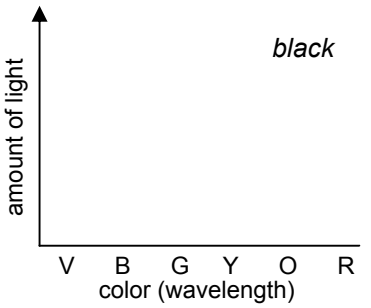
Light and Color

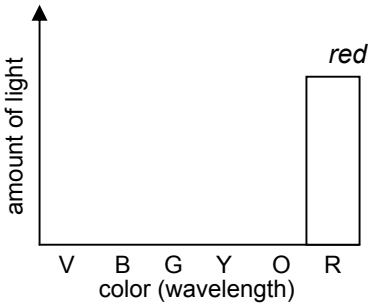
One of the most obvious things about light is that it comes in different colors. Physically, these colors correspond to different wavelengths, starting with red having the longest wavelengths and proceeding up the rainbow to violet having the shortest. But we can also combine light of different colors to make other colors! For example, a computer monitor combines red and blue light to make purple. What's going on?

To get a handle on how this works, we will make a simple bar graph. At the bottom of the graph (x-axis) we list the six rainbow colors familiar to us in order of increasing wavelength. Above each color is a bar designating how much light is coming in at that color.

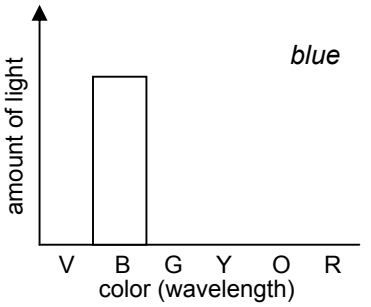
The graph at right is empty, so it corresponds to no light being emitted at all (black).



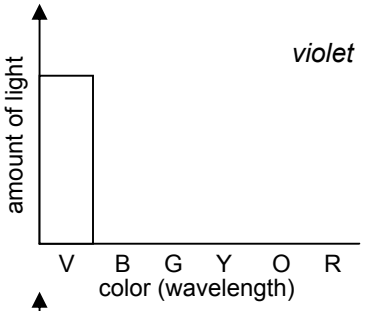
For a slightly more interesting graph, imagine taking pure red light (such as from a red laser or LED). This light would be represented like this:



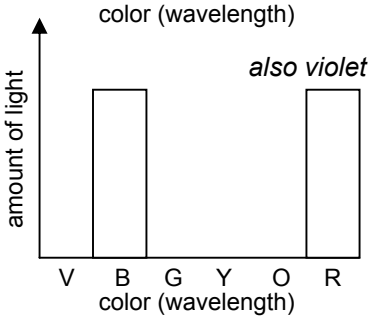
Likewise, pure blue light would be represented this way:



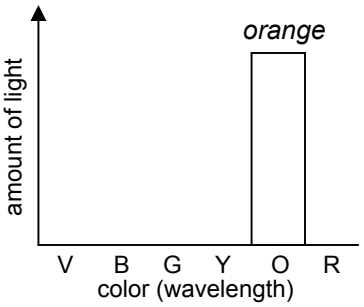
And pure violet light:

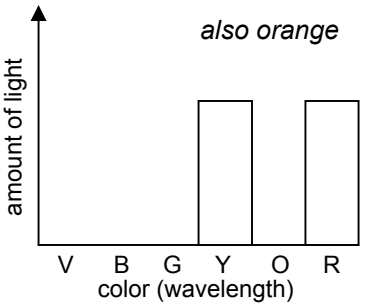


However... we can also create light that we see as purple or violet by combining red and blue light together. There's no paradox here: our eyes are limited in how they can perceive different colors, and in this case the human eye simply cannot distinguish between what are, physically, two *very* different distributions of light. (However, a bird or an insect could tell the difference, as could many scientific measuring instruments.)

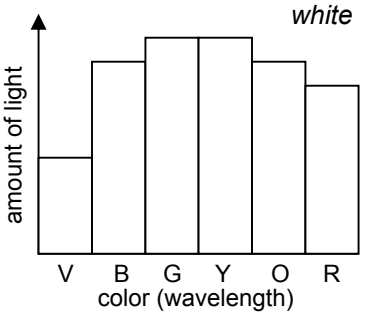


Likewise, we can create what we see as "orange" either by taking pure orange light or combining red and yellow light. Both cases look the same to us, even though they're physically different.

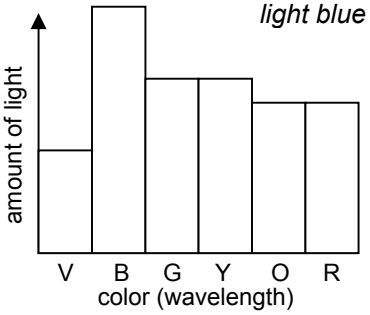




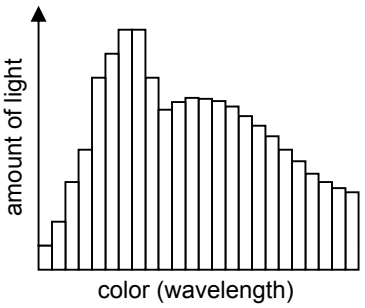
Finally, there is the case of white light. There is no such thing as pure white light: white light is a mixture of all different colors (in approximately but not quite equal proportions), and so would look like this:



We can combine white light with colored light to create lighter shades of any color.



Two things to note for future reference. First of all, light can be divided into far more than six colors – our eye and brain only see the world in terms of a few distinct colors (and their "shades"), but a scientific instrument can easily detect, say, short-wavelength red versus long-wavelength red and we could draw a far more detailed graph:



And second, what we actually see with our eyes (*visible* light) is only a tiny portion of the full spectrum of light: there are many types of "invisible light" with longer wavelengths than red light (infrared light and radio waves) and shorter than blue light (ultraviolet, x-rays, and gamma rays). Again, however, scientific instruments can detect these, and so a very detailed graph could go beyond the visible wavelengths into these invisible regions to give far more information than is evident from a visible spectrum alone.