

By SUSAN KANEKO BINKLEY

COLOR ON, COLOR OFF



ALBINO SQUIRREL BY DOMINIQUE BRAUD, DEMBINSKY PHOTO ASSOCIATES

Without thinking about it, we use color to recognize things in nature. A male cardinal is red. A deer turns

THERE'S MORE TO ALBINISM THAN MEETS THE EYE.

a bright rust color in summer. A gray squirrel is, well, gray. That is, unless they have a rare condition called *albinism*. Albino animals are astonishingly all white, sometimes partly white. And their eyes are deep pink or icy blue.

Maybe you've seen a white squirrel in the wild or a white rabbit or mouse in a pet store. They stand out among other animals with normal color, especially the ones that blend into their surroundings. Though they are very different on the outside, they differ only in small ways on the inside.

Their striking appearance has always made people wonder about albino animals. Some people believed albinos had special powers and worshiped them; others believed they were spooky and feared them.

Today we know that the real wonder and mystery of albinism lies in the complex function of *pigment*, the coloring matter found in certain cells of living organisms. Pigment is controlled by genes, inherited from an animal's mother and father.

THE NATURE OF ALBINISM



TOM AND PAT LEESON

Not all albinos are pure white. Albinism occurs when an animal inherits either a single trait or set of traits that interrupt the making of the pigment *melanin*. Melanin is the primary pigment that determines the color of a mammal's skin, fur, and eyes.

Not all albinos are pure white, because some traits that control melanin allow forms of the pigment to appear in the fur of the animal.

Siamese cats are albinos too. So are Himalayan rabbits and mice. In this albino variation, cooler regions of the body produce more melanin than others, so that these animals have darker "points," that is, a dark face, tail, paws, and ear tips. They have pink or blue eyes, and their vision is affected to varying degrees.



The chipmunk (left) and bison cow (above) are both albinos. Even though they both have color in their fur, they also have aberrant eye color, a key albino clue.

E.R. DEGGINGER, DEMBINSKY PHOTO ASSOCIATES

GREG BREINING





Notice the normal color of eyes of this snowshoe hare. It is an example of a white mammal that is not albino.

Not all white animals are albinos.

So how can you tell if an animal is really an albino? The difference is in the eyes. Melanin affects the development of an animal's eyes and vision. Without the brown-black or red-yellow pigments of melanin coloring the iris, the eyes of albino animals appear pink or light blue.

Many animals are white, even pure white,

BILL MARCHEL

but are not albino. If an animal's eyes are any color other than pinkish-red or pale blue, it is not albino. White animals, such as the polar bear, whose eyes are normal in color and function are called *leucistic*. Some animals, such as the snowshoe hare, have a leucistic phase for camouflage during the snowiest time of the year.

The Albino Squirrels of Olney, Illinois.

One town in Illinois is so taken by albino squirrels that residents have purposely cultivated a population since 1902. Impaired vision makes it more difficult for albino animals to stay out of harm's way. That's why the Olney albino squirrel population—once almost 1,000 and now little more than 200—is pampered with food from the townspeople and protected by law from cats, motorists, and squirrel-nappers.

A.B. SHELDON



Studying albinism in amphibians, reptiles, birds, fish, and other non-mammals is complicated by the presence of several other visible pigments. Xanthin, a yellow pigment, can be seen in this albino leopard frog.

DON ENGER



An adult barn swallow feeds its albino nestling.

From whales to snails. Albinism probably occurs in every kind of animal that produces melanin. It has been observed in mammals, birds, reptiles, amphibians, fish, mollusks, and insects—just about every species, from whales to snails. Almost all domestic animals have albino variants. Think about the mice, rabbits, and guinea pigs we know as pets and laboratory animals. One researcher says that albino animals are preferred because they are easier to work with, perhaps because they have poor eyesight. Melanin does not directly affect personality.

THE COLOR OF MELANIN

Melanin is an organic pigment—a coloring agent found in nature—that is critical to producing most of the color seen in mammals. Depending on how it's made, melanin comes in two color ranges: (1) *eumelanin*—dark browns and blacks; and (2) *pheomelanin*—light reddish tans and blondes. These two kinds of melanin provide animals with *cryptic coloration*, or camouflage, helping them to blend into and hide in their surroundings.

Dark and light melanins, working alone or in combination, make either plain or multicolored coats and even multicolored individual hairs, a variation called *agouti*.

Pigments in living things not only provide coloration, but perform other important tasks as well. For example, in plants the green pigment chlorophyll makes nourishing sugars.

TO LEARN MORE ABOUT PIGMENTS, see the Young Naturalists story on leaf color in the Sept.–Oct. 2000 *Volunteer* and the story on camouflage and mimicry coloration in the March–April 2000 issue.

Melanin performs two tasks in most mammals and other animals.

Scientists are trying to understand these tasks better:

- **Protection from sunlight.** *Melanosomes*, or clusters of melanin, block harmful rays of the sun, while allowing beneficial ones to enter.
- **Vision.** Melanin helps develop various parts of the eyes, including the irises, retinas, eye muscles, and optic nerves. The absence of melanin results in disorganized development of eyes and leads to problems with focusing, depth perception, and tracking.

The dark eye spot in most animal embryos is caused by melanin, key to vision development in early stages of animal life. Shown here is a normal 30-hour-old embryo of a zebrafish, commonly used in genetic research.

STEPHEN C. EKKER AND AIDAS INASEVICIUS
UNIVERSITY OF MINNESOTA MEDICAL SCHOOL

MICHAEL SHOOP



This albino deer has no melanin at all, even in its growing antlers.

THE MAKING OF AN ALBINO



ALBINO DOE BY TOM AND PAT LEESON

Melanin is made through a complex chain of chemical reactions that occur in a specialized cell called a *melanocyte*. Because it is a complex process, many factors can alter the production of melanin in a melanocyte. The most critical factor in the process is the presence of a special *enzyme* (agent that starts and speeds up reactions) called *tyrosinase*. Without it, melanin cannot be made.

Animals inherit genes from their parents. Mammals have a special gene that determines the presence of tyrosinase in cells. Geneticists call it the TYR gene. If an animal is born with an altered or damaged TYR gene instead of a normal or whole one, melanin cannot be reliably made. The animal will become an albino.

Susan Kaneko Binkley is art director of Minnesota Conservation Volunteer and lives with two albino cats, Ping and Pong.

The TYR gene can be altered in many ways. More than 50 ways have been discovered in humans and 33 in mice. In all-white, light-eyed albino animals, the TYR gene does not work at all, producing no tyrosinase and no melanin pigmentation. In other albino variations, the TYR gene may cause tyrosinase “leaks” that cause small amounts of melanin to accumulate as the albino grows. These albinos will still have light eyes, but will show some color on their fur as they become older.

Besides the TYR gene, several other genes can cause albino variants. That’s because other hormones and proteins also are key to complete melanin production, and their presence is determined by their own special genes.

In mice, a total of 100 genes are known to affect albinism.

All the genetic traits for albinism are recessive traits, meaning that their power remains hidden when paired with stronger traits. For the recessive albino trait to appear in an animal, the baby animal must inherit a recessive gene from both parents.

HUMAN ALBINISM has been studied a lot more than animal albinism. Much of this research has been conducted at the University of Minnesota International Albinism Center. In Minnesota, one in 20,000 people has albinism. One in 200 people carries the recessive gene for it.

HOW MANY ALBINO OFFSPRING can be made by two parents who each carry the recessive albino gene but are not albino themselves? Since genes come in pairs, each parent can be represented by a pair of letters. Let the uppercase letter *A* represent the dominant or usual form of the gene, and let the lowercase letter *a* represent the unusual, recessive type of this gene that could cause a form of albinism. Now let’s make a box called a *Punnett square* to help us do the math.

Aa x Aa = ?

	A	a
A	AA	Aa
a	Aa	aa

An offspring from two parents with the recessive albino gene has a 1 in 4 chance of being born albino. Since this recessive gene is rare in the first place, rarer still is the chance of both parents having it. That’s why albinos in the wild and among humans are so rare.

CHALLENGES OF SURVIVAL

To live and flourish in the wild, animals must be able to find food and avoid becoming food themselves. They must also find mates for making offspring.

Do albino animals, with their poor eyesight, have trouble finding food or seeing danger? Does their sense of smell or hearing make up for their impaired vision? With their light coloration, will they be more likely to be seen and eaten by predators? With their unusual appearance, will they be accepted by potential mates? Little research has been done to answer these questions.

Scientists have explored how an albino's white coat or missing camouflage affects them as prey. Sometimes albinos are noticed and captured more easily than normal animals. But in other instances, predators didn't seem to recognize them as food. (Would you recognize white hamburgers as good to eat?) In studies where animals had many places to hide, predators captured albino and normally colored animals at the same rate. Coat color did not make a difference.

Hunting Albino Animals. Some people believe hunting albino animals should be off-limits. In fact, 13 states have made it illegal to do so. In Minnesota it is legal to hunt albino animals, although the hunting of white bears, albino or leucistic, is outlawed. Is it unsporting to hunt an animal that may be easier to find? Should we make a law to prevent hunting albino animals? Or should we continue to allow hunters to decide for themselves?



SHAWN PERICH

Several studies of birds, including ravens, barn swallows, red-winged blackbirds, and penguins, have demonstrated that albino birds have trouble winning a mate. Albino birds were consistently rejected, perhaps because they lacked the characteristics, such as feather color and pattern, that potential mates rely on to make choices.

The curiosity of a scientist. If albino animals make you wonder, follow the trails that lead into the world of science. From the how and why of color, to the study of genes, to views of social behavior, science offers a powerful way to explore, understand, and organize the mysteries at work in our astonishing natural world. 📍



An albino skunk is easy to see but, like other skunks, has a potent weapon—the stinky liquid in its scent glands. Will its enemies recognize an all-white animal as a skunk?

MARY CLAY, DEMBINSKY PHOTO ASSOCIATES