



## 25.2 Color Mixing with Additive and Subtractive Processes

**READ**


The way that color appears on a piece of paper and how your eyes interpret color involve two different color mixing processes. Your eyes see color using an additive color process. The RGB color model is the basis for how the additive process works and involves mixing colors of light. The CMYK color model is the basis for how the subtractive color process works and involves pigments of color which absorb colors of light.

RGB color model			CMYK color model		
Primary colors	Mixed colors	New color	Primary colors	Mixed colors	New color
red	red + green	yellow	magenta	magenta + yellow	red
green	green + blue	cyan	yellow	yellow + cyan	green
blue	blue + red	magenta	cyan	cyan + magenta	blue
How black is made	Absence of light		How black is made	Pure black pigment	
How white is made	red + green + blue		How white is made	Absence of pigment or use of pure white pigment	

### EXAMPLE

- The human eye has photoreceptors for red, green, and blue light. Which of these photoreceptors are stimulated when looking at white paint?  
**Solution:** All three of these photoreceptors are stimulated equally.
- A laser printer prints a piece of paper that includes black lettering and a blue border. How are these colors made using the CMYK color model?  
**Solution:** Pure black pigment is used to make the black lettering. If you were to mix the other colors (magenta, yellow, and cyan), you would only get a muddy gray. The blue border was made by mixing cyan and magenta pigments.

### PRACTICE

- A friend asks you to describe the difference between the RGB color model and the CMYK color model. Give him three differences between these color models.
- How would you see the following combinations of light colors?
  - red only
  - blue + red, both at equal intensity
  - green only
  - green + blue, both at equal intensity
- The color orange is perceived by the eyes when both the red and green photoreceptors are stimulated and the red signal is stronger than the green. Given this information, what kind of signals would be received by the eye for the color purple?



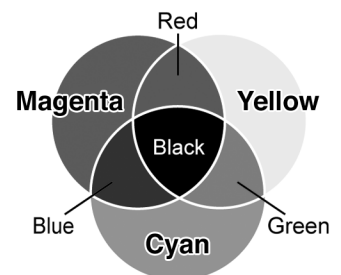
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4. You see a chair that is painted yellow. Most likely, pure yellow pigment was used to make the paint. However, explain how your eyes interpret the color yellow.
5. White paint purchased at a store is often made of a pure white pigment called titanium dioxide. This white paint reflects about 97% of the light that strikes it. Why might this property of the paint mean that you interpret its color as white?
6. The image you see on a color TV screen is made using the RGB color model. The image is made of thousands of pixels or dots of color. Describe how you could make the following pixels using the RGB color model.
  - a. A white pixel
  - b. A black pixel
  - c. A cyan pixel
  - d. A yellow pixel
7. What colors of light are reflected and/or absorbed by a red apple when:
  - a. white light shines on it?
  - b. only red light shines on it?
  - c. only blue light shines on it?
8. The CMYK color model works because the combination of pigments absorb and reflect light. Imagine that white light containing a mixture of red, green, and blue light shines on the combination of CMYK pigments in the table below. Copy the table on your own paper. Indicate in the blank spaces which colors of light the pigments absorb and which color is reflected. Some parts of the table are filled in for you.

CMYK color model		
Mixed colors	Reflected color	Which colors of light are absorbed?
<b>magenta + yellow</b>	<b>red</b>	
<b>yellow + cyan</b>		<b>blue is absorbed by yellow red is absorbed by cyan</b>
<b>cyan + magenta</b>		

9. If you mix magenta paint and cyan paint, what color will you achieve?
10. A laser printer's ink only includes the colors cyan, magenta, yellow, and black.
  - a. Explain how it makes the color green using these pigments.
  - b. Then, explain what happens for your eye to interpret this color as green.
  - c. This Venn diagram illustrates color mixing for the CMYK color model. Now, make a Venn diagram for the RGB color model. Use color when you make your diagram. Be sure to label the difference between the primary colors and the new colors made by mixing.

**The subtractive primary colors**



**The subtractive primary colors are cyan, magenta, and yellow.**