IT'S ALL ABOUT Vit

Fifteen years ago, while at the University of Western Australia, anthropologist Nina Jablonski was asked to give a lecture on human skin. As an expert in primate evolution, she decided to discuss the evolution of skin color, but when she went through the literature on the subject she was dismayed. Some theories advanced before the 1970s were racist, and others were less than convincing. White skin, for example, was reported to be more resistant to cold weather. After the 1970s, when researchers were probably more aware of the controversy such studies could kick up, there was very little work at all. "It's one of these things everybody notices," Jablonski says, "but nobody wants to talk about."

No longer. Jablonski and her husband, George Chaplin, also a scientist, have formulated the first comprehensive theory of skin color. Their findings show skin color is related to the strength of sunlight across the globe. But they also show a deeper, more surprising process at work: Skin color, they say, is largely a matter of vitamins.

If these kids belong to four races, where should the lines be drawn?

amins

by Gina Kirchweger, art by Tom Dunne

Jablonski, now at the California Academy of Sciences, begins by assuming that our earliest ancestors had fair skin just like chimpanzees, our closest biological relatives. Between 4.5 million and 2 million years ago, early humans moved out of the rainforest onto the East African savanna. Once on the savanna, however, they had to develop a better cooling system to avoid overheating.

The answer was sweat, which carries off heat through evaporation. Early humans, like chimpanzees, probably had few sweat glands, and those were mainly located on the palms of their hands and the bottoms of their feet. Occasionally, however, individuals were born with more glands than usual. A million years of natural selection later, each human has about two million sweat glands spread across his or her body and much less hair to get in the way of evaporation.

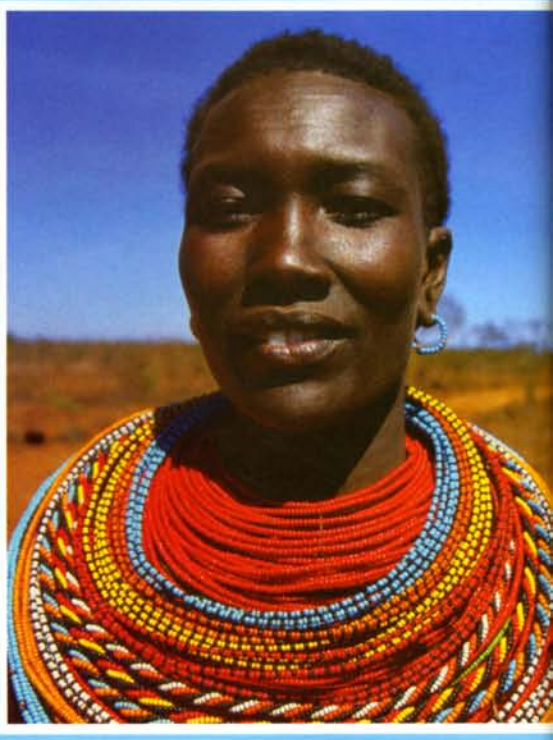
Hairless skin, however, is particularly vulnerable to damage from sunlight. Scientists long assumed that humans evolved melanin, the main skin pigment,

Special cells called melanocytes produce the brown pigment melanin and package it in melanosomes.

to absorb or disperse ultraviolet light. But what is it about ultraviolet light that melanin protects against? Some researchers pointed to the threat of skin cancer. But cancer usually develops late in life, after people have already had children, and so does not affect their ability to pass on genes to the next generation.

During her preparation for the lecture in Australia, Jablonski found a 1978 study that examined the effects of ultraviolet light on folate, which is one of the B vitamins. An hour of intense sunlight, the study showed, is enough to cut folate levels in half if your skin is light. Jablonski made the next, crucial connection only a few weeks later. At a seminar, she heard that low folate levels are linked to fatal birth defects. (To prevent these defects, the United States has added folate to flour and other foods people eat frequently.)

Jablonski later came across three documented cases in which children's defects were linked to their mothers' visits



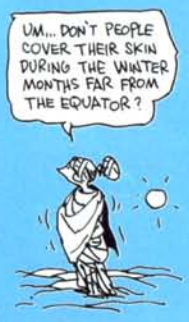
Everyone has the same number of melanocytes. But the amount of melanin they produce varies from person to person.

to tanning salons during early pregnancy. She now had some intriguing evidence that folate might be the driving force behind the evolution of darker skin. But if dark skin is an advantage, why aren't we all dark? Why do some people have light skin?

As far back as the 1960s, the biochemist W. Farnsworth Loomis had suggested that skin color is determined by the body's need for vitamin D. The vitamin helps the body absorb calcium and deposit it in bones, preventing devastating bone diseases. This is why vitamin D is added to milk. Whereas folate is *destroyed* by ultraviolet light, the body *uses* ultraviolet light to produce vitamin D. Loomis believed that people who live in the north, where daylight is weakest, evolved fair skin to help absorb more ultraviolet light and that people in the tropics evolved dark skin to block the light, keeping the body from overdosing on vitamin D, which can be toxic at high concentrations.

By the time Jablonski did her research, Loomis's hypothesis had been partially disproved. "You can never overdose on natural amounts of vitamin D," Jablonski says. (In fact, scientists have recently discovered that vitamin D also supports the immune system, helping us fight off infection and cancer, and that most people do not get enough of this vitamin.) But Loomis's insight about fair skin held up, and it made a perfect complement for Jablonski's insight about folate and dark skin. Skin color is a balancing act between the need to protect vitamin B and the need to make vitamin D. People living near the equator have dark skin to stop folate from being destroyed, and people living near the poles have light skin so they can make vitamin D.

Dark skin prevents sunlight from reaching blood vessels where it can destroy a B vitamin that prevents birth defects.



Could protecting vitamins be one reason people who live where sunlight is strong often cover themselves from head to toe?

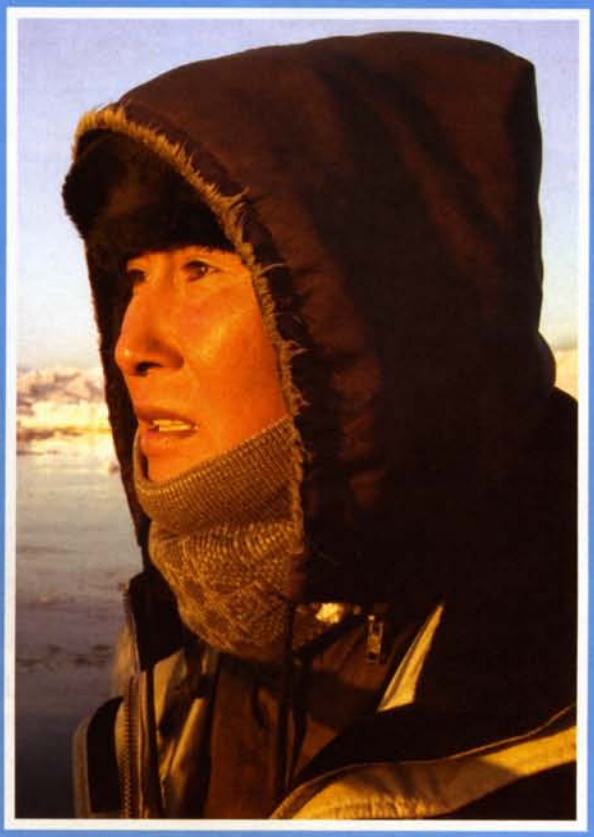
Light skin lets sunlight reach keratinocytes, cell factories that help make vitamin D, a vitamin with many health benefits.

Schoolchildren who live north of the Arctic Circle stand in ultraviolet light to make sure they make enough vitamin D. Recent studies have shown that most people in the industrialized world—not just those who live in the far north—are getting too little vitamin D.

But so far all Jablonski had was a plausible theory. The next step was to find some hard data matching skin color to light levels. Twelve years ago, Jablonski and Chaplin took satellite ultraviolet measurements and compared them with published data on skin color in populations from more than 50 countries. To their delight, there was an unmistakable link: The weaker the ultraviolet light, the fairer the skin. Jablonski went on to show that people living above 50 degrees latitude have the highest risk of vitamin D deficiency. "This was one of the last barriers in the history of human settlement," Jablonski says. "Only after humans learned fishing, and therefore had access to food rich in vitamin D, could they settle these regions."

Humans have spent most of their history moving around. To do that, they've had to adapt their tools, clothes, housing, and eating habits to each new climate and landscape. But Jablonski's work indicates that our adaptations go much further. People in the tropics have developed dark skin to block out the sun and protect their body's folate reserves. People far from the equator have developed fair skin to drink in the sun and produce adequate amounts of vitamin D during the long winter months.

Jablonski hopes her work will begin to change the way people think about



The Inuit are an exception that proves the rule. Their skin is darker than Jablonski's theory predicts it should be, given how far north they live, but they also eat a vitamin D–rich diet of fish.

skin color. "We can take a topic that has caused so much disagreement, so much suffering, and so much misunderstanding," she says, "and completely disarm it."

Gina Kirchweger, a biologist turned science journalist, grew up in Austria but now lives in Southern California, where she has to apply much more sun block to protect her folate.

When people move, skin color can take thousands of years to catch up. Both the Sudanese man (left) and the Arab man (right) live on the Red Sea, which is near the equator. The Sudanese are long-term residents, but the Arabs arrived only about 2000 years ago.