WHAT CAN ZEBRAFISH TELL US ABOUT HUMAN SKIN COLOR?

Student Handout

NAME_____ **DATE**_____

This worksheet complements the short film ***The Biology of Skin Color*** (http://www.hhmi.org/biointeractive/biology-skin-color) and requires the **"**Zebrafish and Skin Color Reference Data."

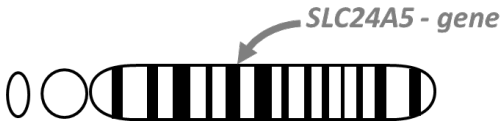
INTRODUCTION

You probably know that many phenotypes are determined by more than one gene. What you might not know is that the relative influence of a gene on an organism's overall phenotype varies. One gene may account for nearly all the phenotypic variation, while other genes contribute only minor variations.

From the short film *The Biology of Skin Color*, you know that the *MC1R* gene is very important in generating dark-skin phenotypes, but it is by no means the only gene involved in skin color variation. Studies have concluded that at least 34 genes (and likely many more) are involved in human skin color (Sturm and Duffy 2012). In this activity, you will study the *SLC24A5* gene. Studies have shown that *SLC24A5* plays a huge role in the generation of light-skin phenotypes in people of European descent.

SLC24A5 is found on human chromosome 15 (see figure below). Its full name is "solute carrier family 24 member 5." The protein coded for by *SLC24A5* is found in the membrane of melanosomes, where it is involved in the exchange of sodium and calcium ions that may regulate pigment levels in melanosomes. How did scientists find this gene and come to conclude its importance? Not in the way you might expect; they first discovered it not in a human but in a fish.

Chromosome 15



In humans, the S*LC24A5* gene is located on the long arm of chromosome 15 between nucleotides 48,120,971 and 48,142,391. (Image adapted from *Genetics Home Reference* 2013.)

PROCEDURE

Answer the questions using the information and reference data provided.

1. Compare and contrast the cell size and amount of melanin in cells from the wild-type zebrafish and the golden zebrafish seen in Figure 1.

2. Compare and contrast the zebrafish cells in Figure 1 with the human cells shown in Figure 2.

3. How is the molecule melanin related to human skin color?

4. Review the information in the Table 1 reading, then briefly explain how a single change in a DNA sequence could alter the function of a protein.

5. To develop an explanation based on natural selection, biologists look for evidence of adaptation. Look at Table 1. Is the A allele frequency difference between Europeans and West Africans evidence of selection? Why or why not?

6. According to the graphs in Figure 3, is the Δ melanin index a good way to predict the *SLC24A5* genotype? Explain your answer.

7. Research suggests that variation in *SLC24A5* accounts for 25 percent to 38 percent of skin color differences among Europeans and Africans.

    a. What accounts for the rest?

    b. Describe how the graphs in Figure 3 support the conclusion that *SLC24A5* variation does *not* account for all of the phenotypic differences between Europeans and Africans.

8. From Figure 4, it's clear that the *SLC24A5* gene sequences are highly similar among different species. What can you conclude from this about the importance of the function performed by the protein encoded by the *SLC24A5* gene? What is the simplest explanation for the similarity across species?

9. What do the results in Figure 5 suggest about the similarity or dissimilarity of the function of the protein encoded by the *SLC24A5* gene in different species?

10. Based on Figure 6, how long ago do you think the *SLC24A5* gene evolved? Explain your answer.

11. Use Figure 7 to predict the geographic region(s) where you'd expect the A allele for *SLC24A5* to be most common. Explain your reasoning.

12. Do the data in Figure 8 match your prediction in Question 11? Explain why or why not.

13. Use evidence in Figures 7 and 8 to support or contradict the claim that light-skinned phenotypes evolved only once in human history. (*Hint:* Focus on European and Asian populations. Compare their phenotypes and allele frequencies.)

14. Support the claim that zebrafish can serve as a model organism for studying the biology of human skin color with three pieces of evidence from the reference figures provided and discuss why this makes sense using scientific reasoning.

REFERENCES

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