A Cases for Evolution Education Question Guide

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The Case of Color Vision Evolution in New World Monkeys

This Evo-Ed case consists of five modules that support the teaching and learning of biology in the framework of evolution of color vision in New World Monkeys. Together, the modules present evidence that evolution occurs because of:

1) competition for resources and differential reproductive success in populations

2) heritable genetic variation and resulting differences in gene expression.

The following activities are designed to guide students' learning as they engage in the modules of this case. They can also be used as learning objectives. That is, "students will be able to" accomplish each of these as objectives.

The modules and activities are presented in the order in which they appear in the case and can be used as in-class activities, homework and/or formative assessments.

The background information on this case, and accompanying slides can be found at:
→ www.evo-ed.org/Pages/Primates

The Natural History and Ecology of Color Vision in Monkeys

1) Explain the world-wide distribution of dichromatic and trichromatic vision in monkeys.

2) Collect data from the Hungry Monkey (Kix) simulation using these pairings: dichromatic with both green and orange Kix and trichromatic with both green and orange Kix. Based on these data, construct an explanation of how each can persist in different environments.

3) Provide a scientific explanation as to why, in the Kix study, success was 60% or less for finding food of any color.

4) Describe the design and results of the experiment that studied the role of shape and color in finding food.

5) Collect data from the Find the Circle Quickly game and determine conditions under which conditions di- or trichromatic vision is advantageous.

6) Explain how color vision in monkeys could influence their interactions with other aspects of their environment (besides food).

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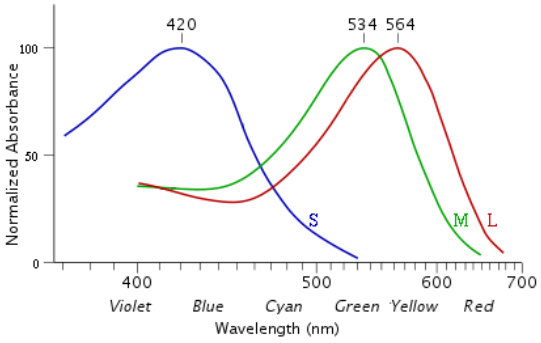
The Cell Biology of Color Vision in Monkeys



1) Develop a model of color vision, including the following parameters: wavelength of light, three types of opsins in cone cells, central processing in the brain and color perception.

2) Research another cell related to sensory perception (touch, olfaction, hearing, taste). Determine the commonalities and differences to the cells and proteins required for color perception.

3) Based on this research (two items above) develop a general model of the phenomenon known as signal transduction.

4) Explain how "adding" a third opsin resulted in richer color perception. Extending this idea, explain how fourth opsin might affect color vision

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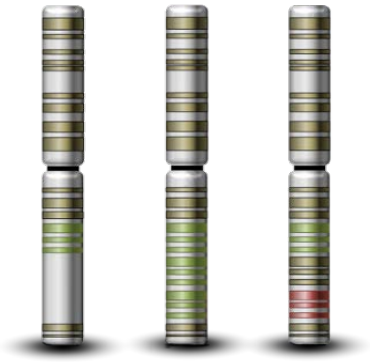
The Genetics of Color Vision in Monkeys



1) Explain the origin of genetic material, in terms of chromosomes and meiosis, that permitted the evolution of an additional gene (LWS) for trichromatic vision.

2) Compare the differences in the amino acids of proteins expressed by the MWS and LWS genes. Explain how these differences produced enhanced color perception.

3) Explain why LWS and MWS are not alleles, but separate genes.

4) Compare the expression of genes on autosomal and sex chromosomes.

5) A very few human females have four-color vision. Propose a mechanism for the evolution of an additional gene for an opsin.

6) Explain how substitution mutations in a gene (in this case, a gene for opsin) could lead to changes in gene expression.

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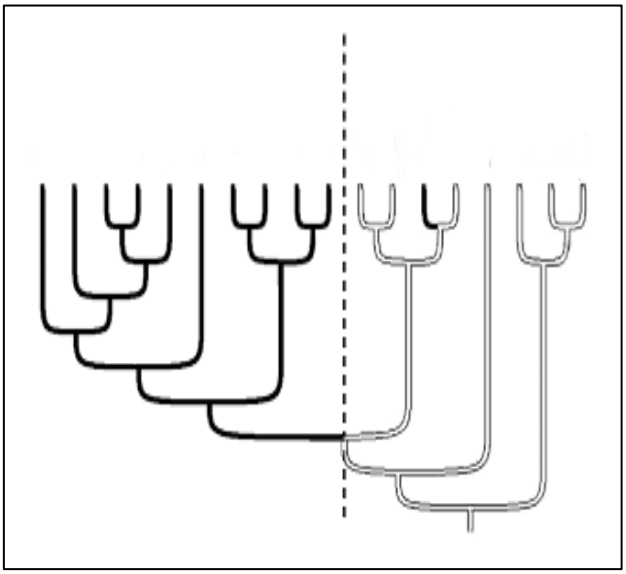
The Phylogenetics of Color Vision in Monkeys

1) Using both geological and biological data, determine the key event(s) leading to the separation (for the most part) of tri- and dichromatic monkeys.

2) Provide a scientific explanation for the existence of a species of monkey in the new world that has trichromatic vision.

3) Conduct a research project to determine whether or not monkey fossils can tell us anything about color vision in primates from 40-30 million years ago.

4) Construct an explanation as to why lemurs, Old World primates found in Madagascar, have dichromatic vision.



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