Subtractive primary colors filter out all light when combined

When blue light and yellow light are mixed, white light results. However, if you mix a blue pigment (such as paint or the colored wax of a crayon) with a yellow pigment, the resulting color is green, not white. This difference is due to the fact that pigments rely on colors of light that are absorbed, or subtracted, from the incoming light.

For example, yellow pigment subtracts blue and violet colors from white light and reflects red, orange, yellow, and green light. Blue pigment subtracts red, orange, and yellow from the light and reflects green, blue, and violet. When yellow and blue pigments are combined, only green light is reflected.

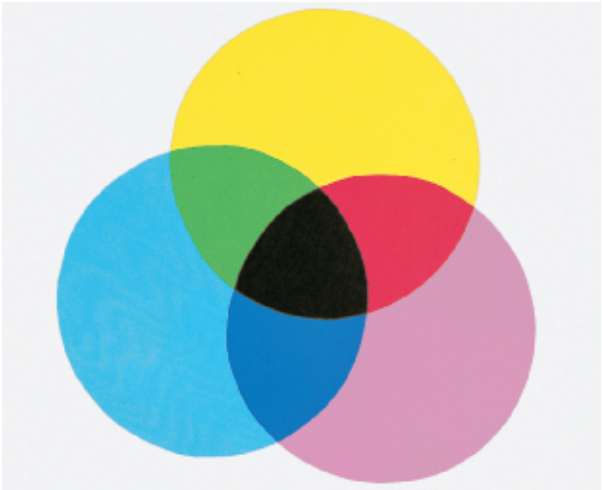

Figure 20
The combination of the subtractive primary colors by any two filters produces the complementary color of the third subtractive primary color.

When pigments are mixed, each one subtracts certain colors from white light, and the resulting color depends on the frequencies that are not absorbed. The primary pigments (or *primary subtractive colors,* as they are sometimes called) are cyan, magenta, and yellow. These are the same colors that are complementary to the additive primary colors (see **Table 6**). When any two primary subtractive colors are combined, they produce either red, green, or blue pigments. When the three primary pigments are mixed together in the proper proportions, all of the colors are subtracted from white light, and the mixture is black, as shown in **Figure 20.**

Combining yellow pigment and its complementary color, blue, should produce a black pigment. Yet earlier, blue and yellow were combined to produce green. The difference between these two situations is explained by the broad use of color names. The "blue" pigment that is added to a "yellow" pigment to produce green is not a pure blue. If it were, only blue light would be reflected from it. Similarly, a pure yellow pigment will reflect only yellow light. Because most pigments found in paints and dyes are combinations of different substances, they reflect light from nearby parts of the visible spectrum. Without knowledge of the light-absorption characteristics of these pigments, it is hard to predict exactly what colors will result from different combinations.

Why it Matters

Conceptual Challenge

1. Colors in a Blanket Brown is a mixture of yellow with small amounts of red and green. If you shine red light on a brown woolen blanket, what color will the blanket appear? Will it appear lighter or darker than it would under white light? Explain your answers.

2. Blueprints If a blueprint (a blue drawing on a white background) is viewed under blue light, will you still be able to perceive the drawing? What will the blueprint look like under yellow light?