Skin color: Handy tool for teaching evolution

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Variations in skin color provide one of the best examples of evolution by natural selection acting on the human body and should be used to teach evolution in schools, according to a Penn State anthropologist.

"There is an inherent level of interest in skin color and for teachers, that is a great bonus -- kids want to know," said Nina Jablonski, professor and head, Department of Anthropology, Penn State. "The mechanism of evolution can be completely understood from skin color."

Scientists have understood for years that evolutionary selection of skin pigmentation was caused by the sun. As human ancestors gradually lost their pelts to allow evaporative cooling through sweating, their naked skin was directly exposed to sunlight. In the tropics, natural selection created darkly pigmented individuals to protect against the sun.

Ultraviolet B radiation produces vitamin D in human skin, but can destroy folate. Folate is important for the rapid growth of cells, especially during pregnancy, when its deficiency can cause neural tube defects. Destruction of folate and deficiencies in vitamin D are evolutionary factors because folate-deficient mothers produce fewer children who survive, and vitamin D-deficient women are less fertile than healthy women.

Dark skin pigmentation in the tropics protects people from folate destruction, allowing normal reproduction. However, because levels of ultraviolet B are high year round, the body can still produce sufficient vitamin D. As humans moved out of Africa, they moved into the

subtropics and eventually inhabited areas up to the Arctic Circle. North or south of 46 degrees latitude -- Canada, Russia, Scandinavia, Western Europe and Mongolia -- dark-skinned people could not produce enough vitamin D, while lighter-skinned people could and thrived. Natural selection of light skin occurred.

The differences between light-skinned and dark-skinned people are more interesting than studying changes in the wing color of moths or, the most commonly used evolutionary example, bacterial colonies, according to Jablonski. Adaptation to the environment through evolutionary change becomes even more interesting when looking at the mechanism of tanning.

"In the middle latitudes tanning evolved multiple times as a mechanism to partly protect humans from harmful effect of the sun," Jablonski told attendees at the annual meeting of the American Association for the Advancement of Science today (Feb. 20) in Washington, D.C.

Tanning evolved for humans so that when ultraviolet B radiation increases in early spring, the skin gradually darkens. As the sun becomes stronger, the tan deepens. During the winter, as ultraviolet B wanes, so does the tan, allowing appropriate protection against folate destruction but sufficient vitamin D production. Tanning evolved in North Africa, South America, the Mediterranean and most of China.

Natural variation in skin color due to natural selection can be seen in nearly every classroom in the U.S. because humans now move around the globe far faster than evolution can adjust for the sun. The idea that variation in skin color is due to where someone's ancestors originated and how strong the sun was in those locations is inherently interesting, Jablonski noted.

"People are really socially aware of skin color, intensely self-conscious

about it," she said. "The nice thing about skin color is that we can teach the principles of evolution using an example on our own bodies and relieve a lot of social stress about personal skin color at the same time."

Jablonski noted that the ability to tan developed in a wide variety of peoples and while the outcome, tanablity, is the same, the underlying genetic mechanisms are not necessarily identical. She also noted that depigmentated skin also developed at least three times through different genetic mechanisms. Students who never tan, will also understand why they do not and that they never will.

Provided by Pennsylvania State University