

NTS NEWSLETTER

PUBLISHED BY THE NON-TRADITIONAL SPECIES CLUB AT THE UNIVERSITY OF ILLINOIS

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WHAT ARE NANOBODIES?

BY RACHEL ANGLES

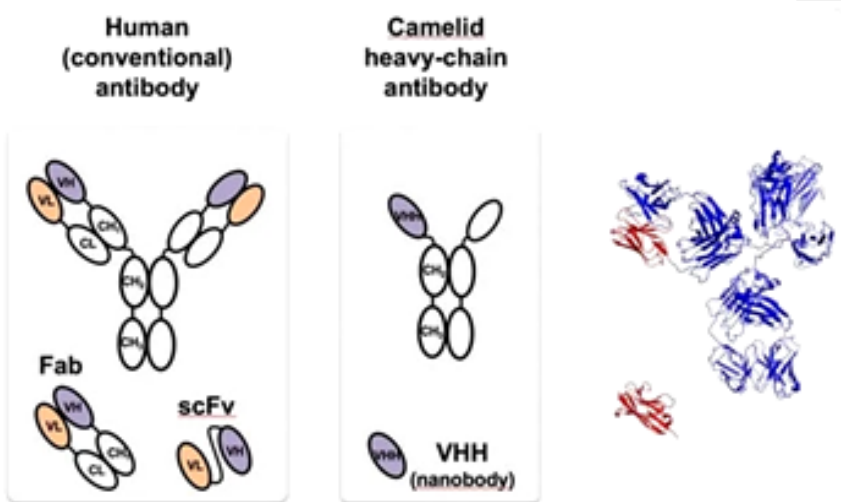
What does an alpaca have in common with a hammerhead shark? Except for the fact that both are important members of the animal kingdom, they seem to be about as different as can be! However, both species produce a special type of molecule as a part of their immune system which is known throughout the medical research community as a nanobody.

A nanobody is a specialized subset of antibodies produced naturally by the immune systems of camelids and cartilaginous fishes. They play an important role in immune defense, like other antibodies by recognizing foreign proteins such as those present in viruses and bacteria. Nanobodies are much smaller than the typical antibody, consisting only of the variable heavy (VHH) protein chain and lacking the constant (C region) and variable light (VL) chains that form the traditional Y-shape of a more typical antibody.



ALPACAS (TOP) AND A HAMMERHEAD SHARK (BOTTOM)

Because they are smaller and more hydrophilic than a typical antibody, nanobodies have several advantages that give them a wide range of potential applications. They are less expensive to produce in bulk, more stable across a wider range of temperatures and pH values (including the ability to survive in gastric fluid), and more soluble. They are also more compatible with genetic engineering, making them invaluable in many medical research studies.



Since their discovery 26 years ago, nanobody applications have been found in a broad number of medical fields such as oncology, infectious disease, and immunology. Recent advances include the use of nanobodies to detect industrial chemicals in the environment or for medical imaging through the attachment of a fluorescent dye. Additionally, nanobodies are being explored as a treatment for COVID-19.

Future research will include attempting to breed transgenic mice to produce nanobodies and make them more widely available within a lab setting. Nanobodies are extremely versatile and novel treatments and therapeutic uses are constantly being discovered, making them a very valuable tool for further research within the medical community.



IN VIVO IMAGING OF A TUMOR USING RADIO-LABELLED NANOBODIES IN A MOUSE

Test Your Trivia Knowledge!

BY: RYAN PATTERSON

1. What is a group of rhinos called?

- a. Crash
- b. Pow
- c. Whomp
- d. Bang

2. Which bird species has the largest talons in the world, growing up to 3-4 inches in length?

- a. California Condor
- b. Harpy Eagle
- c. Golden Eagle
- d. Great Gray Owl

3. What type of feces do African Dung Beetles prefer, according to research?

- a. Carnivore
- b. Omnivore
- c. Herbivore
- d. Piscivore

4. Which animal has the thickest fur in the world?

- a. Polar Bears
- b. Otters
- c. Fur Seals
- d. Arctic Fox

5. Adwaita, an Aldabra Giant Tortoise, is believed to be the longest living tortoise in the world. Approximately how old was he when he died in 2006?

- a. 175 years old
- b. 215 years old
- c. 230 years old
- d. 250 years old

(answers on p.12)

COVID-19 INFECTION IN WESTERN LOWLAND GORILLAS

BY KENNYMAC DURANTE

A tiresome subject to talk about but COVID continues to impact zoos in unpredictable ways. For a few months, most if not all zoos closed their doors to the public during the beginning of the pandemic. This, of course, led to many financial and logistical hurdles for many zoological institutions. Fortunately, many zoos have been able to bounce back somewhat but the uncertainty of COVID still lingers. While health professionals and researchers were still trying to learn as much as they could about COVID-19 at the beginning of the pandemic, the virus impacted the zoo community once again in a very unpredictable way. Back in April of 2020, the zoo community learned that some species of wild cats can be susceptible to COVID-19 and can lead to clinical disease as a few cases were reported at the Bronx Zoo. Not only had the virus become a danger to humans but to the animals that zoos protect as well.

Another maybe not so surprising but still shocking series of events took place, as on January 11th, 2021, San Diego Zoo Global announced that a few members of their gorilla troop at the San Diego Safari Park had tested positive for the SARS CoV-2 virus, the exact same virus that causes COVID-19 in humans. Despite strict protocols and biosecurity (such as fully protective suits for direct contact), suspicions of an infection originated when two gorillas started coughing on January 6th. They obtained and tested fecal samples for COVID-19 and on January 8th, the preliminary tests detected the presence of the virus in the gorilla troop. The infection was confirmed by USDA National Veterinary Services Laboratories on January 11th. The entire media news release can be read by following this link: <https://zoo.sandiegozoo.org/pressroom/news-releases/gorilla-troop-san-diego-zoo-safari-park-test-positive-covid-19>

Fortunately, the gorilla troop seems to be doing well despite slight congestion and coughing as reported by the executive director of San Diego Safari Park. Gorillas have become the seventh animal species to have contracted COVID-19 naturally, following confirmed infections in tigers, lions, mink, snow leopards, dogs, and domestic cats. This news can be concerning mainly because the more we discover which species of animals are susceptible to COVID-19, the more we are surrounded by uncertainty and additional questions. The one thing that remains certain however is that the brilliant and dedicated minds at San Diego Zoo Global continue to provide the best care for their animals despite the unique challenges caused by the pandemic. These cases can be scary at first but with diligence and hope, zoos can learn more about COVID-19 in animals and how to help protect other susceptible species along with their wild populations.

YOU ARE WHAT YOU EAT: HOW DIETS AFFECT SOME BIRD SPECIES

BY FAYTH KIM

Flamingos are immediately characterized by their pink-orange feathers. This distinct feature derives from their diet of primarily shellfish and algae. Many believe that the pink color is from the shrimp they consume, however, this theory negates the fact that they also feed on blue-green algae. Both the algae and shellfish they consume are rich in the chemical beta carotene. Beta carotene contains orange and red pigments known as carotenoids. After a feeding, digestive enzymes break down the beta carotene and the carotenoids are absorbed by the fat in the liver. As the fat is metabolized, the resulting pigmentation can be seen in the feathers, beak, and skin. Flamingo chicks initially appear dull grey, but gradually develop their iconic colors from carotenoid-rich crop milk. The more carotenoid-rich the diet is, the feathers may appear a deeper shade of pink-red. The lack of carotenoid supplementation could result in pink feathers molting away and being replaced with paler feathers. Thus, there may be fluctuations in the color of a flamingo within its lifespan, which may be 20-30 years in the wild.

Similar metabolic phenomena can be seen in cedar waxwings. These songbirds are native to North America and present usually with yellow-tip tails. They primarily feed on fruits and berries. Following the introduction and spread of Asian honeysuckle plants in the 1960s, cedar waxwings with orange-colored tails were noted. It was discovered that if a waxwing consumes enough of a honeysuckle's red berries while growing a tail feather, the tip of the feather will appear orange.



The dietary-derived pigmentation is critical in mating for some species. Blue-footed boobies get their bright blue feet from carotenoids from the fish they consume. Scientists have determined that there is some correlation between feet color and overall health. Boobies with bluer feet have been seen to have better success at finding mates than those with duller feet, as females seek the healthiest, most-nourished partners. A lot of information is displayed simply by the intensity of the foot color.

BIRDS: BODY LANGUAGE AND BEHAVIOR

BY KAYLA LADEZ

Do you know when it is safe to approach a bird? Are you worried about being bitten or have you been unexpectedly bitten? Does this bird want you to come closer or give them some space? Place each behavior into green, yellow, or red categories to learn more.

(Remember: these are just general descriptions but there can always be species and individual differences.)

Behaviors:

- Beak grinding
- Head bobbing
- Eye pinning (pupil dilating in and out)
- Tail flaring (tail feathers fan out and stay in that position)
- Beak clicking
- Feather fluffing
- Vocalizations (chattering, contact calling, growling, hissing)
- Crest position (in cockatiels, cockatoos, etc.)
- Flapping wings
- Preening



ANSWERS BELOW!

Beak grinding – content, sometimes seen before falling sleep

Preening – normal behavior, usually a sign of comfort

Vocalizations – contact calling and chattering can be signs your bird wants your attention-but be careful encouraging this behavior!

Feather fluffing – many meanings from normal removal of debris, being agitated, or ill

Crest position – position (up or down) and the change of position can indicate various emotional states

Flapping wings – exercise, happiness, or excitement

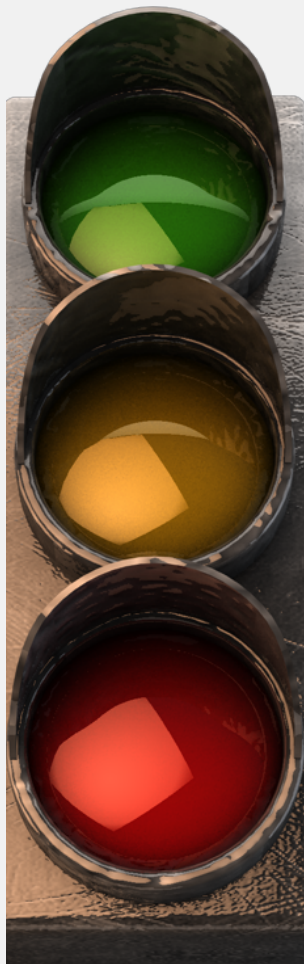
Head bobbing – excitement, part of regurgitating behavior

Eye pinning – very excited and not a good time to approach!

Tail flaring – very excited and not a good time to approach!

Beak clicking – excited or warning to give space

Vocalizations – some species will hiss and growl if they feel trapped



LIZARDS WITH BITE

BY BROOKE DUGAN

Lizards aren't typically the image that comes to mind when we talk about venomous reptiles. Scientists may debate the presence or absence of venom, regardless of how weak, in larger monitor lizard species, but it's well known that there are venomous lizards in North America. Gila monsters are probably the most common, but there are 5 known species in the *Heloderma* genus.

The Gila monster (*Heloderma suspectum*) is the largest lizard species in North America found north of the Mexico border. Its range includes hot, arid scrublands and succulent deserts in the Southwestern US, primarily Sonora, Arizona, southern California, Nevada, Utah, and New Mexico. Their natural diet varies, but the bulk of it includes small animals and eggs.

The rest of the *Heloderma* species are beaded lizards, including the Chiapan beaded lizard (*H. alvarezii*), the Guatemalan beaded lizard (*H. charlesbogerti*), the Rio Fuerte beaded lizard (*H. exasperatum*), and the Mexican beaded lizard (*H. horridum*).



CHIAPAN BEADED LIZARD
(HELODERMA ALVAREZII)



CHIAPAN BEADED LIZARD
(HELODERMA ALVAREZII)

Beaded lizards tend to occupy similar ranges, have similar diets, and similar in body type and coloration. Chiapan beaded lizards are found in Mexico, Chiapas, and northwest Guatemala. Unlike other bearded lizards that are typically black with yellow spotting or banding, the Chiapan beaded lizard is generally solid black. The Rio Fuerte beaded lizard occupies closer to northwestern Mexico, including Sonora, Sinaloa, and Chihuahua. Mexican beaded lizards have the widest range, found from southern Sinaloa to Oaxaca. While these species are known to prey on small animals and insects, the majority of their diet in the wild is birds and eggs.

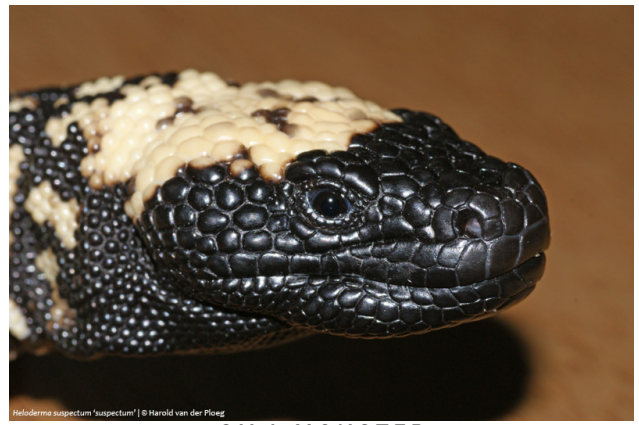
Guatemalan beaded lizards are the most endangered of all beaded lizard species, with fewer than 200 individuals suspected in the wild. They're isolated from other *Heloderma* species in the Motagua Valley thornscrub region of Guatemala, with over 150 miles separating them from the closest documented population of Chiapan beaded lizards. Their diet mostly consists of bird eggs found close to the ground and occasional insects.

Despite all of these species being venomous, scientists still debate why they evolved to produce venom. Since their primary diet consists of eggs and small animals, the current belief is that their venom evolved as a defensive mechanism rather than for hunting.

Unlike in snakes, whose venom glands are located in the top jaw, *Heloderma* venom glands are located toward the end of their lower jaw. Tubes connect the venom gland to the base of the teeth. Because they lack the musculature to inject venom, they deliver it by chewing.

There haven't been any confirmed human fatalities from Gila monster bites in approximately the last 100 years.

Despite being non-fatal to healthy adult humans, Gila monster and beaded lizard bites are known to be extremely painful, with other symptoms including edema, weakness, and decreased blood pressure. Although rare, respiratory failure has been documented in humans following beaded lizard bites.



GILA MONSTER
(HELODERMA SUSPECTUM)

Effects of venom vary depending on species, but in rats, hemorrhage in the GI tract, lungs, eyes, liver, and kidneys is common. Isolated peptides in Gila monster venom are also known to cause exophthalmos, lethargy, partial limb paralysis, and hypothermia. Some peptides are similar to the vasoactive intestinal peptide (VIP), which causes smooth muscle relaxation and regulates water and electrolyte secretion in the intestines, and the VIP-like peptides will bind to VIP receptors. Beaded lizard venom has been known to cause rapid decreases in carotid blood flow and blood pressure, as well as tachycardia and respiratory distress.

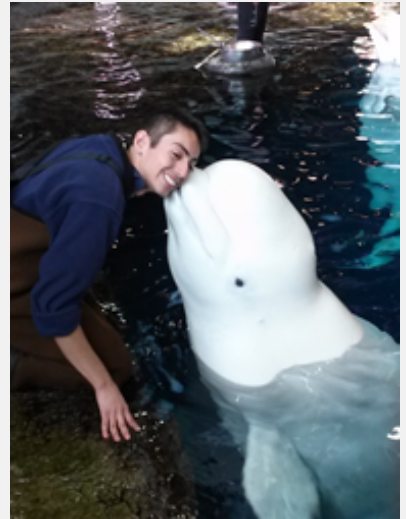
While Heloderma venom can have drastic effects on small mammals, isolated compounds have been incorporated into modern medicine. Helodermin, a bioactive peptide that can bind to VIP receptors, can inhibit the growth of lung cancer. A study in 1996 found that the hormone exendin-3 binds to receptors in breast cancer cells and may also inhibit lung cancer growth. Other compounds have been shown to aid in treatments of diabetes, Alzheimer's disease, and HIV. Exendin-4, which is specifically found in Gila monster venom, has been approved for type 2 diabetes due to its strong similarities to glucagon-like peptide-1 in humans, which helps regulate insulin and glucagon.

Conservation efforts for all Heloderma species are vital for their survival in the wild, especially for Guatemalan beaded lizards. These species are unique because of their venom, and as scientists isolate and study their venom more, we're better able to understand the potentially life-saving applications different proteins and compounds can have. So while their venom may not be as potent as most venomous snake species and they may not look as aesthetically pleasing as some other lizards, Gila monsters and beaded lizards are still exciting and could hold answers to creating treatments for different diseases in humans.

MEMBER SPOTLIGHT CORNER

BY SHEVON MEADOWS

Our first spotlight is on Danny Raya Pantoja, a first-year student. In 2016 he completed a 6-month internship at the Shedd Aquarium in Chicago after finishing his undergraduate degree. He had the opportunity to work along-side trainers and assist in the care of marine mammals such as Beluga Whales, Pacific North Sided Dolphins, Sea Otters, and California Sea Lions. He was also able to assist with other species such as Red-Tailed Hawks and the very rare *Canis familiaris*...the domestic dog! Danny's main job was to prepare the food for the Whales and Dolphins which were given during training and live shows, though the bulk of the work was in cleaning the facilities. He also had the opportunity to assist the trainers during the show and give commands to the belugas and dolphins. Towards the end of the internship, he and the other interns took on the role of mentorship and were given the responsibility of training the incoming interns that would replace them. Danny found this internship online and highly recommends the internships at Shedd. The internships are open to all ages and career paths, and the application for the internship he participated in opens in March and included 32-hour workweeks. Danny would like to mention that this was a unique experience and gave him another way to view the husbandry of animals in captive care.



Our next spotlight is on Maural Sowlat, a first-year student. In 2018 Maural completed a 3-month summer internship at a satellite facility of the New England Aquarium called the Quincy Animal Care Center in Quincy, MA. The facility was the home of medically significant animals and the quarantine area. Maural's responsibilities included diet preparation, feeding, and cleaning tanks. As a dive intern, she also spent time diving in the tanks to scrub algae. While there she had the chance to assist with some medical procedures, including holding southern rays in a pool of anesthetic-treated water while the veterinarians performed ultrasounds. Maural found the application for the internship on Glassdoor. For more information, you can contact Hannah Cutting, one of the aquarists, at hcutting@neaq.org.



GET TO KNOW YOUR NORTH AMERICAN MUSTELIDS!*

BY KYLIE AYERS

There are currently 56 living species in the family Mustelidae, 11 of which can be found in North America. Many members of this charismatic family are carnivorous and nocturnal, but some species can be diurnal. This family consists of a variety of species, including otters, badgers, and wolverines, but we're going to focus on the ones that are commonly confused based on their size and slender appearance that you may come into contact within the wild in North America (or in a veterinary clinic!)



American mink

- *Neovison vison*
- Least concern
- Brown to black with a white throat patch
- Often live in swamps, marshes, or near bodies of water



Long-tailed weasel

- *Mustela frenata*
- Least concern
- Reddish-brown color with a light yellow underside; can be completely white in colder climates
- Larger than the least weasel with a black-tipped tail



= native to Illinois



Least weasel

- *Mustela nivalis*
- Least concern
- Smallest member of the genus
- Usually, the underside is white, while the back, limbs, and tail are brown



Stoat (Ermine, Short-tailed weasel)

- *Mustela erminea*
- Least concern
- Black-tipped tail
- Dark brown and white in the summer and white in the winter



Fisher

- *Martes pennanti*
- Least concern
- Closely related to American marten, but are larger and darker colored
- Fishers are excellent climbers!



Black-footed ferret

- *Mustela nigripes*
- Endangered
- Once considered extinct, they have been reintroduced into their native habitat via captive breeding programs
- They have black feet, ears, tails, and part of their head
- Mainly feed on prairie dogs



American marten

- *Martes americana*
- Least concern
- Yellow to dark brown color with characteristic yellow chest patch that can be pale or vibrant
- o Males are much larger than females and can weigh up to 65% more!



Domesticated ferret

- *Mustela putorius furo*
- Come in a wide variety of colors and patterns listed by the American Ferret Association
- Domesticated from European polecat
- They are very common pets, but they are illegal to own as pets in certain regions of the world and United States - be sure to know your local laws!

HARMFUL ALGAE AND SEA LION BRAINS

BY ALEC COLOSI

Harmful algal blooms are a common occurrence along both coasts of the United States with different species of algae and bacteria depending on the region. Unfortunately, due to nutrient-rich runoff from agricultural areas, these blooms have become more common over the years. Along the Pacific coast, algae in the genus *Pseudo-nitzschia* produce a toxin called domoic acid (DOM). This chemical builds up in the tissues of shellfish and fishes that are then consumed by marine mammals. These marine mammals then experience the toxic effects of DOM, particularly neurologic damage.

California sea lions are a species of interest when it comes to DOM-producing algal blooms, and many strandings are attributed to these events. Juveniles and pups commonly strand and are seen exhibiting signs of DOM toxicosis. This group of individuals is of special importance, as California sea lions face many threats, and losing young members of the population will decrease potential future population sizes.

Recent MRI studies have investigated the developmental effects of DOM on California sea lion pups. Once in the blood, DOM slowly crosses the blood-brain barrier and quickly causes cell death, particularly in the hippocampus and amygdala. Imaging revealed reduced hippocampus size of the hippocampus and increased ventricular size in the brain. Affected individuals showed deficits in spatial memory, habituation, and sensitization - all important functions for a growing sea lion.

It turns out a sea lion pup can be exposed to DOM via several routes. DOM can easily cross the placenta, be sequestered in amniotic fluid, exposing the fetus to a greater concentration of the toxin than the mother, and sea lion mothers will excrete DOM in their milk. If that all isn't enough, toxic algal blooms that produce DOM tend to occur during spring and summer - the exact same time sea lions are breeding and pupping. In short, sea lion pups can be exposed to DOM as fetuses, while nursing, and after they begin eating fish.

There has been a growing interest in imaging studies with a focus on improving the methods of investigating marine mammal brains and the effects of toxins on structure and function. Though many of these studies focus on sea lions, the methods that are developed can be used on any animal that fits inside an MRI machine. The applicability of neurological studies across species makes this field particularly interesting, and one of the many marvels of working in the field of veterinary medicine is that we can all learn something from each other, no matter the species.

DEADLY JELLYFISH

BY COLLEEN ELZINGA

When swimming in open water, you might imagine that it would be frightening to encounter a shark or a crocodile. However, there is a stealthier killer that does not have rows of sharp teeth. The box jellyfish (class Cubozoa) is a tiny animal with lethal power. They live primarily in the coastal waters of Northern Australia and throughout the Indo-Pacific. Box jellyfish are highly advanced compared to other jellyfish. These jellies have developed the ability to swim rather than just drift with the currents. They can also see with eyes they have developed on the four sides of their bell. These eyes are grouped into clusters of six, each including a pair of eyes with a sophisticated lens, retina, iris, and cornea.

Box jellies are about 10 inches across, 10 feet long, and have up to 15 tentacles growing from each corner of the bell. Each tentacle has about 5,000 stinging cells, which are triggered by the presence of chemicals on the outer layer of prey. These creatures are transparent and pale blue in color, which makes them almost invisible to unsuspecting swimmers. Their venom is considered to be among the most deadly in the world. It contains toxins that attack the skin cells, nervous system, and heart. One box jellyfish contains enough venom to kill up to 60 people. Even more dangerous is their venom's speed of acting because the sting of a box jellyfish can kill someone in less than five minutes. The venom is so painful, human victims have been known to go into shock and drown or die of heart failure before they can reach the shore for help. So if you decide to visit Australia and take a dive in the ocean, you may want to bring along a sting protector.

BIOACTIVE ENCLOSURES, PART 1: WHY GO BIOACTIVE?

BY EMILY GRZEDA

A new fad in reptile keeping is keeping animals in planted enclosures instead of more basic tanks with plastic hides. It's growing in popularity, but is it worth it? What are the pros and cons? If you wanted to make one yourself, how would you go about it? Most of my animals are in bioactives, so I decided to write a series about their benefits, how to build them, and what to include in order to be the most successful, depending on your type of animal. This article will be the most generic – these tips apply to whether you have a crested gecko, dart frog, ball python, bearded dragon, or nearly any other reptile type. Later in the series, I will go into tips for more specific environment creation appropriate for the most common species. So, here are the basics:

Pros:

- Humidity can be retained more efficiently for tropical species due to all the plants and natural soil.
- They typically do not need to be cleaned at all, other than the glass or initial spot cleaning as the system gets established. That's a lot of time saved later!
- There are opportunities to create more species-specific or variety of hides for your animal – without spending any extra money for them.
- They are typically more cost-effective in the long run, as you do not need to replace substrate or buy store-made hides/accessories.
- They look awesome; let's be real, that matters. 😊



Cons:

- They take longer to set up initially than a standard tank.
- They can be more expensive initially to set up, depending on the plants and bugs you choose.
- If you hate all bugs in every capacity possible, this may not be for you.
- Plants require grow lights in addition to the normal lights your reptile may need.
- Plants will require watering occasionally, although this is likely not more work than what you would normally need to do for your reptile normally.



What does the basic set-up of a bioactive enclosure look like?

A glass tank is given a drainage layer (usually stone), a screen separator, and a thick dirt mixture layer. The background is typically made with some sort of spray foam and carved to have various ledges or plant pots to cover the back, sometimes with branches or pieces of cork bark adhered to it. Plants that are non-toxic to your reptile are added, and a layer of leaf litter is added on top of the soil. More branches or enrichment can be added depending on the reptile type, making sure to have plenty of places for the animal to hide or climb, depending on its needs.

How does a bioactive enclosure work?

One of the biggest benefits of a bioactive enclosure to me, at least, was the fact that it requires almost no cleaning. How does that work? Obviously, your animal still poops, so where does it go? The answer: bugs. Isopods, more commonly known as roly-poly bugs, are added to eat all the waste and recycle it in the enclosure. They also help move soil around a little, which helps nourish the plants so that they continue to thrive as well. You'd be surprised at how many types of roly-polies are available for bioactive enclosures; there are many different sizes, environments they are suitable for, and even colors. They can be entertaining of their own accord! Springtails are the other bioactive staple; these are very tiny, "springy" bugs that do well for eating debris out of reach of the roly-polies.

Hopefully, by this point you're at least intrigued by going bioactive – the beautiful enclosures are much more colorful and natural for our animals and have a lot of benefits. Next month, I'll go into how to start building these enclosures. Until then, I hope I've given you a little bit of the "bioactive bug"!

A note on snakes:

Bioactives can work for snakes, but there may still be some cleaning involved, depending on the size. However, this should just include spot-cleaning large clumps of fecal material; bugs still will consume small amounts and will even eat sheds.

A note on water features:

I personally do not have any experience with making waterfalls/permanent water features; I just use water bowls that I wash/replace once/week. If you are determined to incorporate a permanent feature in your enclosure, that's awesome, but I won't be going into detail about it. A lot more "cons" start to show up on your list once you include daily water testing, filtration, and safety depending on your type of reptile, but they can be beautiful and rewarding when done correctly.

Test Your Trivia (answers)

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- d. Bang

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