



Basic Reptile Husbandry

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Reptile husbandry is a tricky topic. Some scaly pets thrive in a broad array of habitats, while others (like chameleons) will not thrive unless everything is perfect. The following is a general guide; if you have specific questions about an animal, look it up on a good website like The World Chelonian Trust (<http://www.chelonia.org/>), **Melissa Kaplan's** Herp Care Collection (<http://www.anapsid.org/>), Kingsnake.com (www.kingsnake.com), or the Chameleon Forums (<https://www.chameleonforums.com/>). The bottom line is that correcting husbandry is a huge part of reptilian veterinary medicine, as **90% of reptile medical cases involve improper husbandry.**

The best captive environment simulates the animal's natural habitat. All organisms have a major habitat & a microhabitat. The major habitat is the general ecosystem that the animal lives in (i.e. this is a desert lizard, or a tropical lizard). The microhabitat is the portion of the major habitat that a particular species uses, including lifestyle & resource use. Microhabitat use can be very different between species, even in the same geographic location. It is both harder to understand than the major habitat, and more important to the animal's well-being that we understand it. Elements of the microhabitat include optimal temperature, daylight length, terrain use (burrowing vs arboreal vs leaf litter vs cave-dwelling), water use, & diet (leaves vs. fruit vs. insects vs. meat, etc.). There are five factors that interact to make the perfect reptile habitat. As stated before, a huge diversity exists between species regarding where they live and how they eat. Mimicking these five basic requirements are paramount to successful care for the pet/captive reptile. These five main factors are: 1) Housing, 2) Temperature, 3) Lighting, 4) Humidity, and 5) Water.

Housing

Housing includes a reptile's cage, cage furniture, and substrate (bedding material). The enclosure should resemble the animal's natural habitat as much as possible. This varies greatly depending on the origin and habits of the particular species – arboreal, terrestrial, tropical, burrowing, desert, aquatic, or semi aquatic. For instance, an arboreal animal (crested geckoes, tree boas) usually requires a taller rather than longer cage. For snakes, the circumference of the terrarium should be 1.5 times the snake's length. Enclosures must be escape proof with secure doors and openings. This cannot be over-emphasized! Snakes in particular are escape artists and cages need to have latching or sliding doors. Wood is less ideal than glass or Plexiglas as it is porous and more difficult to clean and disinfect. Snake mites also love to hide in the cracks in wood cages. Screen or wire can be used with caution to avoid trauma from sharp edges. Depending on the species and temperament of individuals, housing animals together may or may not be a good idea. A veterinary exam and quarantine period of 60 days should occur before any introduction of new animals into the midst of previously owned individuals.

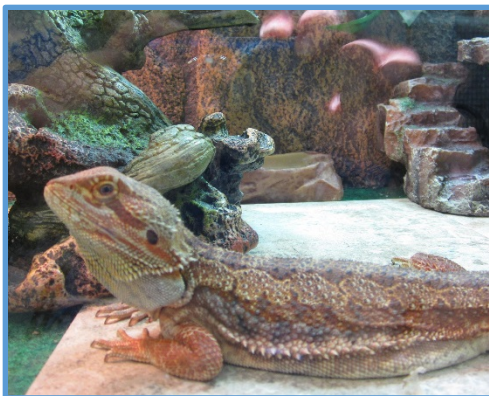
A proper substrate should increase enrichment, decrease stress, be safe, be easy to clean, & be visually appealing (this last one is the least concern, though). Good substrates include:

1. Newspaper is ideal in many situations since it is inexpensive, non-toxic, and easy to maintain, although it is not very attractive.
2. Reptile carpet is more appealing and relatively easy to clean. Multiple pieces can be cut to fit so one is always clean and dry, ready to be used.
3. Care Fresh litter is a good substitute for a loose substrate for a burrowing animal.
4. Alfalfa pellets & potting soil have been used as well, but these tend to grow mold easily once they get wet.

AVOID using any sort of particle substrate (corn cob, wood chips or shavings, soil, and sand) as these can get stuck in the mouth (leading to stomatitis/mouth rot), exacerbate skin irritation, or cause intestinal obstructions. Even so-called “calcium sands” are NOT always 100% digestible: In an unpublished study, Dr. Byron de la Navarre found that calcium sand breaks down (with significant agitation) at a pH of 1-2 (stomach acid levels) in 2-3 days, at a pH of 3-4 in 2-3 months, and never at a pH of 5-6 (small intestine acid levels). Obstructions seem to be a particular risk in juveniles housed on sand of any kind. In addition, aromatic oils in cedar wood shavings are toxic to reptiles – never use these as cage substrate. Multiple substrates can be present in the same terrarium. For instance, the whole bottom can be covered by newspaper, & then a tub with soil can be placed in the cage for digging purposes.

Reptiles should NOT be fed on their normal substrate (unless it is newspaper or cage carpet), as this increases the risk of both foreign body impactions & parasite ingestion.

The ONLY animals that should be on sand are sand boas & sand skinks, as they need to hide in it naturally (reduces stress). These animals should still NOT be fed on the sand, and the coarsest grain sand possible is advised. Care Fresh may also make an acceptable alternative to sand for these species.



Cage furniture is necessary to provide visual security, a den/seclusion, and natural climbing structures. Clay pots, flat rocks, plastic and natural plants, branches, hollow trunks, plastic tubing, and manufactured dwellings are examples. Furniture should include textured items to rub against (which aid in shedding). Avoid sharp or excessively abrasive materials including lava rocks that could damage tender new skin. Many habitats use branches or other climbing material to help the animal use more of its living space and access

basking sites. Arboreal animals need secure branches for climbing and resting. If using live plants, avoid *Ficus* & *Pothos* spp. of plants, as these have been linked to conjunctivitis in chameleons.

Temperature

There are 4 types of physiological heat transfer: radiation, conduction, convection, & evaporation. Evaporation is the most important in terms of heat loss (see humidity section),

but our husbandry efforts have the greatest effects with radiation & convection within the cage. All reptiles have a preferred optimal temperature zone (or POTZ) where their metabolism runs efficiently. For instance, enzyme activity, blood oxygen carrying capacity, antibody production, digestion, healing rate, and drug activity all function best when the animal is within its POTZ - for every 5 degrees outside of the POTZ, a reptile's immune system function is cut by 50%. Outside this zone, the animal will exhibit thermal seeking or avoidance activity, and if they are within this zone, they will lose this activity. Appropriate cage set-ups take into account the POTZ and natural circadian (i.e. the daytime and nighttime) cycle habits of the individual. It is extremely important to know the POTZ of the animal being kept. It is also extremely important to *use thermometers* to know and maintain the temperature within the POTZ. Keep in mind the POTZ is a range. A temperature gradient is needed from the upper to the lower end of the POTZ. The warmer side is where the heat source is positioned, often with climbing material for the animal to get closer.



Temperature can be supplied as either focal or background heat, or both. For basking animals, (most reptiles) focal, radiant heat from above is ideal. Radiant heat is provided by bulbs and/or ceramic heat emitters (ceramic flood bulbs that only give off heat). Choose the appropriate wattage bulb and adjust its distance to achieve the POTZ. Bulbs that emit white light must be turned off at night to provide a day-night cycle. With non-snake reptiles, basking lights are usually combined with UV-B lights. Under tank heating pads & room heat both work well as background heat sources. If a heating pad is used, it should be outside the tank, and the pad's size should not be more than 1/2 of the underside of the tank. The heat should be uniform & controlled (think thermostats & rheostats). Heat tape and space heaters are acceptable for larger areas if used with care.

All reptile cages should have a thermal gradient within the cage (i.e. the cage should not be uniformly the same temperature, but be different temperatures in different areas), so that the reptile can choose its own temperature suited to its needs at the moment.

The most temperature-sensitive part of many reptiles is the head (greater surface-to-volume ratio, so the head cools faster). When the head doesn't have the correct temperature, the animal will start seeking more or less heat. The body can sense temperature too, but not as well as the head.

This is how hot rocks lead to burns: the head is normal while the body is too hot over a long time period. **DO NOT** use hot rocks OR any other in-cage heaters!!

Nocturnal reptiles still thermoregulate during the day, so give them a thermal-neutral substrate & a heat source all the time.

Use all heat with caution and know the temperature at the hottest and coldest areas of the enclosure by using thermometers. A digital thermometer with a probe can be moved around the cage throughout the day, but otherwise, multiple thermometers will be needed. Allowing the animal to get too close or allowing the heat source to get too hot are serious problems that do cause burns and sometimes fatality. Avoid fire hazards as well. For most individuals housed indoors, providing heat during the day and having it go off overnight is acceptable as this is similar to natural variations in day/night temperatures experienced in the wild. As a general rule, sick and healing animals should be maintained toward the upper end of the POTZ not allowing nighttime temperatures to drop significantly.

General cage temperature setup based upon macro-habitat:

1. Desert – Day: 75-95+ °F; Night: 65-75 °F
2. Temperate – Day: 72-88 °F; Night: 70-72 °F
3. Tropical – Day: 78-100 °F; Night: 72-75 °F
4. Aquatic/Semi-aquatic animals – Land: 75-88 °F; Water: 68-75 °F

These are general ranges that species inhabiting these environments should be housed within. Exact species information should be looked-up.

See additional warning about overheating in the lighting section.

Lighting & Calcium/Vitamin D Metabolism

Light is important for two reasons. First, it provides a day/night cycle which is important for all species. Secondly, light of certain wavelengths (ultraviolet [UV]-B), commonly referred to as “full spectrum” light, are necessary for correct calcium metabolism in many species.

The requirement for ultraviolet/full spectrum light is variable, being particularly necessary for basking lizards and turtles while less critical for snakes (who tend to get all of their Vitamin D3 from their whole prey item diet). Crepuscular (active at dawn and dusk) and nocturnal reptiles are more efficient at converting vitamin D3 than diurnal ones, but most still need UV-B light. In nature, they are still exposed to brief amounts of UV-B light, be it at sunrise and sunset, or from solar light reflecting off of the moon. Recent work suggests that they may benefit from short durations of low level (2%) UV-B exposure (1-4 hours).

The relationship of calcium to light is through the skin and vitamin D3. Vitamin D3 is referred to as the sunshine vitamin because UV-B light wavelengths from the sun help convert precursor molecules into active vitamin D3 within the skin. Since vitamin D3's function is to allow intestinal absorption of calcium, it therefore takes both, exposure to adequate UV-B rays and appropriate amounts of calcium in the diet to achieve normal calcium metabolism. UV-B light includes those wavelengths just shorter than visible light (~295 nm). UV-A light stimulates behavior & appetite, but it is usually found in all UV lights. Not all light bulbs emit UV-A and/or UV-B rays, hence the need for special bulbs.

Light is often intertwined with heat and brings another factor to the equation. Sunlight is the gold standard for truly full spectrum light plus heat. Sunlight can provide full spectrum

light only if un-obstructed by glass or Plexiglas. This means exposure to the sun from behind a window or glass enclosure only provides light and warmth; it will not aid vitamin D3/calcium metabolism. This also means artificial lights cannot be obstructed by glass or Plexiglas, making screen lids the norm. Please use ***extreme caution*** placing animals outdoors in direct sun, especially inside aquariums, as heat builds up like the inside of a car. Heat exhaustion kills!

Three categories of artificial light bulbs are recommended for providing UVB: mercury vapor, metal halide, and fluorescent. The only good bulb at providing all three elements of daylight, heat, and ultraviolet/full spectrum light is the mercury vapor lamp. They provide good UV-B output. Mercury vapor bulbs generally cost about \$60-70 and are readily available under different brand names (T-Rex® and PowerSun® are examples). These look like flood bulbs and screw into an incandescent fixture. Drop off of UV-B intensity over time is less of a concern with mercury vapor lamps. Mercury vapor lights should be replaced every 24 months. With mercury vapor, one bulb does it all!

Metal halide lamps provide good to excellent UV-B output and bright light. They do not get very hot, necessitating an additional heat source such as a ceramic heat emitter or another light bulb. Metal halide bulbs can also be used until they burn out. For metal halide lamp information go to reptileuv.com.

Fluorescent bulbs emit moderate to good amounts of UV-B and give off white light. Similar to metal halide bulbs, however, they don't provide much heat. There are many of these bulbs marketed for reptiles and vary in the strength of their UV-B output. These can have an advantage over mercury vapor lamps by casting light over a larger area of the habitat, but most baskers spend a lot of time directly under the basking light anyway. Historically all these were straight tubes and fit into long fluorescent fixtures, but now there are also versions that are made to fit incandescent screw fixtures. Smaller bulbs will decrease the area over which the light shines. Fluorescent lights should be replaced every 6-12 months (preferably 6) due to UV decay. They should be replaced even if the light is still on (i.e. has not burned out).

Other forms of light are variations of regular light bulbs and natural light coming through windows. These are fine for daylight, a day/night, cycle, and heat, but do not function as a source of "full spectrum" (UV-A & UV-B) light. These can be used for animals that have minimal need for UV-B rays, but this is not recommended. It is generally preferred to use some form of UV-B emitting bulb or exposure to unfiltered (no glass or Plexiglas) sunlight with reptiles kept in man-made environments, regardless of species. Also of note, normal environmental UV-B radiation exposure causes neither sunburn nor immune-suppression in reptiles. However, the heat produced can still burn the reptile, & excess UV-B can sunburn the animal!!

As with all light bulbs, the closer to the bulb is to the target, the greater the strength of its output (in this case, UV-B). This means we want to place bulbs far enough away to not cause burns (remember thermometers!), but close enough to have the desired effect. Meters to measure UV-B are available for testing the actual output strength of the bulb and to compare bulbs. A good starting place is that fluorescent lights should be placed 12-18 inches

from the basking site, and mercury vapor lights should be placed 18-24 inches from the basking site.

Automatic timers make lighting and heating more fool proof and easier. It also makes establishing a light:dark cycle simple for your reptile.

Humidity

Relative humidity is the amount of water that the air can hold at a given temperature as compared to the actual amount of water in the air. As temperatures increase, so does the air's capacity for holding water vapor. However, the actual amount of water in the air will not change unless water is added to the system, so with a temperature increase in a water stable system, relative humidity decreases.

All animals will lose water (and heat, via evaporation of water) in environments where the humidity is less than 100%. They lose water through their eyes, salivary & nasal secretions, urinary, fecal, and reproductive secretions, respiration, and during ecdysis (shedding). To minimize water loss, reptiles will be most active during the times of the highest humidity. They will also exhibit behaviors that have evolved, at least in part, to reduce water loss, such as burrowing in sand or leaf litter, or moving into crevices. This means that desert animals do not live normally at a humidity of 10%, despite being in the desert. They find areas, such as burrows, with higher humidity and spend the worst parts of the day camped out in appropriate microhabitats.

Humidity can be measured in your reptile's terrarium with a hygrometer, or even a digital humidity meter with a probe (made by Exoterra). The probe or hygrometer should be where the reptile spends its time, not at the top of the cage. General humidity guidelines for the major habitats are:

1. Desert habitat: 45-65% humidity
2. Temperate habitat: 55-70% humidity
3. Tropical habitat: 60-80%+ humidity

These are general ranges that species inhabiting these environments should be housed within. For more exact species information, owners are encouraged to check species specific sources in the literature or online.

Humidity can be maintained in several ways. Daily, thorough spraying of the cage with water can be effective if done properly, but it can also result in great variability both in humidity throughout the day, and the amount of water that gets into the cage. An automatic mist system is much better (Zoo-Med), as it can adjust to the humidity & temperature throughout the day. Live plants & waterfalls in the cage will also consistently add to the humidity. Ultrasonic foggers tend to break, so avoid them.

Weekly or daily (during periods of disease or ecdysis) soaking will help keep the animals hydrated. Soaks should be 10-20 minutes, in lukewarm water. Owners should monitor the animals during the soaking, so that the pet does not drown.

In addition to the general cage humidity, you can set up specific areas of higher humidity. The most common method of doing this is to use a hide box with sphagnum moss

inside. A second method is to have 2 or 3 “half-logs”. One should be submerged in water for an hour, then rotated into the cage while another one soaks.

No matter what, the habitat must be ventilated (i.e. a way for air circulation to occur). Humidity without ventilation = diseased animals. Adult chameleons especially benefit from a habitat with screens on multiple sides.

Reptile Nutrition

Reptiles can be broken down into three basic dietary groups: *carnivores*, *herbivores*, and *omnivores*. *Insectivore* is a subset of carnivore and includes many of the lizard species. The omnivores are fed as both carnivores and herbivores, utilizing a combined feeding strategy.

It is not uncommon for a primary herbivore to enjoy some insects (or an occasional meat item) or a primary insectivore to eat vegetables. Therefore, it is important to know specific details of the species being cared for. Research each animal’s specific dietary needs to provide optimal nutrition.

If feasible, vary the food items being offered for more rounded nutrition and enjoyment. Aquatic turtles will generally only eat in the water. Snakes are often fed virtually the same diet lifelong, graduating to larger prey items. However, some snakes (especially indigo snakes) may do better on a varied diet (i.e. rodent, chick, lizard, and frog prey items). Frequency of feeding also varies greatly. Most animals should be fed daily, especially immature lizards and turtles. Snakes are fed once every 5 to 14 days. Snakes should not be fed just before or during a shed when their eyes are cloudy.

HERBIVORES:

Tortoises and lizards such as the green iguana, desert spiny tail (*Uromastyx* spp.), and chuckwalla are herbivores. Other lizards and turtles that are omnivores also get fed some of their diet from vegetation; bearded dragons, sliders, and box turtles are examples.



Much variety exists for the herbivore. Dark leafy greens make up the bulk of their diet. Mustard greens, collards, kale, romaine and leaf lettuce (avoid head lettuce such as iceberg), bok choy, radicchio, spinach, broccoli, green beans, peas, alfalfa sprouts, escarole, zucchini and yellow squash, parsley, lima beans, yams, corn, carrots, beet greens, dandelion flowers and greens, Swiss chard, bell peppers, Brussels sprouts, and mixed vegetables are all appropriate. Grasses and hays can and should be fed to larger tortoises. Timothy and alfalfa rabbit pellets can also be fed to herbivorous reptiles, but many of them have pelleted foods specifically for them as well (ex: ReptoMin, Mazuri, etc.)

Fruits and berries can make up part of the diet but should be limited to approximately 10-15%. Such items include raspberries, melons, strawberries, blackberries, peaches, banana, mango, kiwi, apple, blueberries, and cherries.

CARNIVORES:

All snakes, as well as, many lizards and some turtles are carnivores. Aquatic turtles tend to be more carnivorous than terrestrial turtles. Much variety exists as to what food items are fed to and eaten by carnivores. These animals eat whole prey items such as mice, rats, rabbits,



chicks, insects, feeder fish, earthworms, and slugs. Other meat-based foods can be offered to carnivores, such as dog food, fish flakes, aquatic turtle pellets, trout chow, cooked scrambled egg, primate chow, and small amounts of cat food. Dog and cat food are only to be used when the reptile will eat nothing else, as these diets are very high in protein, and can lead to gout. Also, avoid or limit frozen fish in the diet, as this can lead to a thiamine (a.k.a. Vitamin B1) deficiency.

Some insectivores can rarely be fed whole prey items (this works well for adult leopard geckoes, which can get a pinkie mouse 1-2 times a month – a great source of Vitamin A for them)

Never feed carnivores a diet of only muscle/meat (such as ground beef or chicken breasts) as this will lead to severe nutritional deficiencies. Whole prey animals **MUST** be given balanced and complete rations to ensure they become a well-balanced meal. Pre-killed, frozen thawed mice, rats, or birds are recommended (if the animal will accept it) for multiple reasons:

1. It avoids suffering of the prey animal.
2. It prevents bite trauma to the reptile.
3. It reduces the bacteria & parasite loads that your pet will receive with any given meal

As Vitamin E slowly leeches out of frozen rats, mice, & birds, do not get more than a 6-month supply of these food items at any one time.



INSECTIVORES:

This group includes geckoes, chameleons, and a few other reptiles. Invertebrate diets can include crickets, mealworms, cockroaches, earthworms, superworms, hornworms, and other prey items. The invertebrates must also be fed a balanced diet to be a nutritious food for a reptile. The term “gut loading” describes offering healthy foods to insects prior to them being fed as prey.

Commercial gut load diets are available for crickets and some other insects and can be a dry or a gel-like consistency. It is preferred to use dry formulas and offer water separately. Do not use bowls of water as the insects may drown – instead use soaked paper towels or sponges to give the prey their daily water. Some of the

feeder crickets will die no matter what, so the cricket container will need regular cleaning of the dead crickets and waste material. DO NOT feed insects with an unhealthy appearance to your reptile. DO NOT offer fireflies, as some firefly species are very toxic to reptiles.

Do not EVER leave live, uneaten prey (vertebrate or invertebrate) unattended in the reptile's enclosure. Severe bite injury can occur from both mice/rats and insects that are left unattended and become hungry themselves. An exception can be made for worm insects offered from a bowl in which they cannot climb out.

OMNIVORES:

Omnivore dietary rations are comprised of ingredients from both herbivore and carnivore categories. Specifics vary widely with respect to percentages and items from each category depending on the particular species.



Common omnivorous reptiles include box turtles, sliders (rarely eat vegetable matter that falls into water), red-footed tortoises (occasionally eat carrion), bearded dragons, water dragons, tegu lizards, and blue tongue skinks.

Dietary requirements must be researched for each type of animal. The aquatic turtles tend to be carnivorous as juveniles and become more omnivorous with maturity. Aquatic turtles should be fed in water as it is their normal way of eating. For bearded dragons and chameleons, some researchers suggest a mixed insect diet to improve their dental health (such as adult mealworms & roaches in addition to crickets and mealworm larvae).

Gut Loading Insects

By Peter G. Fisher, D.V.M.

Several species of reptiles and amphibians (Water Dragons, Geckos, Bearded Dragons, some Tortoises, Skinks, and Anoles, to name a few) are insectivores which means they get all or some of their nutrition from eating live, moving insect prey. Crickets and mealworms are the most common insects sold in pet shops for this purpose however; insectivorous reptiles also do well with locusts, wax worms, flies, cockroaches and termites. These insects will provide optimum nutrition for your reptile only if they are well fed themselves. Feeding your reptile a starved cricket or mealworm provides only an empty meal of chitin (the insect's crunchy exoskeleton). Gut loading is the process of feeding insects a nutritious diet prior to using them as food for your reptile. A gut-loaded insect is full of good nutrition that is also good for your reptile.

The following are some suggestions for a gut load mixture that you can offer the insects 48 hours prior to feeding to your reptile. Start with a powder or pelleted base diet such as Harrison's High Potency Mash or a good quality dry dog food. Add beta-carotene for Vitamin A production in the form of dark leafy greens, grated carrots, grated squash or

sweet potato. You can also sprinkle in Calcium powder (Phosphorus free RepCal (<http://www.repcal.com/supp.htm>) available at most pet stores) or powdered/shaved cuttle bone. Mix these ingredients and offer to your insects; again for 48 hours prior to the reptile's mealtime. Insects should also be dusted with Phosphorus-free Calcium powder just prior to offering them to your reptile.

As a rule, the insect food item should be no more than the length and 1/2 the width of the lizard's head. Offer insects in a shallow glass or ceramic dish or plastic pet dish. Some herpetologists recommend leaving mealworms in the food dish all the time or as many crickets your lizard will eat in 15 minutes, every other day. Note: Do not leave uneaten crickets in with your lizard as they may begin to feed on the reptile's skin. Follow these tips and you will be going a long way in offering your insectivorous reptile a nutritious and balanced diet.

Dietary supplements:

Experience with feeding reptiles has led to the current recommendation of supplementing vitamins and minerals to many of the lizard and turtle species. Supplements are usually not necessary for carnivorous animals, including snakes, monitor lizards and snapping turtles that eat whole prey such as mice, rats, chicks, and rabbits. It is very important, however, to supplement insectivore, omnivore, and herbivore diets with calcium and other minerals plus multivitamins. Use powder supplements not spray products.

Supplements are administered differently to growing juveniles than for mature adults. During growth, calcium requirements are the greatest, leading to increased amounts added to the diet for young animals. With maturity, calcium needs are diminished and therefore limited amounts of calcium are added to adult rations. Too much calcium and/or vitamin D in adult reptiles will cause problems (namely, mineralization of soft tissues).

For juveniles, alternate between two products: a multivitamin/mineral supplement used once a week, and a calcium/vitamin D only supplement used 3-5 times weekly (so most meals are supplemented). Sprinkle and mix the powdered supplement into veggies and shake insect prey in the powder prior to offering as food.

For adults a calcium/vitamin D supplement should be added to the diet about twice weekly for herbivores and shaken onto insect prey 2-3 times weekly for insectivores. Remember, insects should also be "gut loaded" to become optimal nutrition. A multivitamin without vitamin D should be offered once every 1-2 weeks. Supplements are typically not needed for aquatic turtles that are fed some amount of commercial aquatic turtle food.

The type of vitamin A given to a reptile in the multivitamin should also be considered. Beta-carotene (or "pre-vitamin A") is appropriate for herbivores and some omnivores, as these reptiles can convert it into vitamin A. However, other omnivores (iguanas), and insectivores (geckoes, chameleons) should only get pre-formed vitamin A (also known as retinol), as the



beta-carotene will be useless to them. Nutritional secondary hyperparathyroidism, better known as nutritional metabolic bone disease, is a common problem in improperly supplemented reptiles. The animal's body will maintain blood calcium at the expense of bone calcium, so that bones become soft & pliable over time. The animal gets weak, doesn't eat as much, may have flexible jaws or long bones, and can develop twitches or seizures in extreme cases. Aspects of husbandry & diet that can lead to

nutritional metabolic bone disease:

1. Lack of UV-B light exposure
2. Improper temperature ranges
3. Decreased calcium in the diet
4. Decreased Vitamin D3 in the diet
5. Too much phosphorous in the diet
6. Anything that causes improper absorption of calcium or Vitamin D3 from the intestine (low vitamin A, parasites)
7. Any combination of the aspects listed above

Water:

Water is a nutritional requirement for all animals and, in addition, is a vital environmental/habitat requirement for many reptiles. Water requirements are just as important to know as the dietary needs for each type of reptile kept.

Aquatic turtles need an appropriate aquarium with good filtration and frequent (weekly to monthly) water changes. It is recommended to de-chlorinate municipal water after a water change to prevent irritation to eyes. A "haul out" area or platform is essential for aquatic turtles to bask.

Some chameleons and snakes need high humidity to replicate rain forest conditions. This is accomplished with water misting from spray bottles, drip systems, and automatic water misting systems. Monitor humidity in the enclosure with a hygrometer. Most terrestrial and arboreal reptiles should have a water source in their enclosure, referred to as a soak pit, which allows them to enter and exit this "pool" safely. Some arid species do not require a soak pit and get all their water from their diet.

Most chameleons enjoy running or dripping water, and many lizards (especially chameleons) WILL NOT drink from a standing water source (like a bowl). Instead they will lap water droplets from plants, cage furniture, and themselves after misting. It is also a good idea to sprinkle water onto the greens and vegetables for herbivores.

What Is A Humid Hide?



A humid hide is a microenvironment with a higher humidity than the rest of the enclosure. It is useful to include in almost all reptile enclosures to allow your pet to have access to a higher humidity when needed such as times when your reptile is shedding. Making a humid hide is generally inexpensive and simple!



All you need to build a humid hide is an appropriate sized plastic container that your reptile can easily fit inside (and can easily fit inside of your reptile's habitat), either sphagnum moss or damp paper towels as the substrate inside, and something to cut the plastic. You can obtain an appropriately sized plastic container by purchasing Tupperware or by using old butter or sour cream containers (make sure they have been thoroughly washed).



Cut a hole big enough for your reptile to comfortably enter either in the side or the top of the container. Make sure you do not leave any sharp edges or corners.



Fill the container with damp sphagnum moss or damp paper towels, replace the lid, and you're done!



Keep your humid hide clean and change the sphagnum moss or damp paper towels at least once a week to keep your reptiles clean, healthy, and happy.

***Salmonella* Bacteria and Reptiles:**

Most, if not all, reptiles carry *Salmonella* bacteria in their intestinal tract and intermittently or continuously shed these bacteria in their feces. *Salmonella* bacteria usually do not cause any illness in reptiles but can cause serious illness in people.

Salmonella bacteria are easily spread from reptiles to humans. Humans may become infected when they place their hands-on objects, including food items that have been in contact with the stool of reptiles, in their mouths. For example, infants have become infected after drinking from bottles of infant formula that became contaminated during preparation. Individuals who prepared the formula had not washed their hands after touching a reptile or because reptiles could walk on kitchen counters. For *Salmonella* bacteria to spread from reptiles to humans, the bacteria must be ingested. Therefore, simply touching or holding a reptile will not result in spread of bacteria unless something contaminated with reptiles' feces or the reptile itself is placed in the mouth.

Most *Salmonella* infections in humans result in a mild, self-limiting illness characterized by diarrhea, fever, and abdominal cramps. However, the infection can spread to the bloodstream, bone marrow or nervous system, leading to severe, and sometimes fatal, illness. Such severe infections are more likely to occur in infants and in individuals whose immune system is compromised (for instance, bone marrow transplant recipients, persons with diabetes mellitus, persons infected with the human immunodeficiency virus, and chemotherapy patients).

Unfortunately, *Salmonella* bacteria cannot be eliminated from the intestinal tract of reptiles. Administration of antibiotics to eliminate these bacteria has been unsuccessful and may result in emergence of *Salmonella* bacteria that are resistant to antibiotics. Attempts to raise or identify reptiles that do not carry *Salmonella* bacteria have also been unsuccessful;

therefore, bacterial culture of stool samples in an attempt to identify reptiles that are not carrying *Salmonella* bacteria is not recommended.



Fortunately, the spread of *Salmonella* bacteria from reptiles to humans can be easily prevented by using the following routine precautions:

- Always wash your hands with hot, soapy water after handling reptiles, reptile cages and equipment, and the stool of reptiles.
- Do not allow reptiles to have access to the kitchen, dining room, or any other area in which food is prepared. Also, do not allow reptiles to have access to bathroom sinks and tubs or to any area where infants

are bathed. Consider keeping your reptiles caged or limiting the parts of the house where reptiles can roam free. Always wash your hands after coming into contact with any area where reptiles are allowed to roam free.

- Do not eat, drink, or smoke while handling reptiles, reptile cages, or reptile equipment. Do not kiss reptiles or share food or drink with them.
- Do not use the kitchen sink, kitchen counters, bathroom sinks or bathtubs to bathe reptiles or to wash reptile cages, dishes or aquariums. Reptile owners may wish to purchase a plastic basin or tub in which to bathe or swim their reptiles. Waste water and fecal material should be disposed of in the toilet instead of the bathtub or household sink.
- The Centers for Disease Control and Prevention recommends that children less than five years of age avoid contact with reptiles and that households with children less than one year of age not own reptiles. The Association of Reptilian and Amphibian Veterinarians (ARAV) encourages reptile owners with young children to discuss steps to minimize risks associated with owning reptiles with their reptiles' veterinarian and their physician. Children should be supervised when they are handling reptiles to ensure that they do not place their hands or objects that a reptile has contacted in their mouths. Reptiles should not be kept in child care centers.
- Immunocompromised persons should avoid contact with reptiles.
- Follow instructions from your reptile's veterinarian concerning proper diet and environment for your reptile. Healthy reptiles living in proper environments are less likely to shed *Salmonella* bacteria.

The information in this handout is not meant to discourage reptile ownership. With a few exceptions (for example, infants or immunocompromised individuals), most people have a low risk of acquiring salmonellosis from reptiles, but this risk can be reduced even further by following simple precautions. Reptiles can be safely kept as pets, but reptile owners should be aware of the methods for reducing their risk of acquiring *Salmonella* bacteria from their reptiles.

This handout was developed by the Association of Reptilian and Amphibian Veterinarians in collaboration with the Centers for Disease Control and Prevention and is intended for informational purposes only; please seek advice from your physician and your reptile's veterinarian if questions or problems occur.

This handout is also available on the ARAV website: www.arav.org/



Adenoviruses in Reptiles

Adenoviruses are small, highly resilient viruses. Until recently, all known reptile adenoviruses fell into the “Atadenovirus” grouping, so that phrase has become a synonym for reptile adenovirus infection. Currently, there are 16 known reptilian adenoviruses (Nile crocodile, monitor lizard, agamid, skink, chameleon, 2 gecko, 2 Gila monster, 3 snake, Sulawesi tortoise, leopard tortoise, red-footed tortoise, & box turtle). They are thought to be very host specific (i.e. the bearded dragon form will not infect a skink, dog, person, etc.). Transmission is via contaminated food and water but may be passed from mother to offspring as well. Reptiles infected with adenoviruses may be infected for life and serve as a source of infection to other members of their species for the rest of their lives. While uncommon in other reptiles, agamid adenovirus now appears to be widespread in captive bearded dragon populations.

Adenovirus infections appear to take the greatest toll on young or immune-compromised animals. The gastrointestinal tract and liver are the most affected organ systems but reports of the virus causing damage to the kidneys, brain, and bone marrow have been published as well. Clinical signs of disease include **failure to thrive, anorexia, weight loss, lethargy, green feces/urates, hind leg weakness, abnormal postures, neurologic abnormalities, seizures, and sudden death**. As this virus can suppress the patient’s immune system, **bacterial and parasitic infections** often occur (especially in bearded dragons, in which pinworms and coccidia are prevalent).

Unfortunately, none of these clinical signs are specific to this disease, and some individuals can be infected and not show any clinical signs. Older animals are often less likely to develop disease but can infect younger animals. Diagnosis is best via a PCR test (which looks for specific segments of the virus’ DNA) performed on a swab of the oral and cloacal

surfaces +/- feces. The agamid (bearded dragon) adenovirus has a commercially available test. In other species, the test must be performed in research laboratories.

In cases of suspected clinical disease, treatment consists of optimizing husbandry problems, supportive care (e.g. fluid therapy, assist feeding, anti-inflammatory medications, & liver support), and anti-viral medications (if available). Acyclovir, a medication for herpesvirus infection, does not appear to have much effectiveness against adenoviruses. However, some promise has been shown in cidofovir and oseltamvir (Tami-Flu) in bearded dragons. In addition, feeding more vegetables may help. These treatments may only control clinical signs, but do not necessarily eliminate the virus from infected individuals.

Prevention is best achieved by quarantining new animals for 30-90 days, testing, and exclusion of positive animals from a population. Positive animals often lead productive lives but should be kept separate from adenovirus negative animals. Positive animals should NOT be bred. Unfortunately, if the virus does progress to the neurologic stage, prognosis becomes very poor. There is no effective vaccine to date. The virus is very hardy and survives for long time periods in the environment. Bleach may be used to disinfect contaminated cages or cage furniture.

We currently recommend adenovirus testing in all bearded dragons, healthy or sick. We now **require** adenovirus testing for all **boarding** bearded dragons as well. If your bearded dragon tests positive for adenovirus, it can still board with us, but we will need to keep it separate from adenovirus negative animals.

What to Do When Your Snake Is Not Eating



Inappetence or anorexia are common causes of reptile visits to a veterinarian. When a pet snake misses several meals, it is best to try and determine if this is the result of an illness, a physiological change, or the result of environmental/seasonal changes. Environmental or husbandry-related issues include the cage temperature being kept too low (or high), too much human handling or aquarium tapping, or housing in close proximity to a noisy home entertainment center. Physiologically, the breeding season, times of pregnancy, shedding (ecdysis), hibernation/estivation, or having just been born/hatched are times when a snake may not eat in nature!

Environmental husbandry is the most common non-physiologic reason for lack of appetite. Ensure that your pet reptile's diet, cage temperature range, humidity, light cycle, substrate, and water presentation are correct. The Preferred Optimum Temperature Zone (POTZ) is the range of environmental temperatures that are best suited to a particular reptile species. The POTZ varies somewhat between snake species:

Species	T°Celsius	T°Fahrenheit
Common Kingsnake	25-50	77-86

(<i>Lampropeltis getulus</i>)		
Corn Snake (<i>Elaphe guttata</i>)	25-30	77-86
Boa Constrictor (<i>Boa constrictor</i>)	28-34	82-93
Burmese python (<i>Python molurus</i>)	25-34	77-93
Royal python (<i>Python regius</i>)	22-30	78-94

As a rule, the cooler temperature in the recommended range represents the evening or nighttime temperature and the warmer temperature the environmental temperature near the basking light during the daytime. If the vivarium environmental temperature remains outside this range, lack of appetite may occur. Lizards and turtles need UV-B light, which can stimulate appetite in addition to helping maintain calcium-phosphorus-Vitamin D3 balance.

Cage size, providing a “hide box”, providing stable branches for species that live in trees, preference for live or dead prey, the presence of a more dominant snake in the same cage, and too frequent handling or human interference are additional factors that may affect a snake’s appetite. Lighting left on for prolonged periods of time may also cause stress in a captive snake, making it stop eating. Lastly, a snake may not eat if the wrong food is offered or if the food is offered incorrectly (e.g., on the ground for a snake that lives primarily in trees or during the day for a nocturnal snake). Overfeeding a snake may also create a period of in-appetence afterwards. For carnivores, prey should be appropriately sized for the animal. Offering prey during the correct time of day can help entice reptiles to eat as well. Reptiles with round pupils should be fed during the daytime, while reptiles with cat’s-eye or vertical pupils should be fed in the evening.

Keep in mind that some periods of anorexia (appetite loss) are natural for many snakes especially just prior to shedding, during the ‘hibernation’ or fall/winter rest period, or during breeding season. As the day shortens in the fall or winter and if there is a window in the room where the snake is maintained, appetite loss may occur. In this situation anorexia may occur regardless of whether artificial lighting is provided or not.

A visit to a veterinarian who is knowledgeable in the care of reptiles is always a good idea in order to get tips on appropriate care and to ensure there is not a medical illness causing the appetite loss. Always bring a fresh stool specimen during your visit, as intestinal parasites are a leading cause of not wanting to eat. Your veterinarian will assess for digestive and urinary tract parasites, respiratory infections, oral gum infections, as well as other health problems. If determined to be healthy, there are several reasons why an otherwise healthy pet snake may not eat in captivity. If your veterinarian determines your snake is healthy, intestinal parasites have been ruled out, and you have corrected the environmental influences discussed above, the following are some tips you may try to encourage your pet snake to eat:

1. Try different prey items – attempt to vary the type of prey (rat, mouse, lizard, day-old chick, fish) or the color of the prey (brown vs. white rats). The snake may be

used to one particular type of prey item, or it could require variety (especially indigo snakes!).

2. Try fresh-killed vs. thawed, warmed previously frozen prey.
3. Feed in a dark, very quiet environment and leave alone- depending on the size of the snake a small, dark box in the evening works well. It is OK to leave dead prey in overnight, but **NEVER** leave live prey in with a snake unless you are monitoring the activity. Live prey can bite & cause serious damage to the snake.
4. Turn a small plastic bucket upside down, with a hole in its side large enough for the snake to enter. Place the prey/food item under the container and leave overnight.
5. Instead of the bucket, try putting the snake and food item together in a brown paper shopping bag – staple it shut and leave in the vivarium overnight.
6. Braining – cut open the head of a frozen-thawed prey item & offer it to the snake. This increases the smells that would occur with normal hunting of prey.
7. Scenting – rub a pinkie mouse on something the snake would eat in the wild, such as a lizard or fish, to make it smell like your pet’s normal diet. Or, if you snake likes a particular prey type, like gerbils, try placing the mouse prey in dirty gerbil litter to mimic the gerbil’s scent.
8. If the snake is newly born or hatched, allow the first shed to occur, then leave a pinky mouse in the cage with them overnight.
9. Try dipping the dead mouse in chicken soup, straight out of the can, prior to feeding.
10. Turn off all cage lights for 1 week, then try feeding again.
11. Ball pythons (that actually ball up) – turn them over, put the prey item (**NEVER LIVE**) in their coils, and leave them alone.
12. Live prey – this is not preferred, as there is an increased chance of parasite transmission & risk of injury to the pet reptile, but some snakes & lizards will accept nothing else. We recommend trying this **LAST**.
13. Medications – there is some anecdotal evidence that single doses of the following medications or vitamins will act as an appetite stimulant: Metronidazole, Lactulose, Vitamin E/Selenium (usually in combination), & Vitamin B1 (Thiamine).

NOT Recommended:

1. Putting a snake in the refrigerator for 6-8 weeks – the concept is to induce a “forced hibernation” state in the snake, so it will be hungry after it comes out of the fridge. However, as a reptile’s digestion & immune system function are directly influenced by temperature, this often leads to infections instead of an appetite increase.

Finally, be patient – if these tips don’t work one week, try again a week later. If your snake continues to refuse food for months, starts to lose obvious weight, or becomes depressed or lethargic, another health checkup may be warranted.

Adapted from a presentation by Dr. P. Koelle at the 2013 A.R.A.V. conference

Common Exotic Pet Toxins

Pesticides – these are a common source of intoxication for domestic pets and exotic pets alike. If your pet spends time outside, it is at risk for exposure to pesticides placed not only in your yard, but from run-off from adjacent yards or farmland. Herbivorous grazers and reptiles that eat insects from outdoors can ingest the toxins, but sometimes animals may become intoxicated from skin exposure alone. Always be aware of what your house and yard are treated with, as well as that of your neighbors. **DO NOT** allow your pet to graze or hunt if the safety of the food source is in question. If you are treating your pet for any external parasites (such as snake mites) with any of these products, **DO NOT** use them in conjunction with each other, especially products within the same class of chemical.

Organophosphates, Pyrethrins, and Metaldehyde are all examples of toxic to reptile pesticides.

Always check with us before you use/put any type of pesticides around/near your reptile's environment.

Rodenticides are rarely ingested by exotic animals. There are three main classes: vitamin K1 blockers, bromethalin, and vitamin D3 amplifiers. It is important to differentiate between these three types for treatment, so if you suspect that your pet has eaten one of these compounds, please make every effort to bring in the box, or otherwise identify the compound.

Vitamin Supplements – Vitamins A and D (in addition to minerals) often need to be supplemented by reptile owners to their pets but can sometimes be given too often. These vitamins are fat-soluble and have a lower margin of safety than water-soluble vitamins (the excess of which can be excreted by the kidneys). Vitamin D can also be increased by the actions of some rodenticides (see above). Too much vitamin D can cause increased blood calcium, which will lead to depression, weakness, anorexia, and kidney failure (increased drinking, increased urination, weight loss, vomiting). It can also lead to calcification of soft tissues if the calcium increases enough. Both radiographs and a serum chemistry profile are indicated if hypervitaminosis D is suspected. Too much vitamin A can cause lethargy, inappetance, full-thickness skin sloughing, skin discoloration, and secondary bacterial infections. Prognosis depends upon the severity of the lesions. Vitamin D induced tissue mineralization may not resolve with treatment but remain a lifelong problem. The author currently recommends supplementing calcium and vitamin D3 1-2 times per week, and supplementing vitamin A (in a multivitamin without vitamin D) once every other week (not on the same day as a calcium and D3 supplementation) in **adult** animals.

Ivermectin – members of this drug class are found in many heartworm preventatives and anti-parasite medications. However, it is toxic to several reptiles, including all chelonians (turtles, tortoises, and terrapins), all skinks, and the indigo snake (*Drymarchon* spp.). Crocodylians may also be negatively affected. Clinical signs are mainly neurologic, including depression, paralysis, blindness, ataxia, coma, and death. Unlike other poisons that cause neurologic signs and seizures, diazepam and midazolam do not really help control the clinical signs with this poison. The only options are supportive care, fluids, anesthesia if seizures occur (which could be dangerous if the animal is depressed or comatose), and drugs to

counter any anaphylactic reactions. Never administer these to turtles, skinks, or indigo snakes.

Fireflies – fireflies of the genus *Photinus* contain cardiotoxic compounds, similar in action to the toxins of oleander, foxglove, and lily of the valley plants. The most common victim of this poisoning is the bearded dragon (other lizard species are often immune to the effects, know not to eat the insect, or flick it out of their mouths upon biting it). Signs of intoxication include pronounced mouth gaping, intense beard color change, and trouble breathing within 30 minutes of firefly ingestion. One firefly is reported to be enough to easily kill a 200 g lizard in 60-90 minutes. As only a trained entomologist can tell *Photinus* fireflies apart from other firefly species, we recommend not feeding any fireflies to your pets, or allowing them to hunt for insects unsupervised.

Medications – as Paracelsus stated long ago, “Dosage differentiates the poison from the remedy.” Many commonly used medications, including antibiotic, anti-fungal, and anti-parasitic drugs, can be toxic to your pets if given at improper dosage ranges. In addition, individual animals may have allergic reactions to specific classes of medication (these reactions are impossible to predict). Always store medications where all of your pets (and children) cannot reach them. Always give the amount of medication directed by your veterinarian and call your veterinarian if you have any questions or concerns about a medication, a pet’s reaction to a medication, or a dosing regimen.