

Reptile Vision: What you need to know and how it pertains to your husbandry

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What Reptile Keepers Need to Know About Reptile Vision

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As a major sense, we depend on our eyes a lot. Our eyes help determine when we feel awake and when we feel sleepy. They help us choose what to eat. They also enable us to recognize friends from a distance. And that's just a few examples. It's safe to say that for those of us who can see, vision plays a significant role in how we perceive and interact with the world around us.

Vision is a major sense for reptiles, too. Although some believe that reptiles have relatively poor vision compared to humans, the truth is that reptiles arguably have *better* vision than humans do. Here's a quick rundown of how reptile vision works, how vision affects how they perceive and interact with the world, and how this knowledge affects how we need to be caring for reptiles in captivity.

The Reptile Eye

Reptilian eyes are generally similar to other vertebrates. Each eye is a sphere filled with fluid (*aqueous humor* and *vitreous humor*) to keep it from collapsing. The outside wall of the eyeball is called the *sclera*. The inside surface of the sclera is lined with a heavily pigmented sensory layer called the *retina*. The outside surface of the sclera is covered in a transparent layer called the *cornea*, which also covers a round hole in the sclera, the *pupil*. The size of the pupil is governed by a set of pigmented muscles surrounding the pupil, called the *iris*. Behind the iris and pupil is the *lens*, which is what all light passes through before reaching the retina.

Snakes, geckos, and other eyelid-less reptiles have an additional covering over their eye called a *spectacle*. This scale acts as a transparent eyelid and is replaced every time the animal sheds its skin.

The Retina

The retina has two main types of photoreceptor (light-receiving) cells: *rods* and *cones*.

Rods contain a single photo-sensitive pigment and don't distinguish colors. However, they are very sensitive to light and help in perceiving motion. Nocturnal reptiles generally have more rods than cones.

Reptile cones generally contain colored drops of oil, and different types of cones are attuned to different colors. The different pigmented oils act as miniature lenses, channeling and filtering light depending on which wavelength they're attuned to. However, they only function above a certain level of light. Diurnal reptiles generally have more cones than rods.

The Lens

Like humans and other mammals, lizards change the shape of their lens to focus on nearby or distant objects. Snakes, on the other hand, move their lens forward or backward, which is similar to how cameras focus.

Speaking of snakes, snakes don't actually have colored drops of oil in their cones. Instead, many of them have an amber-tinted lens, which plays a similar role.

The Pupil

Reptiles usually have round or vertical (slit) pupils, although a few of them have horizontal pupils. Turtles and most lizards have round pupils. Snakes can have either round or vertical pupils. Crocodylians and geckos have vertical pupils.

Generally speaking, nocturnal reptiles tend to have vertical pupils, and diurnal reptiles tend to have round pupils.

The Parietal "Eye"

Some lizards actually have 3 eyes! The third eye is known as the *parietal eye*, and is located on the top of the head halfway between the other eyes. This “eye” is only an eye in a very basic sense: it has a lens and a retina, and it connects to the pineal body of the brain. This eye can’t form images or differentiate color, but it senses light and darkness, and plays a role in thermoregulation, hormone production, and the amount of time that a lizard spends basking in the sun.

The Pit Organ

Pit vipers, boas, and pythons have a *pit organ*, which enables them to see the infrared (heat) wavelengths that are invisible to humans. Pit vipers have *heat pits* on either side of the head, between the nostril and the eye. Boas and pythons have *labial pits* which are placed among the labial (lip) and/or rostral (snout) scales.

However, research shows that many pitless snakes also have the ability to detect infrared.

What Can Reptiles See?

Reptiles can see color. Most reptiles are *tetrachromats*, which means they have 4 types of cones (humans only have 3 – red, green, and blue). This means that they can see the entire rainbow that humans can see, and more. However, certain species of geckos are known to lack the red-sensitive cone, which makes them red-green colorblind, which works the same as in humans with the same condition. Reptiles that have fourth cone allows them to see UVA light.

Some reptiles can see UVA. UVA is a spectrum of ultraviolet that is invisible to humans, but is perceived as an “expansion pack” on the rainbow for reptiles that can perceive it. This expanded rainbow is speculated to drastically change the way that reptiles see the world in the presence of UVA, and reptiles that don’t typically have UVA lighting in their enclosure have been known to “freak out” when taken outside, where the world is flooded with UVA. It can play a role in identifying food, recognizing other members of their species, identifying good basking sites

Some reptiles can see very well at night. With lots of light-sensitive rod cells in their retina and/or a vertical pupil that can expand to cover almost the entire eye in dark conditions, nocturnal reptiles can see just as well in total darkness as humans can see during the day — they can even see color! In studies they have shown the ability to be able to distinguish blues from browns in extremely dim light where humans are unable to perceive color.

Some snakes can see heat — and they see it well. This ability is assumed to have evolved to assist in hunting warm-blooded prey (ex: mammals, birds), as those that prey primarily on cold-blooded creatures (lizards, other snakes, fish, insects) don’t seem to have a pit organ. The pit organ is extremely sensitive to tiny changes in temperature, or the amount of infrared radiation — they can distinguish changes as small as 0.001°C! It is speculated that these snakes can “see” their surrounding just as well with infrared as they can optically, although in the presence of light, their vision is likely a combination of images from infrared, visual light, and (where relevant) UVA perception.

Reptiles can see well. Many diurnal reptile species are known to have high visual acuity. Many diurnal lizards have a *fovea centralis*, which is a depression in the retina that makes acute vision possible. Certain diurnal snakes are known to rely on their vision for hunting, rather than infrared or scent, and have demonstrated the ability to track distant objects.

What Does This Mean for Reptiles in Captivity?

It's important to provide a day-night cycle. Even without a parietal eye, significant changes in light levels affect the amount of melatonin that reptiles produce, which in turn helps govern their circadian rhythm. Even something as small as providing a halogen heat lamp for basking that turns off at night can make a difference. However, diurnal species are often reported to have higher energy levels, better appetite, and all-around more natural behavior when more light is provided, such as from a very bright 6500K fluorescent or LED lamp.

UVA should be provided as part of the lighting setup. The good news is that all UVB bulbs also emit UVA. The bad news is that UVA-emitting daylight bulbs are not yet readily available in the US. This means that it is extra important to install a UVA/UVB bulb of appropriate strength and high-quality manufacture as part of reptile enclosures, which will facilitate both full-color vision and vitamin D3 synthesis.

Frozen feeder birds and rodents should be warmed to 98-107°F during the process of thawing in warm water (you can use a temp gun to check). Average mouse body temperature is 98-100°F. Average chicken body temperature is 103-107°F. Warming thawed prey items to this temperature helps snakes better recognize food, resulting in better feeding responses and fewer accidents where the snake bites the human instead of the prey.

Color can be used to help train reptiles. Different species are attracted to different colors — for example, Sudan plated lizards seem to have a preference for red, while chuckwallas seem to have a preference for yellow. Herbivorous reptiles are highly attuned to the color green. Some have observed that snakes may prefer blue and green over other colors. This can be helpful for choosing the color of a training target.

Conclusion

Reptiles are just as dependent on their sense of vision as humans are — and quite possibly more! When we ignore the unique way that they perceive the world, we reduce their quality of life in captivity and miss out on an opportunity to enable them to exercise natural behaviors as part of overall welfare.

The Dude Abides

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