are accomplished escape artists. Enclosures, even temporary ones, should be free of rough surfaces and sharp edges. An animal in a new environment will often try rubbing and scratching against the walls, floor, and ceiling of their container and can give themselves lacerations and abrasions.

Until you can find out more, try to house amphibians (soft skinned animals like frogs or salamanders) at room temperature in a non-drafty place. House reptiles at a slightly higher temperature (80°F) until you can obtain guidance to make more specific adjustments.

Temperature and humidity gradients allow the animal to select what it most needs. If you can give the animal options (for example by placing a heat source such as a

lamp or heating pad on low on one side of the enclosure) it will be able to make adjustments on its own if it is too hot or too cold. Do NOT allow the warm side to get over 95°F or the cool side to get above 85°F unless instructed to do so by someone experienced in the care of that species.

Other than pond turtles and a very few amphibians, most reptiles and amphibians seen in the pet trade are not aquatic, and many can easily drown. Do NOT house these animals in water unless you know there is a reason to do so. In particular, tortoises (land-dwelling turtles) are not good swimmers and should not be mistaken for aquatic turtles. A good indicator is whether the animal's rear feet are elephantine (for land) or webbed (for water). Even aquatic turtles can go for long periods on land, so err on the side of assuming any animal is terrestrial until you know otherwise.

Amphibians are carnivores and most can be fed crickets short term. Reptiles exhibit a considerable variety of dietary needs and should not be offered food until a proper identification can be made.

Clean water (bottled or treated to remove chlorine) should be provided in a bowl (not the drippers sold for small mammals). Care should be taken that the animal cannot drown in the bowl (particularly very small animals).

A veterinarian competent with exotic animals should be located for an exam and further guidance as soon as possible. Please do not guess as to what species you have or get advice from pet store employees (there may be knowledgeable pet store associates in your town, but that is often not the norm). Alternately, you may be able to locate a wildlife rehabilitator with the proper expertise. Rehabilitators should be listed on your state wildlife agency's website.

Unless you need the animal as evidence in a criminal proceeding (and possibly even if you do), your goal should likely be to transfer the animal to a qualified keeper as soon as practicable (for example, after any mandated stray hold time).

More care guides can be found at Anapsid.org



Kimberley Rock Monitor photo by Chad M. Lane

If you have questions, visit learnaboutcritters.org/connect. If you have a snake that you are not sure is harmless, take a photo and post in one of the groups on that page. If you need to house the animal longer than three days, please purchase a care manual to get more comprehensive information.

Designing a Temporary Enclosure (for Shelters)

It is a good practice for any animal shelter to have at least a rudimentary enclosure for non-traditional pets. If you have a budget to draw from, an optimal enclosure can be constructed for a cost of around \$500. If you have a tighter budget, a temporary enclosure (suitable for up to 72 hours) can be assembled for about half that. If you only have pocket money, a safe overnight container can be thrown together for about \$40.

To create a multi-purpose enclosure for small to medium-sized terrestrial herps:

Purchase a 55-gallon glass tank or similar enclosure measuring around 48" L x 24" W x 24" H (122 cm x 61 cm x 61 cm). This should either come with a lid (if sold for reptiles) or a ventilated lid should be purchased separately. Do not purchase an aquarium lid. You want a ventilated cover with a frame that is designed to fit securely on the enclosure, not just sit on top like a fish tank lid. It is important that the lid fits securely and that you purchase clips or retaining devices (also available in pet stores) to keep it firmly in place. Many reptiles, especially snakes, are escape artists. You may purchase a stand or use an existing sturdy, level surface. **Cost: \$155-\$235**

Purchase a self-ballasted mercury vapor bulb designed to produce light, heat, UVA, and UVB rays. For general purpose use, something in the 125W range should suffice (for extended housing a different wattage may be necessary). Purchase a timer, reflective fixture for the lamp, and (preferably) a stand to hang it from. Set timer to run the lamp during daylight hours. **Cost: ~\$120**

Purchase a few hiding places. Pet stores should have a variety of resin caves, rocks, and the like that are easy to clean and sterilize. You will want at least two small hides and two larger hides. **Cost: ~\$90**

Purchase 2-3 water dishes of varying sizes. Most animals should be provided ample water, but ill or injured animals may need smaller dishes to make drinking easier or to prevent drowning. **Cost: ~\$50**

Purchase a few climbing branches or other furniture that the animal can use to situate themselves under the light and warm up when desired. **Cost: ~\$45**

Purchase two thermometers and hygrometers (to measure humidity). You will want to make sure that the warm

end of the tank is not too warm and the cool end is not too cool. The purpose of an adjustable stand for the light is so you can adjust the height to get the temps right. Until you can do a search for more specific temps, an "all-purpose" range is 72°F-76°F on the cool side and 85°F-95°F on the hot side. Get a spray bottle to mist the enclosure; most animals will need little more humidity than the air at the shelter provides. Seek further guidance and adjust these parameters as soon as you can. You can also buy a book that contains the parameters for various animals. **Cost: \$25-\$40**

If you need an enclosure and cannot afford the above items, you can buy a 40-gallon (160 L) tank and a less expensive light. If you really cannot afford a light that produces UV, a regular (not "energy saver") light may be used for short-term housing, but the animal will need to be transferred to a more appropriate environment soon. Likewise, hides can be constructed out of cardboard boxes and the like. You may be able to use the water bowls you already have available, but they should be clean and free of ANY residues of any kind. Wash all bowls with soap and water and rinse/dry thoroughly. The water depth should generally not be more than the animal's shoulder height. If the bowl has high, slick sides, something should be set in it to help small animals climb out.

If you really only have \$40, go to a department store and get a large plastic storage container. Look for something that is at least 20"x36" (51 cm x 92 cm), but bigger is better. This should be a sturdy product with a secure lid. Carefully use a drill, a wood-burning tool, or a soldering iron to create plenty of air holes. Place a heating pad on low under one side of the container so the animal can get warm or retreat from the warmth. The important part is that it closes securely and has air holes. Putting a hide box and a water dish in it would also be nice. *Keeping an animal in a container like this should be for emergency, overnight purposes only!*

Paper towels may be used as a temporary floor lining until further guidance can be obtained. Treat any tap water with a dechlorinating product. Try to keep the animal somewhere quiet and read the bulletins in the herpetoculture section of this Primer for additional details.



For further guidance in setting up an enclosure, consult a vet or visit LearnAboutCritters.org/connect



Spiny-tailed Monitor photo by Chad M. Lane



Captive Animal History Record

Keep and update this record to assist with the diagnosis of health issues or other emergencies.

Owner's Name: _____ Phone: _____

Address: _____

Animal's Name: _____ Date of Birth or Estimated Age: _____

Species: _____

Description/Morphology: _____

Where Acquired: _____ Date: ____ / ____ / ____

Acquisition Type: ☐ Pet Store ☐ Friend ☐ Trade Show ☐ Rescue ☐ Wild-caught ☐ Breeder ☐ Other: _____

Reason for Acquisition: _____

Diet Provided to Animal (note frozen or live, if applicable): _____

Feeding Frequency and Date of Last Meal: _____

Water Provided: ☐ Tap (treated? ☐ Yes ☐ No) ☐ Bottled ☐ Rain/river ☐ Other: _____

Method of Providing Water: ☐ Bowl ☐ Drip system ☐ Misting System ☐ Other: _____

Date of Last Shed: ____ / ____ / ____ Frequency of Previous Sheds: _____

Species Animal Has Had Contact With: _____

Size and Type of Enclosure Provided: _____

Substrate Type Provided: _____

History of Breeding/Egg Deposition (if applicable): _____

Have Hiding Places Been Provided? ☐ No ☐ Yes Including Moist Hides? ☐ No ☐ Yes How Many? _____

Type, Wattage and Location of Heating Used: _____

Was UVB Lighting Provided? ☐ No ☐ Yes Date of Last Bulb Replacement: _____

Schedule of Visible Light the Animal is Accustomed to: _____

Has the Animal Had Access to Natural Sunlight? ☐ No ☐ Yes Frequency: _____

Temperatures provided: Basking _____ Ambient _____ Nighttime _____

Percentage level and method of provided humidity: _____

Weight: _____ Date Weighed: ____ / ____ / ____

Length: _____ Date Measured: ____ / ____ / ____

Any Changes to the Animal's Environment, Behavior, Appetite, or Droppings in the Past Three Months: _____

Current or Previous Health Issues (if applicable): _____

Animal's Veterinarian: _____ Phone: _____

Additional Notes— Behavioral Issues, Past or Present Medications, etc.: _____



Field Observation Record

Record pertinent data regarding an observation– use discretion when sharing these data.

Observer's Name: _____ Date: ____ / ____ / ____

Email Address: _____

Time of Observation: _____ ☐ AM ☐ PM Country/Parish: _____

Species: _____ Sex (if known): _____

Description (life stage, morphology, etc.): _____

Location (be as specific as possible, e.g. municipal address, nearest intersection, distance and direction from landmark, etc.): _____

GPS Coordinates (Long./Lat.) (See Google Earth, if needed): _____

Record Type: ☐ Photographed ☐ Collected, Live ☐ Collected, Deceased ☐ Other: _____

If Collected Live, Reason for Collection: _____

If Collected, Specimen Delivered To: _____ Specimen ID#: _____

Record Verified By: _____

Email of Verifying Party: _____

Photos Taken (Check all that apply): ☐ Entire Body (from distance) ☐ Entire Body (close) ☐ *In Situ*, Partially Obscured ☐ Close-up, Head ☐ Close-up, Dorsal ☐ Close-up, Ventral ☐ Other: _____

Weight (if recorded): _____ Snout-Vent Length (SVL): _____

Snout-Tail Length (STL): _____ Tail Length: _____ Girth: _____

Tail Appearance: ☐ Never Autotomized ☐ Regrown ☐ Autotomized, Not Regrown ☐ Other _____

Markings or Tags Observed (describe): _____

Type of Habitat (e.g., mesic forest, hardwood bottomland, clear stream, grassland, behind bark of standing deadwood, etc.): _____

Environmental Description/Other (e.g. prevalent plant species, evidence of wild hogs abundant, etc.): _____

Situation Observed [e.g. basking on log, climbing a tree, under deadwood (soil moist), under deadwood (soil dry), etc.]: _____

If Predation Record, Describe Interaction (eating or being eaten by what species): _____

If Egg or Larval Record, Number or Density Observed: _____

Air Temp: _____ Ground Surface Temp (Sun): _____ Ground Surface Temp (Shade): _____

Relative Humidity: _____ Barometric Pressure: _____ Elevation: _____

Precipitation Present (type & severity, or time since cessation): _____ Moon Phase: _____

Record Uploaded to: ☐ iNaturalist ☐ HerpMapper ☐ Other _____

Other Pertinent Notes (e.g. signs of disease, in shed, cloud cover, etc.): _____

Irresponsible Handling of Venomous Snakes

If you have always imagined snakes as some sort of sinister creature that spends its time lurking about waiting for some hapless bystander to slither out and bite the life out of, then you will may wonder why this bulletin even warrants writing. Conversely, if you know snakes intimately and realize that their motivations are akin to any other animal (hunger, thirst, the desire for shelter, a mate, etc.), it may be less surprising to see videos on social media of people sitting on their couch with their cobra or picking up a rattlesnake barehanded to move it across the road.

Variable Coralsnake photo by Armin Meier



Are there people who have handled venomous snakes without tools or protection and been none the worse for it? Sure. There are also plenty of people who drive their car on the road every day without getting in a major accident. The question becomes, “Where is the line between acceptable risk and recklessness, and when does recklessness become unacceptable?”

L.E.A.R.N. shares the same position as most biologists and people that work with animals professionally. Namely, that there is no good reason to freely handle a medically-significant venomous snake. Furthermore, the best

practice is to never handle *any* snake that you cannot positively identify as harmless. Even if you know all the venomous snakes in your area, there is no guarantee that an unfamiliar snake is not an exotic escapee.

Do snakes have an innate desire to bite people? Not at all. They are not stupid and generally know that biting an animal many times their own size is antagonistic and dangerous. However, any animal—especially one that does not know you personally—will defend itself if it feels threatened, and you approaching them is a good reason for them to feel threatened. Even a pet snake, which is what is often seen on YouTube or Facebook, can react suddenly and unpredictably.

There are many photos and videos on social media of “fearless” (you can choose your own alternate term for it) keepers holding their pet viper or elapid to show “how gentle they are.” There are also plenty of examples of these same folks in the hospital or morgue sooner or later. Just because an animal “probably won’t” hurt you is no reason to be irresponsible. Even in countries with “free health care,” suddenly finding complex toxins coursing through your arm is something you’re sure to wish you had avoided in hindsight.

If you do insist on free-handling a venomous snake, please don’t post it on the web for “likes” or “retweets.” You may tell yourself that you are trying to send a “positive message” that they are friendly, but—even if you do not get bitten—you are setting a dangerous example for impressionable viewers who will think that following your lead means they can handle any snake they see with impunity. If you’re not going to play it safe for your own sake, please consider the effects your actions may have on others and don’t handle venomous reptiles without proper reason, tools, and precautions.



Indian Cobras photo by Gunjan Pancholi

Some feel that it is acceptable to handle venomous snakes barehanded. While each person must decide for themselves what risks they consider acceptable, L.E.A.R.N.’s position is that only those with training and good reason should handle these animals, and even then only with proper protections in place.



Part IX Appendices

Black-masked Racer photo by Justin Sokol

Northern Cottonmouth photo by Luke Smith



SAVE A LIFE!

**WARMER TEMPS
MEAN ANIMALS
CROSSING ROADS.**

***PLEASE!*
PAY ATTENTION
WHILE DRIVING.**

Additional Resources

L.E.A.R.N.'s Links

Web Site
Flickr (Find herp memes here)
Facebook Page
Introduction to Herpetology
YouTube

Resources on Facebook

Wild Snakes : Education & Discussion
Wild Amphibians : E & D
Wild Lizards : E & D
Wild Crocodilians : E & D
Wild Turtles and Tortoises : E & D
Reptile and Amphibian Educators
N. American Native Reptile Keepers
Snake Fungal Disease (SFD)
North American Field Herping Association
HerpMapper Community Group
*...find more groups linked at
learnaboutcritters.org/connect/*

Naturalist and Citizen Science Links

iNaturalist
HerpMapper
Nature Conservancy
USGS Amphibian Research and Monitoring Initiative
Tadpoles of the U.S. and Canada

Herpetological Organizations

Society for the Study of Amphibians and Reptiles
American Society of Ichthyologists and Herpetologists
Herpetologists' League
Center for North American Herpetology

Conservation Resources

AmphibiaWeb
Amphibian and Reptile Conservation
IUCN, International Union for Conservation of Nature
Canadian Wildlife Health Cooperative Fact Sheets
Save the Frogs!
Orianne Society
Partners in Amphibian and Reptile Conservation
North American Amphibian Monitoring Program
TRAFFIC– Tracking Wildlife Trade
Turtle Survival Alliance
Crocodilians: Natural History and Conservation
Turtle Conservancy
Scientific Resources
The Reptile Database
Chytrid Fungus Information
SnakeDatabase (with LD50s)
Biology of the Reptilia

Herpetological Review
Biodiversity Heritage Library
Copperhead Institute

Educational Blogs

Melissa Kaplan's Herp Care Collection
Living Alongside Wildlife
Life is Short, but Snakes are Long
Herpetology Unit
Leslie Boyer's Medical Toxinology

Wildlife Rehabilitation

L.E.A.R.N.'s Wildlife Page
So You Found a Baby Bird
So You Found a Baby Mammal
The Reason You Should Never Feed Injured or Orphaned Wildlife
Global Assistance link at the IWRC
Find a Rehabilitator – NWRA

Legal Information

Lacey Act Injurious Species
Municode Law Search Tool
Animal Legal and Historical Center
US Association of Reptile Keepers

Additional Resources

Association of Reptilian and Amphibian Veterinarians
Herp Links at Save The Frogs
Herp Links at ASIH
SSAR Herpetology Resources
WhatTheHerp
Visual Learning Software- VLHERPS
USGS National Wildlife Health Center
Reducing Road Injuries
Tunnel Vision– WI DNR
Roadways and Turtles– MN DNR
WildlifeAndRoads.org

Dictionary of Herpetological Terms

Suggest a Link!
learnaboutcritters.org/links



U.S. State Snake Resources

Alabama

bit.ly/snakes-AL

Arizona

bit.ly/snakes-AZ

Arkansas

bit.ly/snakes-AR

California

bit.ly/snakes-CA

Colorado

bit.ly/snakes-CO

Connecticut

bit.ly/snakes-CT

Florida

bit.ly/snakes-FL

Georgia

bit.ly/snakes-GA

Hawaii

bit.ly/snakes-HI

Idaho

bit.ly/snakes-ID

Illinois

bit.ly/snakes-IL

Indiana

bit.ly/snakes-IN

Iowa

bit.ly/snakes-IA

Kansas

bit.ly/snakes-KS

Kentucky

bit.ly/snakes-KY

Louisiana

bit.ly/snakes-LA

Maine

bit.ly/snakes-ME

Maryland

bit.ly/snakes-MD

Massachusetts

bit.ly/snakes-MA

Michigan

bit.ly/snakes-MI

Minnesota

bit.ly/snakes-MN

Mississippi

bit.ly/snakes-MS

Missouri

bit.ly/snakes-MO

Montana

bit.ly/snakes-MT

Nebraska

bit.ly/snakes-NE

Nevada

bit.ly/snakes-NV

New Hampshire

bit.ly/snakes-NH

New Jersey

bit.ly/snakes-NJ

New Mexico

bit.ly/snakes-NM

New York

bit.ly/snakes-NY

North Carolina

bit.ly/snakes-NC

North Dakota

bit.ly/snakes-ND

Ohio

bit.ly/snakes-OH

Oklahoma

bit.ly/snakes-OK

Oregon

bit.ly/snakes-OR

Pennsylvania

bit.ly/snakes-PA

Rhode Island

bit.ly/snakes-RI

South Carolina

bit.ly/snakes-SC

South Dakota

bit.ly/snakes-SD

Tennessee

bit.ly/snakes-TN

Texas

bit.ly/snakes-TX

Utah

bit.ly/snakes-UT

Vermont

bit.ly/snakes-VT

Virginia

bit.ly/snakes-VA



Washington

bit.ly/snakes-WA

West Virginia

bit.ly/snakes-WV

Wisconsin

bit.ly/snakes-WI

Wyoming

bit.ly/snakes-WY

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Suggest a Link!
learnaboutcritters.org/links
Eastern Slender Glass Lizard
photo by Daniel Thompson

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- Portions of the FAQs were adapted from the LDWF's Snake FAQs, found at bit.ly/WLF-FAQ
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Cope's Gray Treefrog photo by Todd Pierson

About L.E.A.R.N.



Louisiana Exotic Animal Resource Network is a non-profit corporation in the U.S. that freely provides rescue, special-needs sanctuary, and rehabilitation services to exotic and indigenous animals. We also provide conservation education to the public. Our primary focus is on assisting reptiles, amphibians, and invertebrates. We take in exotic birds and mammals when capacity permits. We also direct pet owners to sound sources of husbandry information. We do not sell or profit from animals in any way (we do not even have adoption fees) and are not funded by any government agency.

We have several reptile, amphibian, and invertebrate Animal Ambassadors and regularly provide presentations to kids of all ages at no charge. We set up educational booths at wildlife events and also conduct free herpetology workshops.

L.E.A.R.N. is located on 11 acres in Elm Grove, LA, just north of Lake Bistineau and the Loggy Bayou Wildlife Management Area. The land is fully wooded with a pond and trails. Micha and his wife Pamela are resident managers. Separate from the manager's residence is a 2000sf building which houses the critters, as well as an intake & office area, the clinic & kitchen, a flex space for socialization and classroom activities.

There is also a separate 500 sf quarantine building. The shelter typically has around 75-100 vivariums, aquariums, and enclosures operating at any time and houses 100-300 reptiles, amphibians, invertebrates, aquatics, avians, and small mammals. It has a custom electrical system that controls the lighting in the vivariums, including automatic astronomic adjustments, remote monitoring of temperatures and humidity, and backup power.

Projects we are accepting donations for include:

Outdoor aquatic turtle habitat • Walled garden pens for the tortoises
Further development and refinement of the hiking/observation trails
Conversion of more enclosures to custom vivariums • Outdoor aviaries
Expansion of the facility from 2000sf to 5000sf • Many other improvements....

Tax-deductible donations are always welcome and will forward our mission to

Rescue Locally. Educate Globally.



About the Author



To Nag and Nagaina, the two little Rough Earthsnakes that came home with us years ago and started it all...

Micha R. Petty



Watch an ABC interview with the author at his rescue center here-
learnaboutcritters.org/staff

Micha rarely sleeps. He is a Louisiana Master Naturalist, wildlife rehabilitator, and the President of L.E.A.R.N. He funds his rescue and conservation efforts through his businesses as a contractor and Realtor®, but this project is the first step in his goal of transitioning to Conservation Through Education full-time. He has loved reptiles and amphibians since childhood and is glad to have a chance to be helping them now. He has been observing and identifying herps in the wild for thirty-six years and has twenty-five years of experience with reptile husbandry. His favorite herps are whichever ones happen to be in his own backyard.

Micha serves as the Outreach and Public Relations Officer for the Louisiana Master Naturalist Association and on the board of directors for the Northwest Chapter of the LMNA. He is also the Public Relations Coordinator for the Society for Amphibian and Reptile Education.

He is a member of the Society for the Study of Amphibians and Reptiles, the International Wildlife Rehabilitation Council, the Herpetologists' League, the American Society of Ichthyologists and Herpetologists, the Louisiana Wildlife Federation, Partners in Amphibians and Reptile Conservation, and the Friends of the Red River National Wildlife Refuge.

The International Herpetological Symposium selected Micha as the 2018 recipient of the Laszlo Award for demonstrating "new and exciting views and advances in herpetology" through his outreach and educational efforts, including this Primer. Micha has done over 50 news and television segments about animals and conservation.

He lives in Elm Grove, Louisiana with his wonderful wife as the resident managers of L.E.A.R.N. with a couple hundred critters that no one else wants.



Closing Entreaty

Greetings, kind reader, and thanks for reading my collection of bulletins!
I worked hard on it, and I hope you found it educational and edifying.

Let me be frank with you for a second. I am not the type of person to put his hand out, and I did write this book as a labor of love. With that said, I have been funding my rescue and rehabilitation center out of my own pocket for years, and it can be difficult. My wife and I go without a great many things so that we can do the most we can for the critters and devote time to educational efforts such as this. If you read this far, I hope you will agree that this product is worth money, even though I decided not to charge for the digital version (if you are reading a hard copy—thanks for your purchase!). Please consider pitching in a little something to help fund L.E.A.R.N. The critters and the time I put into this project are costly. You can do that very quickly at learnaboutcritters.org/donate

You don't even have to log in. Just visit the link and put in a donation amount and a card number. Thanks either way, and don't forget to please tell your friends about this project! Happy Herping!



Rough Greensnake photo by Todd Pierson



Follow L.E.A.R.N. on the web for more great content!

learnaboutcritters.org/connect

We have many more bulletins planned– don't miss out!

***"IN THE END WE WILL CONSERVE ONLY WHAT WE LOVE,
WE WILL LOVE ONLY WHAT WE UNDERSTAND, AND WE
WILL UNDERSTAND ONLY WHAT WE ARE TAUGHT."***

– BABA DIOUM, 1968

A Primer on Reptiles & Amphibians is an innovative educational resource designed to forge a connection between the reader and the creeping critters of the world. Turtles, frogs, lizards, salamanders, snakes, and crocodiles... these animals evoke fear and fascination. This primer dispels myths and unlocks mysteries surrounding these diverse survivors which have mastered virtually every habitat on Earth. Tragically, these animals now face pressures of unprecedented severity, but there is still time to make a difference if more of us work together.

Micha Petty is an international award-winning Master Naturalist and wildlife rehabilitator. This critically acclaimed debut volume is a collection of Micha's interpretive writings, carefully crafted to make learning easy for everyone. These bulletins display his passion for *Conservation Through Education* while covering topics such as living harmoniously with wildlife, physiology, natural history, observation, and conservation. Flip to any page to be instantly introduced to new facets of reptiles, amphibians, the perils they face, and how *you* can join the fight to save them!

Reviews from prominent scholars are included on the first page.

Download this collection for free at LearnAboutCritters.org

