

THE SCIENCE AND EVOLUTION OF SKIN COLOR

25

(1) Have you ever wondered why humans have so many different skin colors? Skin color is affected by the presence of various substances but the most important one is a pigment called melanin. Melanin comes in various colors. Eumelanin is the most common type of melanin and it is a brownish-black pigment. Eumelanin is the pigment that darkens hair, skin and eyes (the irises). Pheomelanin is a pinkish to reddish pigment and can be found in red hair, lips, and nipples. In light skinned people, there is less melanin and so other factors like the circulating red blood cells and the bluish-white connective tissue under the skin play a significant role in determining the specific shade of light skin a person possesses.

(2) To highlight how much melanin contributes to skin color, let's consider people who cannot produce melanin. A person with albinism is unable to produce melanin. This pigment is lacking in their skin, hair and eyes due to the absence of an enzyme called tyrosinase. Tyrosinase helps create melanin as well as other pigments. For example, it is tyrosinase that is responsible for the darkening of an apple or potato after it is sliced. Without melanin, albinos have white hair as well as pink skin and pink eyes because the blood vessels in these areas are not covered by any pigments.

(3) Skin is mostly made up of two types of cells, melanocytes and keratinocytes. Melanocytes are the skin cells that make up 5%-10% of the skin and they are the pigment producing cells that make melanin. Within melanocytes are organelles called melanosomes which synthesize and store melanin. Keratinocytes are skin cells that make up 90% of the skin and their main job is to provide a physical barrier against microbial invasion, physical damage and water loss. The keratinocytes absorb the melanosomes from the nearby melanocytes so that melanin can be more evenly spread over the surface of the skin. When melanocytes are found in dense clusters, this causes a build up of melanin in one area which produces a visible dark mark on the surface of the skin that is called a mole. People with darker skin don't have any more melanocytes than those with lighter skin. They have darker skin because their melanocytes are more active so they produce more melanin.



(4) Melanin serves a very important function. This pigment is excellent at absorbing ultraviolet radiation (UVR). It can absorb 99.9% of the UVR that lands on it. This blocks UVR from reaching the DNA within skin cells. Intense and long-term exposure to UVR can result in sunburns as well as skin cancer. Melanin is the body's natural sunscreen and the more you have the more protected you are against UVR.

(5) Our pre-human ancestors had body hair. Among other functions, the body hair protected them from exposure to UVR. Our earliest human ancestors came from sub-Saharan Africa and as they began to lose their body hair, they also began to develop dark skin to shield themselves from the damaging effects of the intense equatorial sunlight.

(6) When some humans began to migrate away from Africa to areas of the world that were further north, like parts of Europe and East Asia, they began to produce less melanin and became lighter skinned. Why did this happen? We will explore two theories that attempt to explain this.

(7) When UVR is absorbed by the skin it helps to produce Vitamin D which is essential for healthy bones. The most popular theory for the evolution of lighter skin proposes that humans who migrated northwards were exposed to less intense sunlight and had to wear more clothing to protect against a colder climate. This put darker skinned individuals at a disadvantage because their melanin blocked out too much UVR in conditions where UVR exposure was already limited. This prevented

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adequate vitamin D synthesis. Lighter skin allowed more UVR to be absorbed and over time genes for light colored skin began to dominate and genes for darker skin began to disappear from these northern populations.

(8) Another theory proposes that people in northern climates still had enough vitamin D from the combination of Sun exposure as well as from their food sources. However, when agriculture developed, human diets changed dramatically and food no longer provided adequate amounts of vitamin D. To compensate for this, lighter skin developed to allow for more vitamin D synthesis.

(9) In all races, women are, on average, lighter skinned than the men. Women evolved to have lighter skin to maximize their ability to synthesize vitamin D which is needed for the proper absorption of calcium from the diet. Women require calcium more than men because calcium is needed for pregnancy and lactation (the production of breast milk). Calcium is vital for building the bones of the fetus and baby. Without adequate calcium, the fetus can develop disorders like spina bifida, which is a defect in spine development. The difference between male and female skin color doesn't emerge until puberty which is when females become capable of bearing children.

Article Questions

1) What is melanin? Describe the two main types of melanin.

2) Why do people with albinism lack melanin?

3) How do melanocytes contribute to skin color?

4) How do keratinocytes contribute to skin color?

5) What causes the difference in pigmentation between people with darker skin and people with lighter skin?

6) In what situation is having a lot of melanin useful and in what situation is having less melanin useful?

7) In a population of humans, why are the women less pigmented than the men?