

Colour magic: additive mixing and coloured shadows

Alternative activity

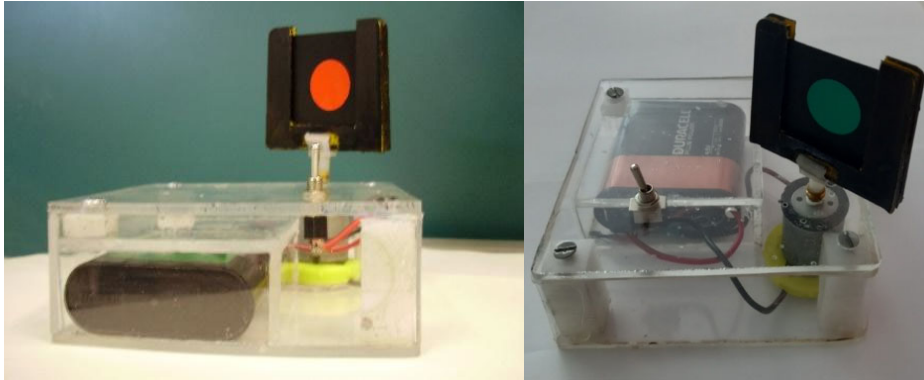
Mixing colours with a motor and coloured stickers

This activity explores the temporal additive mixing of two primary colours using cardstock paper and a small motor. Students will be able to see for themselves that additive colour mixing does not yield the colours expected from childhood experience of mixing paint or clay. They will also be able to observe the phenomenon of retinal persistence. This activity takes approximately 15 minutes.

Materials

- The box with motor setup (detailed assembly instructions are provided)
- Squares of black cardstock paper, about 6 cm × 6 cm
- Round educational stickers of different colours (red, green, blue, and yellow), 15 mm in diameter

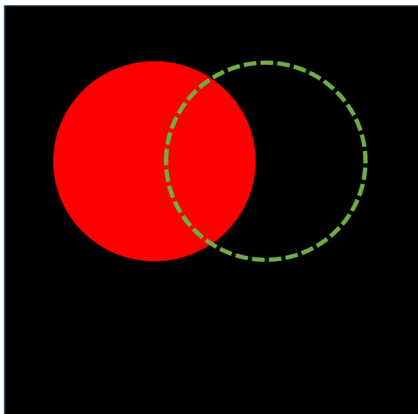
Procedure



Setup

Image courtesy of the author

1. Choose two colours, for instance, red and green, and stick one on each side of one of the cardstock squares. The stickers should be placed off-centre, so the front and back stickers have some overlap



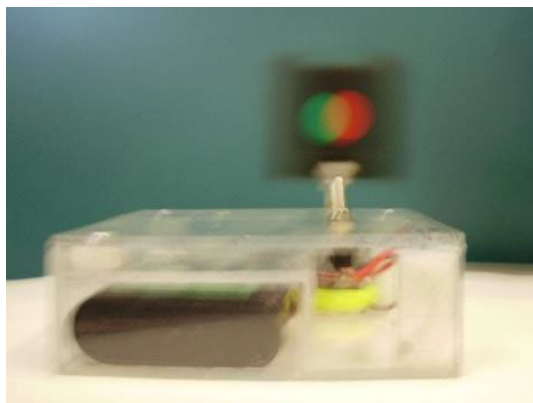
Schematic showing the position of the stickers on either side of the card.

Image courtesy of the author

2. Next, place the card in the holder connected to the motor.
3. Ask students to predict what they will see when the motor is switched on.
4. Hold the motor for students to see and switch it on.
5. Ask students to describe what they see.
6. Repeat with other primary-colour pairs, asking students to predict the results first.
7. Repeat with two complementary colours (e.g., yellow + blue).
8. Optional: use different motor speeds, and see when the colours start to properly blend.
Can we use this to make an estimate of how long retinal persistence lasts?

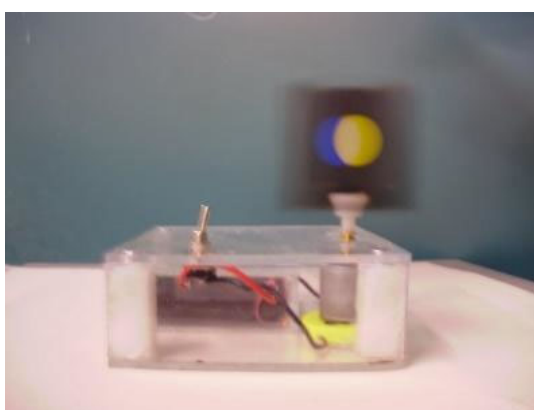
Discussion

As the holder and card rotate, we observe temporal additive mixing of the two colours on the card: red and green flash in quick succession, activating the cones sensitive to these two primary colours in our retina. In the area where the colours do not overlap, we perceive red and green; in the overlapping region we see their addition, namely, yellow.



Temporal additive mixing of red and green gives yellow.
Image courtesy of the author

When mixing two complementary colours, such as blue and yellow, we see white in the overlapping area (see below). The light reflected from the yellow sticker activates the cones that are sensitive to red and green, whereas the light reflected from the blue sticker activates the cones sensitive to blue light. The combined effect is the activation of all three types of cones, leading to the perception of white.



Temporal additive mixing of blue and yellow to give white.
Image courtesy of the author