

## Chapter 1 : Tapetum lucidum - Wikipedia

*8/5/ For something different, and a little fun, here some interesting facts about animal eyes that you may not have known. Shark corneas are similar to human corneas, which is why they have been used in human transplants.*

The tapetum lucidum, which is iridescent, reflects light roughly on the interference principles of thin-film optics, as seen in other iridescent tissues. However, the tapetum lucidum cells are leucophores, not iridophores. The tapetum lucidum functions as a retroreflector which reflects light directly back along the light path. This serves to match the original and reflected light, thus maintaining the sharpness and contrast of the image on the retina. The tapetum lucidum reflects with constructive interference, [3] thus increasing the quantity of light passing through the retina. Retinal tapetum, as seen in teleosts, crocodiles, marsupials and fruit bats. The tapetum lucidum is within the retinal pigment epithelium; in the other three types the tapetum is within the choroid behind the retina. Choroidal guanine tapetum, as seen in elasmobranchii skates, rays, and sharks and chimaeras. The tapetum consists of layers of cells containing organized, highly refractive crystals. These crystals are diverse in shape and makeup. Choroidal tapetum fibrosum, as seen in cows, sheep, goats and horses. The tapetum is an array of extracellular fibers. The functional differences between these four different types of tapeta lucida are not known. Kiwis, stone-curlews, the boat-billed heron, the flightless kakapo and many nightjars, owls, and other night birds such as the swallow-tailed gull also possess a tapetum lucidum. Apart from its eyeshine, the tapetum lucidum itself has a color. It is often described as iridescent. In tigers it is greenish. In dogs it may be whitish with a blue periphery. When light shines into the eye of an animal having a tapetum lucidum, the pupil appears to glow. Eyeshine can be seen in many animals, in nature and in flash photographs. In low light, a hand-held flashlight is sufficient to produce eyeshine that is highly visible to humans despite our inferior night vision. Eyeshine occurs in a wide variety of colors including white, blue, green, yellow, pink and red. However, since eyeshine is a type of iridescence, the color varies with the angle at which it is seen and the minerals which make up the reflective tapetum-lucidum crystals. White eyeshine occurs in many fish, especially walleye; blue eyeshine occurs in many mammals such as horses; green eyeshine occurs in mammals such as cats, dogs, and raccoons; and red eyeshine occurs in coyote, rodents, opossums and birds. In blue-eyed cats and dogs[ edit ] Odd-eyed cat with eyeshine, plus red-eye effect in one eye Cats and dogs with a blue eye color may display both eyeshine and red-eye effect. Both species have a tapetum lucidum, so their pupils may display eyeshine. In flash color photographs, however, individuals with blue eyes may also display a distinctive red eyeshine. These include odd-eyed cats and bi-eyed dogs. The red-eye effect is independent of the eyeshine: This is most apparent when the individual is not looking into the camera because the tapetum lucidum is far less extensive than the retina. In spiders[ edit ] Most species of spider also have a tapetum, which is located only in their smaller, lateral eyes; the larger central eyes have no such structure. This consists of reflective crystalline deposits, and is thought to have a similar function to the structure of the same name in vertebrates. Four general patterns can be distinguished in spiders: Mesothelae, Orthognatha - a simple sheet behind the retina Canoe-shape type e. Araneidae, Theridiidae - two lateral walls separated by a gap for the nerve fibres Grated type e. Lycosidae, Pisauridae - a relatively complex, grill-shaped structure No tapetum e. Salticidae Uses by humans[ edit ] In darkness, eyeshine reveals this raccoon Humans use scanning for reflected eyeshine to detect and identify the species of animals in the dark, and deploying trained search dogs and search horses at night, as these animals benefit from improved night vision through this effect. Using eyeshine to identify animals in the dark employs not only its color but also several other features. The color corresponds approximately to the type of tapetum lucidum, with some variation between species. Other features include the distance between pupils relative to their size; the height above ground; the manner of blinking if any; and the movement of the eyeshine bobbing, weaving, hopping, leaping, climbing, flying. Artificial tapetum lucidum[ edit ] Manufactured retroreflectors modeled after a tapetum lucidum are described in numerous patents and today have many uses. A more recent use of retroreflectors, helping to provide secure communications between two stations in line of sight, is modeled after the combination of tapetum lucidum and bioluminescent "flashlight" in flashlight fish of the

families Anomalopidae and Stomiidae [ citation needed ]. These drugs include ethambutol , macrolide antibiotics, dithizone , antimalarial medications , some receptor H2-antagonists, and cardiovascular agents. The disturbance "is attributed to the chelating action which removes zinc from the tapetal cells. New devices with variable illumination can make this possible, however. Heterochromatic dog with red-eye effect in blue eye.

## Chapter 2 : Colors Animals See | Ask A Biologist

*In New Leaf, the player can change their eye color using contact lenses. The option is made available through Harriet in Shampoodle, once it has been open for 14 days and the player has had at least one hair cut.*

**Biology Behind the Color: Eye by Eye**

**Blue Eyes** Blue-eyed people have no or little melanin on the front layer of the iris, so as light goes through the eye, it hits the back of the iris and then reflects out. As it goes through the stroma, the presence of proteins causes blue light to scatter, which makes the eye look blue. There are, however, some theories on where gray eyes come from: Gray-eyed people could have an even smaller amount of melanin in their eyes than blue-eyed people. They could have a different composition of the stroma that causes the light to scatter differently.

**Brown Eyes** Brown-eyed people have melanin in both parts of their irises, so the effect of the light-scattering cannot be seen. The eyes appear darker because more light is absorbed, and variations in color and shade of brown come from the amount of melanin present.

**Green Eyes** The front iris layer of green-eyed individuals has only a small amount of melanin which tends to be the red or yellowish pheomelanin. Since the melanin concentration is very low, the light scattering effect gives off a blue color, which mixes with the yellowish color of the pheomelanin, making the eye look green.

**Amber Eyes** Amber eyes get their color from the increased presence of lipochrome pheomelanin in the iris.

**Red or Violet Eyes** People with albinism are often considered to have violet or red eyes. However, the truth is a little more complicated. Albinism is a condition that causes people to have a lack of pigment in their hair, skin, and eyes. Since people with albinism lack pigment in their iris, light can bounce off the back of the eye and exit the eye. The light usually reflects back red because of the blood vessels at the back of the retina. Eyes can look violet when this red color combines with the bluish color of the iris that results from a lack of melanin, and the aforementioned light-scattering effects. In fact, the reason the eyes look red is the same reason you might have red-eye in a photograph, which results from light reflecting off the back of the eye and passing back out through the iris. In normal eyes and lighting conditions, light cannot exit the eye like this.

**Lighting Makeup Mood** This is because blue and green eyes get their color from the quality and quantity of light, not from pigment. Thus, different lighting conditions will change the quality of the eye. Mood can change the size of the pupil, which might make the iris appear to be a different color. The quantity of melanin is not changing, but simply the way that the light is reflecting and scattering through the iris. After that, the eye color will most likely remain the same and the only way to change the appearance of your eye color is through makeup, clothing, lighting, and color contacts. Putting honey in your eyes will not change your eye color permanently, though it could cause you to go blind. The reason some people see their eye color change from honey is due to the inflammation of the cornea as it tries to remove it from the eye. In fact, almost any combinations of parent-child eye color can occur. In general, darker colors tend to dominate lighter colors. This is a good example of heterochromia.

**Other Color Variations** There are other variations that can occur in eye color aside from basic color. Its color comes from the combined effect of texture, pigmentation, fibrous tissue and blood vessels within the iris and stroma. Here are some other eye variations that can occur.

**Heterochromia** This is where one eye is differently colored from another one, or one iris has different colors in it. Kate Bosworth is a good example of this. This results from uneven melanin content.

**Limbus Ring** A limbal ring is a dark ring around the iris of an eye. Since they fade with age, they usually signify youth and are considered attractive. Many eyes look like they have different colors toward the middle versus towards the edge, or have small variations around the iris. This is especially true for people with lighter colored eyes. You might also notice flecks of color in them. Each of this is part of what makes each eye extremely unique. Irises like fingerprints are highly unique. Even genetically identical people, like twins, have different iris textures. So just remember that your eyes are special, no matter what color they are!

### Chapter 3 : 32 Facts About Animal Eyes - Discovery Eye Foundation

*Given the importance we affix to looking someone (or something) else in the eyes, it's no wonder that heterochromic creatures, or creatures with two different eye colors, are so striking. Though heterochromia is fairly rare in humans, its occurrence is far higher among animals, especially cats.*

Shark corneas are similar to human corneas, which is why they have been used in human transplants. A worm has no eyes at all. An owl can see a moving mouse more than feet away. Guinea pigs are born with their eyes open! Scorpions can have as many as 12 eyes, but the box jellyfish has 24! Camels have three eyelids! This is to protect their eyes from sand blowing in the desert. Most hamsters only blink one eye at a time. Owls are the only bird which can see the color blue. Goats have rectangular pupils to give them a wide field of vision. A scallop has around eyes around the edge of its shell to detect predators. Snakes have two sets of eyes – one set used to see, and the other to detect heat and movement. The four-eyed fish can see both above and below water at the same time. Owls cannot move their eyeballs – which has led to the distinctive way they turn their heads almost all the way around. A dragonfly has 30, lenses in its eyes, assisting them with motion detection and making them very difficult for predators to kill. Dolphins sleep with one eye open. The largest eye on the planet belongs to the Colossal Squid, and measures around 27cm across. Geckos can see colors around times better than a human, even in dim lighting. The eyes of a chameleon are independent from each other, allowing it to look in two different directions at once. Polar bears have a third eyelid that helps filter UV light. Human eyes are not the most highly evolved. The mantis shrimp has four times as many color receptors as the human eye and some can see ultraviolet light. Pigeons can see millions of different hues, and have better color vision than most animals on earth. Although color blind, cuttlefish can perceive light polarization, which enhances their perception of contrast. A drone may have up to 8, and the queen bee can have 3, lenses. The night vision of tigers is 6 times better than humans. Eyes on horses and zebras point sideways, giving them tremendous peripheral vision, to the point of almost being able to see behind them, but it also means they have a blind spot right in front of their noses.

### Chapter 4 : Animal species, and eye color, is there any difference? - PredatorMasters Forums

*Reflective eye color can also vary depending on the animal's age, health, amount of zinc or riboflavin in the tapetum lucidum, amount of pigmentation inside the retina, eye color and distortions within the lens.*

Some have very poor color vision and others have very good color vision. Poor Color Vision and Animals Dogs, cats, mice, rats and rabbits have very poor color vision. In fact, they see mostly greys and some blues and yellows. This is what humans see. Does a red cape make them angry? Does a red cape make them want to attack it? This is what a bull sees. They charge the red cape because it is moving, not because it is red. Good Color Vision and Animals Some animals do have good color vision. Monkeys, ground squirrels, birds, insects, and many fish can see a fairly good range of color. Scientists say that good color vision helps animals find food on the land or in the water. For land animals, good color vision helps to tell the difference between ripe red fruit and unripe green fruit. Colors can also make animals more attractive to each other when they mate. Finally, the ability to see colors helps animals identify predators other animals who may attack them. Who has super color vision? Their range of color vision extends into the ultraviolet. The leaves of the flowers they pollinate have special ultraviolet patterns which guide the insects deep into the flower. Another example is how a diving bird can see under water without goggles A pit viper sees by feeling the heat in an object. Think about the last time you were really sick. Did you check your forehead to see if you were running a temperature? That "fever-heat" is what gives a pit viper a different kind of vision. This is called "thermal vision.

### Chapter 5 : How to Recognize Animal Eyes at Night | Gone Outdoors | Your Adventure Awaits

*Edit Article How to Change Eye Color in Animal Crossing. Three Parts: Unlocking Shampoodle Unlocking the Eye Color Change Feature Changing Eye Color Community Q&A Animal Crossing: New Leaf is the very first game in the series that offers its players the chance to change their eye color.*

For example, a lion is a predator Animal colors that catch the eye These are just a few of the many colors and patterns that animals use to send signals. In some cases colors are used to find the perfect mate. Animals also use colors as warning signals and as camouflage to hide from predators. The color-changing kings of the animal kingdom have to be the Chameleons. They can change their colors to look a bit more like their surroundings, which helps them hide and stay safe. But could their color fashion also be sexy? Kupos Ladybeetles are both brightly colored and toxic. These colors are a signal to other animals that says "stay away! Calibas Beautiful scale colors in male guppies are perfect examples of sexual selection - yes, redder is better! If the colors are not for females, then why are the males so brightly colored?! Thomas Shahan Quite a set of amazing colors in this red-eyed treefrog and no one really knows why. The red eyes are especially cool to look at, but what are they saying? Could they be telling other tree frogs to stay away? Carey James Balboa This male anole shows off by literally doing push-ups as he flaunts his throat fan - called a dewlap. The ladies find the combination hard to resist. Bold black and orange are familiar colors for a venomous animal. The Gila Monster might be signaling to some animals and using it to hide from others. What is a black and white animal doing here? It might seem boring but this pattern developed over time. This tasty butterfly looks a lot like ones that have a terrible taste. This helps to keep birds from making them into a meal. Adrian Pingstone This poison dart frog is an example of color having two purposes. These tiny creatures protect themselves by storing toxins from the food they eat, like ants and mites. Their red color tells predators they are dangerous to eat, but the female frogs also prefer the super red males. The bright color is a warning that it is toxic and it helps keep predators away. Parrots are unusual, in that many members are covered in red with almost no difference between males and females. Are these social birds using red to stand out against their green background so they can be sure to find their flock-mates?

## Chapter 6 : 37 Animals With The Most Unique Color Mutations In The World

August 13, , Page The New York Times Archives. *THE world of animal vision, long a gray area for scientists, is beginning to come alive with color. While research in the field is in its.*

A Chinchilla Persian with sea-green eyes As with blue eyes, the color of green eyes does not result simply from the pigmentation of the iris. The green color is caused by the combination of: They were present in south Siberia during the Bronze Age. This is how many people mistake hazel eyes to be amber and vice versa. Definitions of the eye color hazel vary: Red and violet "Red" albino eyes The eyes of people with severe forms of albinism may appear red under certain lighting conditions owing to the extremely low quantities of melanin , [79] allowing the blood vessels to show through. In addition, flash photography can sometimes cause a " red-eye effect ", in which the very bright light from a flash reflects off the retina, which is abundantly vascular, causing the pupil to appear red in the photograph. Instead, the copper accumulates in the liver and in other tissues, including the iris of the eye. This results in the formation of Kayserâ€™Fleischer rings , which are dark rings that encircle the periphery of the iris. Yellowing of the sclera the "whites of the eyes" is associated with jaundice , [86] and may be symptomatic of liver diseases such as cirrhosis or hepatitis. Aniridia Aniridia is a congenital condition characterized by an extremely underdeveloped iris, which appears absent on superficial examination. Even people with the lightest blue eyes, with no melanin on the front of the iris at all, have dark brown coloration on the back of it, to prevent light from scattering around inside the eye. In those with milder forms of albinism , the color of the iris is typically blue but can vary from blue to brown. In severe forms of albinism, there is no pigment on the back of the iris, and light from inside the eye can pass through the iris to the front. In these cases, the only color seen is the red from the hemoglobin of the blood in the capillaries of the iris. Such albinos have pink eyes, as do albino rabbits, mice, or any other animal with a total lack of melanin. Transillumination defects can almost always be observed during an eye examination due to lack of iridial pigmentation. Because of this, the pupillary reflex is much more pronounced in albino individuals, and this can emphasize the red eye effect in photographs. Heterochromia This section needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. November An example of complete heterochromia. The subject has one brown eye and one hazel eye. An example of sectoral heterochromia. The subject has a blue iris with a brown section. Heterochromia heterochromia iridum or heterochromia iridis is an eye condition in which one iris is a different color from the other complete heterochromia , or where a part of one iris is a different color from the remainder partial heterochromia or sectoral heterochromia. It is a result of the relative excess or lack of pigment within an iris or part of an iris, which may be inherited or acquired by disease or injury. A chimera can have two different colored eyes just like any two siblings canâ€™because each cell has different eye color genes. A mosaic can have two different colored eyes if the DNA difference happens to be in an eye-color gene. There are many other possible reasons for having two different-colored eyes. For example, the film actor Lee Van Cleef was born with one blue eye and one green eye, a trait that reportedly was common in his family, suggesting that it was a genetic trait. This anomaly, which film producers thought would be disturbing to film audiences, was "corrected" by having Van Cleef wear brown contact lenses. Another hypothesis about heterochromia is that it can result from a viral infection in utero affecting the development of one eye, possibly through some sort of genetic mutation. Occasionally, heterochromia can be a sign of a serious medical condition. A common cause in females with heterochromia is X-inactivation , which can result in a number of heterochromatic traits, such as calico cats. Trauma and certain medications, such as some prostaglandin analogues , can also cause increased pigmentation in one eye. Mate selection and traits that have been linked to iris color Selection for rare iris colors A study compared the frequency of eye color in commercial advertising models in Brazil and the UK, these countries were chosen because they have inverted frequencies of eye-coloration, with Brazil having an excess of brown and the UK an excess of light-colored eyes. Models are chosen for their attractiveness, and it was found that, in Brazil, models with light eyes are in a significant excess compared to the levels found in the general population, while, in the UK,

models with brown or intermediate eyes were in significant excess over their frequency in the general population. This suggests that eye color rarity plays a role in sexual attraction, people with rare eye colors being perceived as being more attractive. Some research indicates that eye color variation is greater in women than in men, which may reflect sexual selection of mates with rare eye colors. A study found a significant incidence of the partners of heterosexual people possessing similar eye and hair color to that of their opposite-sex parent. This is suggestive of a form of parental imprinting on eventual mate selection.



### Chapter 7 : Craft Animal Eyes | eBay

*Mantis shrimp have much better color vision than humans (their eyes having 12 types of color receptors, whereas humans have only three), as well as ultraviolet, infrared and polarized light vision, thus having the most complex eyesight of any animal known.*

But sometimes genetic mutations can make even the animals that are most familiar to us look completely foreign. Albinism and Melanism result in animals that are all-white or all-black, but mother nature has many more tricks up her sleeve. These amazingly beautiful color variants will make you look twice. Deer with Piebaldism, a rare genetic disorder that appears like partial albinism. A rare blue lobster. Erythristic black backed jackal. This rottweiler has vitiligo, a condition that causes depigmentation of parts of the skin or fur. It occurs when melanocytes, the cells responsible for pigmentation, die or are unable to function. Who said all zebras have stripes? Venus the Chimera cat. Chimeric animals have a mixture of genetically distinct tissues that arise from two or more fertilized eggs that fused together in the womb “ which means they are essentially two twins that fused together into a single creature. This Chimeric lobster is its own twin. A beautifully colored Macaw. This strawberry colored leopard is so rare, only one was ever discovered. Pink katydids are the result of Erythrism. This distinctively colored leopard was photographed in India. A spotless cheetah was only ever seen once. A partially melanistic squirrel! A piebald fox kit. Pelusa the polar bear has changed color to bright purple after being treated for a skin condition at an Argentinian zoo. This purple squirrel is named Pete. The cause of his unique coloration remains unknown. Tigers have different color variants due to genetic conditions. This genetic mutation occurs during the first cell division of the fertilized egg, causing one of the cells produced to be male and the other to be female. The result is a peculiar animal whose entire one side is female while the other side is male. Each of these creatures is so uniquely beautiful, but the big cats are particularly breathtaking. I never knew these animals even existed! Share these incredible color-morphs with your friends by clicking below.

### Chapter 8 : How to Change Eye Color in Animal Crossing: 10 Steps

*Human eye color charts once were used to "predict" eye colors of children. In the most simplified versions of these charts, brown eyes are considered dominant over both blue and green eyes. And green eyes are thought to be dominant over blue eyes.*

This part of the brain takes information coming from the body and sends it on to the cerebral cortex. Also called UV light. Eyes are used to capture light and the optic nerves then send signals to the brain where the information is processed into an image. Click to enlarge and to read additional details. This question can be answered pretty easily. If an animal eye has cones they will be able to see some color. What is difficult to know is which colors an animal can see and how strong or weak the color will appear to the animal. Scientists can study an animal eye and find out if it contains cones and what colors of light the cones can detect. It is also possible to count the number of cones and their location in the retina to understand how strong or weak a color might appear to an animal. But, what color does the animal see? Vision, like all of our senses, is processed in the brain. Without being able to get into the head of an animal, it is only possible to know what colors can be detected and not how they "look" to the animal. This is also true for a more familiar animal: Two people may say they see a painted wall as a particular color, but do they see it the same way? The answer is not known at this point. We can study animal eyes but we may never be able to know exactly what different animals see. Images left to right: Jumping spider by Opoterser. Rattlesnake by Karla Moeller. Owl by Woodwalker and Poxnar. Cat by Guylaine Brunet. It is true that we see more colors than some animals. Your pet dog and cat sees fewer and weaker colors. Their view of the world is made of pastel colors. However, some animals see colors we cannot. Spiders and many insects can see a type of light called ultraviolet that most humans cannot see. Other animals, like snakes, are able to see infrared light. You can use the chart below to explore what colors certain animals see and how they compare to human color vision.

**Chapter 9 : 7 Animals That Are Better Color-Changers Than Chameleons | Mental Floss**

*Eye color in non-human animals is regulated differently. For example, instead of blue as in humans, autosomal recessive eye color in the skink species *Corucia zebrata* is black, and the autosomal dominant color is yellow-green.*

Eyeshine Animals that display the brightest eyeshine, such as the bobcat, have more rods light receptors and fewer cones color receptors in their retinas than animals with no eyeshine. As a result, they have excellent night vision, but most are color-blind. Until primitive man discovered fire, making it possible for him to light up the night, he probably was unaware that certain animals have eyes that seem to glow in the dark. Imagine how frightened he must have been the first time he looked beyond the comforting circle of his campfire light to see a pair of shining eyes watching him from the darkness. Perhaps you shared his twinge of fear the first time you saw glowing eyes in the woods, especially if you were sitting around a campfire telling ghost stories or listening to those strange night noises that stir the imagination. Eyeshine occurs when light enters the eye, passes through the rods light receptors and cones color receptors of the retina image surface, strikes a special membrane behind the retina, and is reflected back through the eye to the light source. This special mirrorlike membrane, called the tapetum ta-PEA-tum, is not present in the human eye. We have dark-colored cells behind our retinas, which absorb light rather than reflect it. The majority of animals displaying eyeshine also are nocturnal animals. Most of the animals with eyeshine are night hunters, and their ability to use the available light twice, once on the way in and again on the way out, gives these nocturnal animals additional light to see by. The majority of these glowing eyes belong to mammals, but spiders, alligators, and bullfrogs are a few other creatures with reflecting eyes. Some night birds also have eyes that glow in the dark, but their eyes do not have a tapetum layer. Scientists are still trying to solve the mystery of their source of eyeshine. An interesting sidelight is that animals with the brightest eyeshine generally have more rods and fewer cones in their retinas. As a result they have excellent night vision, but most are color-blind. Eyeshine coloration varies from the glowing reddish orange of the alligator to the yellows and greens of the deer and cat families. Just what causes these color differences has not been documented. Although eyes with eyeshine are said to glow in the dark, they actually do not glow – they reflect available light. Light enters the eye, passes through the retina, and strikes a mirrorlike membrane called the tapetum. The tapetum reflects the light back through the eye to the light source. Eyeshine coloration varies with the species, amount of light, and the direction from which the light strikes the eye. Alligator eyeshine may vary from a bright reddish orange to an iridescent pink. Because eyeshine is directed back to the light source, you must be in the right spot to be able to see it, usually directly behind the light. To increase your chances for seeing eyeshine, watch the roadsides carefully when riding in a car at night. The headlights often are reflected in the eyes of animals by the sides of the road. While walking at night with a flashlight, shine it in an arc around you and try to catch its reflection in the eyes of night creatures just beyond its circle of light. Notice the eyes of your pet dog or cat as it approaches a lighted patio area, and you may be at the right angle to see its eyes reflect. Those of you who have a cooperative cat might like to try this experiment. On the back of a small hand mirror draw a one-quarter-inch circle. Remove the silver from the circle to form a peephole. The reflective side of the mirror should face the cat. Turn off all lights except for one small lamp located across the room from you or let a friend shine a small flashlight in your direction. Since the light striking the eye comes from the mirror, rays from the tapetum will be reflected back to the mirror. Through your peephole you should be able to see the red blood vessels of the retina against the sparkling surface of the tapetum. Cat eyes vary from yellowish gold to bright green. Information on eyeshine is very sketchy, but perhaps one day further research into the subject will reveal some of its secrets. In the meantime we can but wonder about eyeshine, another mystery of nature. Ilo Hiller Eyeshine.