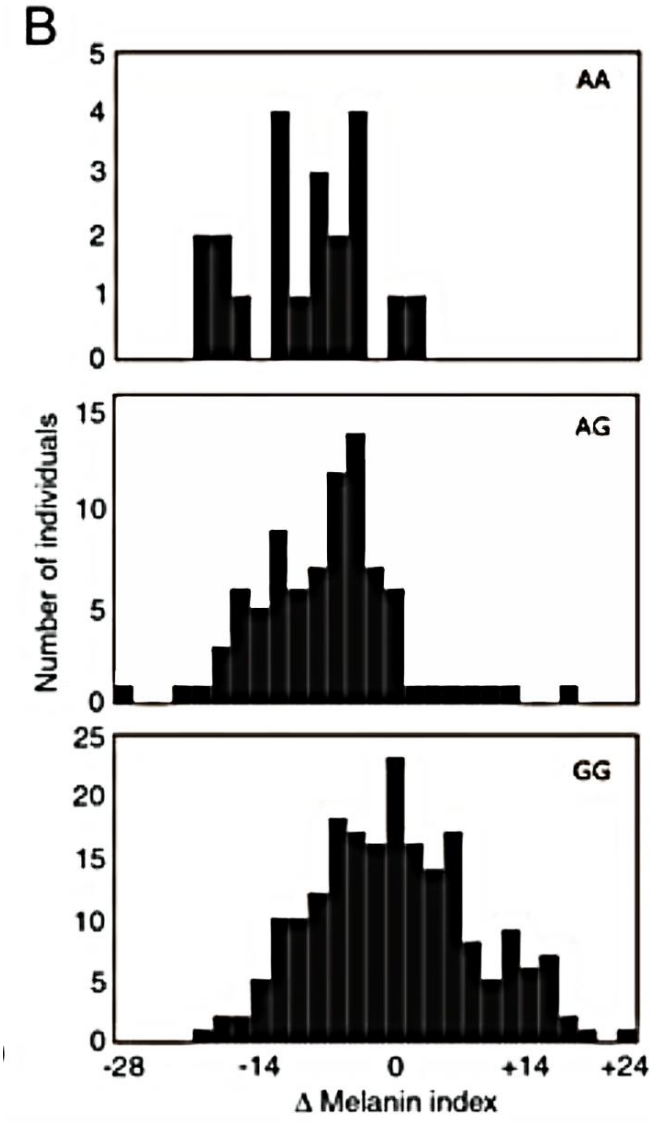
HOW TO USE THIS RESOURCE

Show the figure below to your students along with the caption and background information. The "Interpreting the Graph" and "Discussion Questions" sections provide additional information and suggested questions that you can use to guide a class discussion about the characteristics of the graph and what it shows.



Caption: Histograms showing the distributions of human skin pigmentation (melanin index) of three SLC24A5 genotypes (GG, AG, and AA) relative to the GG genotype. The plotted values are the difference between the melanin index measured for each individual and the regression line calculated for the GG genotype. The mean values for each genotype are 0 (GG), -7 (AG), and -9.6 (AA).

BACKGROUND INFORMATION

Human skin color is a highly variable trait. Human skin cells contain the pigment melanin, which gives skin its color. In general, individuals with lighter skin tones have fewer, smaller, and less densely pigmented melanosomes, the melanin-producing organelles, in their skin cells than individuals with darker skin tones have. To better understand the genetic origin of variation in human skin color, Rebecca Lamason and colleagues turned to a model organism: the zebrafish (*Danio rerio*), which also displays variations in skin color. They identified a

gene (called *golden*) that, when mutated, leads to more lightly pigmented, or golden, fish. Whereas wild-type zebrafish have numerous, dense, round-to-oval melanosomes in their skin cells, the melanosomes of *golden* zebrafish are less numerous, smaller, and less densely pigmented. The scientists searched for an ortholog (a corresponding gene of similar sequence and function) of the *golden* gene in humans. The closest match was a gene called *SLC24A5*. Like the *golden* gene, the *SLC24A5* gene encodes a membrane protein that affects melanosome production.

To determine the gene's role in human skin pigmentation, the researchers searched for polymorphisms within the gene. They identified one single-nucleotide polymorphism with two alleles. The G allele, which encodes alanine, is found in most individuals in African, Indigenous American, and East Asian populations (with an allele frequency of 93% to 100%), while the A allele, which encodes threonine, is found in European-American populations (frequency of 98.7% to 100%). They then studied two populations of recently mixed ancestry, African-American and African-Caribbean, with a range of skin colors to determine whether allele frequencies correlate with skin pigmentation. Skin pigmentation was measured using reflectometry, which involves measuring the amount of light reflected back by an individual's skin to calculate the melanin index. Individuals with a higher melanin index have darker skin.

INTERPRETING THE GRAPH

The figure above includes three histograms that show the differences in skin pigmentation (change in melanin index) between the three genotypes (AA, AG, GG) relative to the ancestral GG genotype. The melanin index value for each genotype was adjusted to the regression line of the GG genotype from a scatterplot of the data (see Figure 6A in the paper) to determine the change (Δ) in melanin index. The values plotted in each histogram are the difference between the melanin index measured for each individual and the regression line calculated for the GG genotype. Compared with the mean of the melanin index distribution for the GG genotype that is set at 0, the mean for the AG genotype is -7 and the mean for the AA genotype is -9.6.

Teacher Tip: Prompt your students to explain the parts of the graph as applicable:

- Graph Type: Histogram
- *X*-Axis: Change in melanin index for each genotype in relation to the GG regression line (not shown)
- *Y*-Axis: Number of individuals

DISCUSSION QUESTIONS

- Why is a histogram used to display data instead of a scatterplot, bar, or line graph?
- Based on your background reading, which ancestry most commonly has the GG genotype and why? Which ancestry most commonly has the AA genotype and why?
- Based on these graphs, which genotype has the darkest skin pigmentation on average? Which has the lightest?
- How does the amount of melanin in skin cells relate to skin color?
- The distributions of skin melanin content for individuals of each genotype overlap. What would you see if only one gene determined skin color? What can this mean in terms of the number of genes that may be involved in skin pigmentation?
- In this study, how did the authors use the genetic variation of another species to better understand the trait of human skin color?
- In this study, why did the authors study populations of mixed ancestry?
- What might be a physiological role/function for the range of skin pigmentation?
- What do the results of this study tell us about the role of genes in determining skin color?

SOURCE

Figure 6 from:
Lamason, Rebecca, *et al*. SLC24A5, a putative cation exchanger, affects pigmentation in zebrafish and humans. 2005. *Science*. 310(5755): 1782-1786.
View Paper: http://www.sciencemag.org/content/310/5755/1782 (requires login to AAAS, set up a free AAAS account to view the article via this link: https://pubs.aaas.org/Promo/promo_setup_rd.asp?dmc=P0RFB1)

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