Additive RGB color mixing

FizziQ activity · Middle and high school · 25 min

Scan to open in FizziQ

One smartphone acts as a colored light source and another as a colorimeter: with the FizziQ camera in RGB mode, students verify the rules of additive color mixing.

Learning objectives

- Identify the three additive primary colors (red, green, blue)
- Verify the additive mixing rules experimentally
- Measure the RGB components of mixed colors
- Observe how monochromatic lighting changes the appearance of colored objects
- Understand the difference between additive and subtractive color mixing

Instruments and sensors

Colorimeter (RGB color detector) · Camera

Materials

- Smartphone or tablet with FizziQ (camera used as RGB color detector)
- A second smartphone or tablet (colored light source)
- A darkened room
- Colored objects (papers, candies)
- Note: the protocol remains adaptable to any comparable color detection tool.

Protocol

1. Prepare two smartphones: the first as a source (color generator), the second as a detector (colorimeter via FizziQ camera).
2. On the source phone, display a fully red screen (R=255, G=0, B=0). Set brightness to maximum.
3. On the detector phone, open FizziQ and select the Camera instrument in RGB color detection mode.
4. In a dark room, place the source facing the detector (about 5 cm apart). Record the detected RGB values.
5. Repeat with a green screen (0, 255, 0) then blue (0, 0, 255). Note the RGB values each time.
6. Test the mixtures: yellow (255, 255, 0), cyan (0, 255, 255), magenta (255, 0, 255). Verify that the detector identifies the correct components.
7. Display white (255, 255, 255): all three channels should be high and balanced.
8. Bonus experiment: in the dark, illuminate colored objects (papers, candies) with only the red screen. Observe how their appearance changes.
9. Repeat with green light then blue light. Photograph the objects under each illumination.
10. Create a summary table: what color does each object appear under each monochromatic illumination.

Expected results

The detector correctly identifies the primary colors and their mixtures. Under red light, red objects keep their color while blue and green objects appear black. White objects take on the color of the illumination. The RGB values for mixtures correspond to the additive rules within measurement precision.

Questions

- Why does mixing red and green light produce yellow, while mixing red and green paint produces brown?

- How does the eye perceive white from three colored lights?
- What is metamerism and why does it matter for color matching?
- Why do colors look different under fluorescent versus incandescent lighting?
- How many colors can a typical screen display?

Going further

- Compare additive synthesis (screens) and subtractive synthesis (paints) on the same color combinations
- Build a Newton's disc and spin it to observe color mixing
- Investigate how screen brightness affects the detected color values
- Use colored filters instead of the screen and compare results
- Explore how the distance between source and detector affects the readings