The genetics of eye color inheritance [1]

Dear Alice,

My husband and I both have brown eyes but our new baby has blue eyes. How come?

Answer

Dear Reader,

Before your husband starts eyeing the milkman suspiciously, it would be good to keep in mind that most babies are born with blue eyes, regardless of the eye colors of their parents. In the early stages of life, newborns have not yet begun to make the dark brown pigment called melanin in the irises of their eyes. As babies get older, their eye color may change as they start producing melanin. The skin also produces melanin when it's exposed to the sun's UV rays. Similar to skin tone, the more melanin that is present, the darker the eye color. Therefore, it is more common for Caucasian babies to be born with blue eyes than for African American babies, since Caucasian babies have less melanin. However, it's still possible for African American babies to be born with blue eyes, and sometimes their blue eyes stay blue.

Eye color is a physical trait that is determined by the pairing of genes from both parents. It was previously thought that a single gene pair following dominant and recessive inheritance patterns was responsible for eye color, but it is now known to be much more complex than that, involving at least three gene pairs. Geneticists have focused on two of the three gene pairs to help clarify the inheritance of eye color: \textit{EYCL}^1, called the gey gene, and \textit{EYCL}^3, called the bey2 gene.

Genes come in different forms, called alleles. The gey gene has two alleles, green and blue; the bey2 gene has two alleles, brown and blue. The brown allele is always dominant over the green and blue alleles, the green allele is always dominant over the blue allele, and the blue allele is always recessive. Because of this, it is possible for two brown-eyed parents to have a child with a different eye color than theirs. For two brown-eyed parents to have a blue-eyed child, for example, the mother and father would need to pass on a pair of blue alleles each to their offspring. If this child were to get one green allele in the mix, he or she would have green eyes; however, if a brown allele were present, regardless of what the other three alleles were, the child would have brown eyes.

But wait, you might protest, this two-gene model cannot explain the inheritance of gray or hazel colored eyes, nor can it explain how two blue-eyed parents can have brown-eyed progeny. That's were modifier genes, other eye color genes, mutations, and additional factors
come in? they can all lead to eye color variability. How you ask? Science is still trying to figure it out! As much as we understand the incredibly complex workings of the human body, there are some details that remain elusively beyond our grasp. Isn’t it nice to know there’s still some mystery in our bodies after all?

Alice!
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