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Shed light on the mysteries of reptile lamps.

BY LANCE RICH

For those of us who go to great lengths to provide our reptiles with the absolute best care possible, the issue of lighting has come up more than once.

We've probably all asked the same questions from time to time. Questions like: "Is ultraviolet light *that* important to the health of my reptiles? How can I make sure my reptiles get enough of it, and how much is enough? Should I go to the effort of allowing them access to natural sunlight? Do the so-called 'reptile lamps' really work? and "How do reptile lamps compare to sunlight?"

Unfortunately, there are more questions than answers at this point. But through the continuing efforts of herpetologists and hobbyists, we're getting closer to solving some of these mysteries.

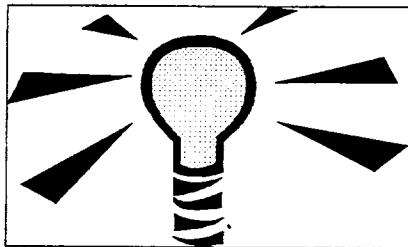
The intent of this article is to help you understand what ultraviolet light is, which

kind of ultraviolet light is beneficial for the health of your reptiles, some basic lighting terms, how to choose the proper lighting and how artificial light compares to natural sunlight. This article is designed for both the beginner and the advanced herp hobbyist, and each should be able to gain valuable insight into ultraviolet light.

Light Defined

The following information will help give you some basic knowledge about ultraviolet light. First, let's take a look at a simplified explanation of a light wave.

Light is composed of a range of energy wavelengths. The distance from the top of two waves is a wave-length. These wavelengths are measured in nanometers. To illustrate how "short" these wavelengths are, a nanometer is equal to .000001 millimeter (That's short!) Light waves are then segmented and labeled according to their lengths.



Now let's take a look at the light spectrum. At the lower end of the light spectrum, gamma rays and X-rays which have the shortest wavelengths. A general rule of thumb when it comes to light wavelengths is, the shorter the wave, the more "intense" it is, and the more deeply it penetrates our bodies.

Visible light, at the right end of the light spectrum, are the light wavelengths we can see with our naked eyes. They have longer wavelengths, and are completely harmless. Visible light is made up of different wavelengths, each one representing a different color.

Infrared rays (not shown) are further

right on the light spectrum and are longer than visible light waves. Infrared rays are an excellent source of heat. They are used in processes such as photography, drying or baking materials and heating food (such as food lamps in cafeterias and last food restaurants).

Infrared spot bulbs are an excellent source of heat for your reptile. You can purchase these at a hardware or pet store. Just be careful to never let your reptile get too close to an infrared bulb; they are intense.

Ultraviolet Light

Ultraviolet light comprises the middle section of the light spectrum graph. Ultraviolet light is broken down into three categories: UVC, UVB and UVA. It is important to know which ultraviolet rays are most important to reptiles, as this is critical when choosing proper lighting.

UVC rays are the shortest ultraviolet rays and are not a factor of importance when dealing with the health of reptiles. Because they are shorter UVC rays are the most "acute" ultra-violet rays. They are so intense that even a small amount of exposure would result in immediate and severe burning to humans, and prolonged exposure would ultimately result in the death of all life on earth.

In fact, one of the primary purposes of the earth's ozone layer is to filter out ultraviolet rays, especially UVC rays because they are so dangerous. One of the consequences of the deterioration of our ozone layer, in addition to global warming, is that it will allow more of these harmful rays to penetrate to the earth's surface.

UVB rays are the medium length ultraviolet rays and are the most important rays when it comes to your reptiles' health. It is the UVB rays that convert ergosterol in the skin to Vitamin D. Vitamin D must be present in the right quantities in order for calcium to be properly absorbed into the system. This process works the same in humans as it does in some reptiles.

In humans, a Vitamin D deficiency results in a bone disease called rickets. In reptile, a Vitamin D deficiency results in what we call metabolic bone disease. This means that because of a Vitamin D deficiency, calcium has not been properly absorbed, resulting in a

weakening and deterioration of the bones.

Thus, the lack of UVB rays can be *one* of the contributing factors of calcium deficiency in our reptiles. (Diet is equally important.) Without the necessary UVB exposure and proper diet, humans and other animals will sooner or later suffer from Vitamin D deficiencies which can ultimately maim, distort and even result in death. This does not apply to all reptiles, just those that

ate considered "basking" reptiles, such as iguanas, many, species of turtles and desert dwelling species such as the uromastix.

UVA rays are the longest ultraviolet rays and do not contribute to the production of Vitamin D. However, many hobbyists and even some

breeders report that exposure to UVA rays seems to have a positive effect on the skin color, appetite and mating behavior of their reptiles. Although the exact long-term health benefits of UVA exposure have never been experimentally proven, it has been demonstrated that UVA rays have an influence on aggressive, reproductive and signaling behaviors in some species of lizards.

Purchasing the right kind of lighting for your reptile can be very confusing. Before throwing down \$20 or \$30, it is important that you understand some of the basic terms manufacturers use, and some of the more commonly asked questions.

What does the term "reptile bulb" mean? The term "reptile bulb or lighting" is just a general term that covers any light-source that is packaged and labeled as "reptile lighting." This certainly doesn't mean that just because it is marketed as reptile lighting it contains the necessary ultraviolet rays your pet needs. However, for the purposes of this article, when I refer to reptile lighting, I am specifically referring to light

sources that produce ultraviolet light.

What does the term "artificial light" mean? The term is a bit misleading. There is no such thing as artificial light. Light waves are light waves, period. What differs is how the light is produced. Artificial light is light that is produced from an artificial source. Essentially, any man made light source is considered to produce artificial light. Sunlight, on the other hand, is "natural" light.

Are there different kinds of "artificial light" sources? There are basically eight different kinds of artificial light sources. Each one produces light using different gases, shapes and processes. The result is a mixture of light waves that are used for different purposes. The two most common artificial light sources are fluorescent and incandescent.

What is a fluorescent lamp? A fluorescent lamp is basically a glass tube that is coated inside with phosphor. (All fluorescent tubes are referred to as lamps. A ballast is the name of the fixture that holds a fluorescent lamp.) Fluorescent lamps are designed to produce a wide range of light waves, including ultraviolet rays. However, there are hundreds of different kinds of fluorescent light lamps, each one emitting different variations and combinations of light rays. Just because it is a fluorescent lamp, doesn't mean it emits ultraviolet rays.

What is an incandescent bulb?

An incandescent bulb is just a standard light bulb like you have at home. Incandescent bulbs are not full-spectrum. They can produce very small amounts of UVA, but do not produce any UVB. They are strictly a source of heat and visible light.

What is "black light"?

Black light is the term applied to certain lamps that produce primarily UVA rays.

What does "CRI" mean?

CRI stands for Color Rendering Index. CRI is a measurement

of how closely the color of light emitted from the lamp, matches the natural color of sunlight. CRI is measured on a scale from 0 to 100. The closer the number is to 100, the closer the light from the lamp matches the sun. The term CRI deals only with visible light rays. For example, if you were to take a red shirt outside in the sun, it would look red. If you were to take that same shirt inside and view it under the light from an incandescent bulb, it may look slightly more orange, or even pink, depending on which light bulb you are using. This is because artificial light sources emit different mixtures of visible light waves, resulting in a difference in the way a color is perceived. So, a fluorescent lamp with a CRI of 91, indicates that the color emitted by this lamp pretty closely matches the natural color of the sun. A standard incandescent bulb, by contrast, only has a CRI of 56.

Since CRI does not indicate whether a lamp produces ultraviolet rays, why does it matter? Well, some lamp manufacturers claim that the more closely the color of the light matches the color of sunlight, the more positive physical and psychological effects it will have on the reptile. Their premise is that the more closely you can replicate the natural environment of the reptile, the better off the reptile will be.

This sounds plausible, and there have been reports indicating that the color of light does have other physical benefits. For example, in animals, light regulates a hormone called melatonin. Melatonin affects the maturation and cyclic activity of sex glands, possibly affecting an animal's ability to reproduce.

In a study done with golden hamsters, it was discovered that hamsters exposed to full-spectrum lights had one-fifth less caries than animals exposed to conventional fluorescent light. Also, the total body, gonad and sub-mandibular gland weights were higher for hamsters exposed to "full-spectrum light" than ani-

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mals exposed only to conventional fluorescent light.

What is "full-spectrum lighting"?

Full spectrum light is a term that was given to the Vita Lite when it was first produced. Technically, full-spectrum lighting" is an artificial light source that has a CRI of 90 or higher, as well as a correlated color temperature and spectral power distribution that is similar to sunlight.

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This simply means that there are three factors that correspond to sunlight--the color (CRI), temperature (CCT) and spectral distribution (SPD) of power among visible light waves. To further simplify, it is the closest thing to sunlight (visible light waves only).

Once again, the term full-spectrum light deals only with visible light rays, and does not necessarily mean that ultraviolet rays are present. Also, the term full-spectrum is not regulated, and there are some companies that erroneously claim their product is a full-spectrum light source. The simplest way to tell if a lamp is full-spectrum is to see if the CRI is above 90.

There are some full-spectrum lights that do emit small quantities of UVA and UVB rays, but you will never get a significant amount of ultraviolet light from a true "full-spectrum" lamp. With fluorescent lamps the phosphor must be increased in order to produce higher amounts of UVB. This, however, reduces the CRI. The higher the phosphor, the more UVB, but the lower the CRI will be.

Full-spectrum lamps are excellent at simulating natural sunlight, which is great for overall color of your enclosure and reptiles, but they do not produce significant amounts of ultraviolet light. Full-spectrum lamps make good choices for snakes and am-

phibians, but not lizards or turtles unless you have full-spectrum lamp for color, and one lamp for UVB.

What is a neodymium bulb?

Neodymium bulb is an incandescent bulb with the yellow colors of the visible spectrum removed and the inside of the glass coated with neodymium, resulting in a brighter, whiter light. Some neodymium bulbs are sold as full-spectrum lights. This is not true, and they are not a significant source of ultraviolet light, UVA or UVB. They are ideal as a source of heat and they provide superior color rendering over standard incandescent bulbs, but they will *not* meet the requirements needed for UVB in your reptiles.

What does it mean when a lamp is rated as 3.0 or 5.0?

This number refers to the percentages of UVB rays emitted by that lamp. The higher the number, the higher the percentage of UVB rays being produced. If the same manufacturer makes a 3.0 lamp and a 5.0 lamp, the 5.0 lamp would emit more UVB rays.

However, you can't compare lamps from different manufacturers based on this number because this is only a percentage of the total output of the lamp. This means that a lamp with a 3.0 or 3 percent rating could emit more UVB rays than a different lamp with a 5.0 or 5 percent rating if the 3.0 lamp was producing more energy overall (called lumens). Let's say that the 3.0 lamp was producing an overall output of 1,000 lumens, this would be a total UVB output of 30 (3 percent x 1,000). If the 5.0 lamp was producing 500 lumens, then there would only be a total UVB output of 25 (5 percent x 500).

How often should I change my UVB lamps?

I recommend changing your lamps every six months to receive maximum impact. With most UVB lamps, after six months usage, at eight hours a day, the distance the UVB rays

emit is cut in half. So if your reptile was receiving some benefit from basking within 12 inches of the lamp, after six months it would have to lay no further than 6 inches from the lamp to continue receiving the same benefits. If you are in doubt, call the manufacturer. They are a good source of information and can provide you with change-out instructions, as well as detailed information about their lamps and UVB output.

Is it safe to look directly at a "reptile lamp"?

As we will discuss later, the concentrations of ultraviolet rays emitted from reptile lamps are fairly insignificant, and are below the legal limits for ultraviolet radiation, so there is little danger of hurting your eyes by looking directly at a reptile lamp. In order to do some damage you would have to be within 6 and 12 inches and stare directly at the lamp for a period of time.

I'm sure you've also heard that you are never supposed to look directly at the sun; this is very true. If you've ever been tanning indoors, you've been instructed to wear goggles. The amount of UVB rays coming off those lamps are very intense and could cause immediate and permanent eye damage. UVA damages the retina and UVB damages the cornea.

Measuring Ultraviolet Light

A radiometer is the instrument used to detect and measure ultraviolet light. The radiometer I use measures the output of ultraviolet rays in microwatts per centimeter squared (mW/cm²). This is not important to understand, it is just a way of representing how much of a particular light wave is being emitted at a particular time. For our purposes. It gives us a way to compare different sources of light to see how much ultraviolet light is being emitted.

I decided to do some experiments with my radiometer to determine how to best meet my reptiles' lighting needs. (The ra-

diometer I was using measures total UVA and UVB output.) First, I took measurements of natural sunlight. The measurements were taken in St. Louis, the 16th of July, throughout the day. The average reading on the radiometer was 5mW/m².

In comparison, a brand new standard tanning lamp we tested emitted 14 mW/cm². That's almost three times the intensity of the sun. Basically, 20 minutes in a tanning bed equals 60 minutes

in the sun. (Considering you lay perfectly still and there are no clouds whatsoever.)

The best "reptile lamps" I measured only emitted readings of .1 mW/cm² at a distance of 6 inches from the surface of the lamp. That's 50 times less intense than natural sunlight.

Some lamps did not register readings in microwatts until distances of 2 inches or less were achieved. (If you'd like specifics on the different lamps and their measurements, I recommend an excellent article, by William H. Gehrriann, called "Reptile Lighting: A Current Perspective," in Volume 8 Issue 2 of the *Vivarium*.)

To illustrate what this means to a basking reptile, I was in the Yucatan Peninsula in July of this year and had a chance to observe spiny-tailed iguanas in their natural habitat. Using my radiometer, I took readings that averaged 4.9mW/cm², almost identical to the readings taken in St. Louis. (The Yucatan Peninsula is just southeast from St. Louis)

The average basking time was approximately four hours per day. This means that the average iguana was exposed to 4.9mW/cm² for a total of four hours, resulting in a total approximate exposure to ultraviolet light (both UVA and UVB) of 19.6 mW/cm². (This will vary according to cloud cover, how often the animal retreats or is forced into hiding by other predators, etc.)

In order to equal just one day's

exposure in the wild, a captive iguana would have to lay under one of the best reptile lamps eight hours a day, for almost 25 days!

However, before you draw any firm conclusions, there are other factors that must be considered. How much UVB is really necessary for reptiles to make the necessary Vitamin D, and how much of the ultraviolet light is the reptile really absorbing?

The answers to these questions are still unknown. However, I do believe we can agree on the following facts according to our current knowledge:

(1) Iguanas, most turtles, as well as other desert-dwelling lizards such as the uromastyx, require UVB for their overall long-term health and to prevent metabolic bone disease.

(2) The long term health benefits of UVA have not been experimentally proven, but reptiles do receive UVA rays in their natural environment, and there are studies that indicate UVA seems to have an effect on social behavior and reproduction in certain lizards.

(3) There is no artificial light source that can entirely compare to the sun.

(4) The best way to insure your reptile receives the necessary light requirements, both physically and psychologically, is to provide them access to natural sunlight.

I have found that the best way to provide for my reptiles' lighting needs is to allow them access to natural sunlight during the warmer months of the year. You can do this fairly easily by allowing your pet to bask through an open window with a screen. Glass filters out UVB rays, although UVA rays will still penetrate. You could also provide an outdoor enclosure, just make sure they have plenty of water and a place to escape the sun. Also, make sure the enclosure is safe so that no other critters can get in, and your pet can't get out. Of course, just spending some quality time outdoors with your pet on a nice, sunny day works, too.

I also provide year-round UVB light and full-spectrum lights in their enclosures. Although full-spectrum light isn't absolutely necessary, I like the way it simulates natural sunlight and I want my pets' captive conditions to be as natural as possible. I use two separate ballasts to accomplish this, placing the full-spectrum lamp centered higher in the cage for an overall effect. I place the UVB light in a position so that my reptiles can bask between 6 and 12 inches from the lamp.

If you cannot provide your pet access to natural sunlight at least several hours per week during the warmer months, then at the very least, provide a highly rated (5.0 or above) UVB lamp and change it every six months. Remember, your pet is completely dependent on you for its health and well-being.

Additional Reading:

W.H. Gehrman.

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R.J. Wurtman. 1975.

"The Effects of Light on the Human Body" *Scientific American*. 233(1):68-77

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