

## **Do you see what I see?** *Light, sight, and natural selection*

### **Lesson 1: What do I see?**

In this opening lesson, students are introduced to the driving question of the unit by examining differences in individual perception of color with a paint chip sorting activity. In small groups, students take turns sorting paint chips into color categories and record and graph the data. Students then develop a model of what they think contributes to the perception of color and light and individual differences in perception. This model can be used by students to generate questions and by teachers to evaluate student's current thinking. In future lessons, students will revise their models as their understanding of light and sight develops.

### **Lesson 2: How does biology affect perception?**

Students begin their investigations of individual difference in perception beginning with a color-blindness test and reading of an interview with a person with colorblindness. In order to further understand how the structures of the eye affect perception, students dissect a cow eye and make connections between the parts and their functions in contributing to sight. Students will use this evidence in Lesson 5 to revise their model of perception.

### **Lesson 3: How does the environment affect perception?**

Students continue to explore factors that affect perception, moving from biological factors to social and physical environments. Students view and discuss a video clip about scientists investigating the effects of language on color perception. Next, students collect and analyze data on how different colored lights affect perception and behaviors like the selection of red candies. Students practice visualizing and analyzing their data in graphs as part of the activity, and collect evidence for revising their model throughout the lesson.

### **Lesson 4: What are color and light?**

Students continue to investigate how the environment affects perception by gaining a deeper understanding of the physical properties of light. The lesson begins with an animated video that contextualizes color in the electromagnetic spectrum and light at a physical phenomenon. Students use spectrophotometers to explore the emission, reflection, absorption, and transmission of light from various light sources and objects. Interpretation of these results is supported with a video of typical results, helping students integrate their observations with knowledge of the Red-Blue-Green color model.



# Do you see what I see?

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### Lesson 5: Do fish have a favorite color?

Students culminate their knowledge on what they have learned about sight, light, and perception by revising their model of color perception from Lesson 1. After incorporating their evidence and justifying their revisions, students plan and carry out an investigation on the color preference of guppies using a digital simulation. This lesson includes an extension activity for testing with live guppies, if those resources are available. After reviewing their results as a class, students compare and interpret their results by comparing them to summaries of primary research articles investigating similar topics.



### Lesson 6: Why do guppies have a favorite color?

In this lesson, students examine how natural and sexual selection can help explain why guppies are attracted to different colors. Students are prompted to ask questions about the different selective pressures that guppies might be exposed to, such as traits to help find food, avoid predators, or attract a mate. By playing The Guppy Game students investigate how fish with a variety of traits are affected by the environments in which they try to survive and reproduce. Analyzing data generated by the game, students begin to understand the selective pressures that drive the evolution of guppies. Finally, students create a scientific explanation that addresses these concepts.

### Lesson 7: What do you see?

In this culminating lesson, students use the knowledge they learned in the previous lessons to make inferences about the significance of color perception and connections to other organisms. Students discuss the biological advantage of color vision in humans during the synthesizing Advantage of Color Vision activity and make connections to other organisms and different visual systems in Vision Adaptation activity. Finally, students investigate the evolution of color vision in mammals by evaluating information on the traits and genetics of extant mammal groups. Using this information, they build a phylogenetic tree and compare it to current scientists' models. There are also supplementary readings for students to learn more about the evolution of color vision in primates, including humans.

#### Wild Female Guppy



Photo: Daragh Owens

#### Preference Threshold

1 •• 2 •• 3 •• 4 •• 5 •• 6

#### Survival

Find food that can be detected by your color preference.

Earn +1 point if roll  $\leq$  threshold

#### Reproduction

Find a mate with a brightness higher than your color preference.

Earn +1 point if roll  $\geq$  threshold