



# Multimedia Tutorial #6

## Using Color - Part II

### User-Friendly Presentations for those with Limited Color Vision

Part of [The Alchemist's Lair](#) Web Site

Maintained by Harry E. Pence, Professor of Chemistry, SUNY Oneonta, for the use of his students. Any opinions are totally coincidental and have no official endorsement, including the people who sign my pay checks. Comments and suggestions are welcome ([pencehe@oneonta.edu](mailto:pencehe@oneonta.edu)).

Last Revised Sept 18, 2001

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**Using Color - Part II, User-friendly presentations for those with limited color vision**, Harry E. Pence, SUNY Oneonta, Oneonta, NY, [pencehe@oneonta.edu](mailto:pencehe@oneonta.edu)

(This article appeared in the [Fall 2001 issue of the Computers in Chemical Education Newsletter](#).)

**Please note! I apologize, but due to a server problem, this link is incorrect. It should read**

**[http://www.eclipse.net/~pankuch/Newsletter/Pages\\_NewsF01/NewsletterCCE\\_Fall\\_01.html](http://www.eclipse.net/~pankuch/Newsletter/Pages_NewsF01/NewsletterCCE_Fall_01.html)**

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The previous tutorial in this series was concerned with selecting the best colors for a PowerPoint presentation that would be given to a general audience. The use of color in chemistry lectures has become so common and convenient that it is easy to forget that about 12 million Americans, most of whom are male, suffer from some form of color blindness. Red or green color blindness is most common and since it involves the X chromosome, it is much more common in men than in women. Despite common belief, color blindness does occur in women, although this is relatively rare. Total color blindness is relatively rare in individuals of either sex. There are several sites that discuss the basics of color vision and how this relates to vision problems, including [ERGOGERO](#), a company that does human factors design, the site on the [Science and Mathematics of Color](#) by Prof. Tom OHaver (U. of Maryland) and [Webvision](#), a site from the University of Utah Medical School.

Some individuals have learned to cope with color limitations, and others have obtained special lenses that assist color vision, but many people who are color blind do not realize that they have a difficulty. Thus, it becomes the responsibility of the instructor using color to insure that it is done in such a way that no one is penalized, even those who do not have normal color vision. This is true both for lecture presentations as well as web materials.

One of the best ways to start is to try to understand the nature of the situation. If you wish to experience

something of what it would be like to be colorblind, the free [Colorfield web site](#) allows a viewer to examine a series of photographs as they would appear if viewed by someone who had Dichromat, one of the main types of color blindness. In this case a single type of color receptor, i.e. red, green or blue visual pigment, is missing. These three types are called Deutan, which is a loss of sensitivity to green light, Protan a loss of red sensitivity, and Tritan, which is a loss of blue sensitivity. Deutan is most common, and Tritan is by far the least common. In each case, moving the mouse across the names of the three types of color limitations converts the image on the right into an approximation of what might be seen with that type of color blindness. Even though the conversions may not be totally accurate, this is a case where the company deserves credit for offering everyone a real service. (Colorfield is trying to sell an inexpensive color adjustment plug-in called Insight that currently works for Photoshop, Fireworks, and several other Macintosh programs. This commercial intent does not detract from the usefulness of their web site.)

Mrs. Christine Rigden, whose spouse is color blind, has created a standard 216-color web-safe palette, which is available for free from her web site, [Safe Web Colors for Color-deficient Viewers](#). Mrs. Rigden also provides color comparisons to show the effect of the main types of color blindness as well as a link [to download a replacement palette](#). Like the Colorfield site, the intention is not to reproduce the experience of color blindness with absolute accuracy, but rather to help a designer understand what colors and color combinations should be avoided whenever possible.

On a more practical note, there are several simple suggestions that will help an instructional designer to make projected text materials more user-friendly to people with all types of vision. Perhaps the most fundamental advice is never to use color as the only visual cue for guiding a user; always provide an alternative cue that is totally color independent. For example, if red (or blue or green) text is being used to indicate emphasis, it should also be underlined to provide a visual cue that is not affected by color vision. Alternately, the emphasized text can be enclosed in a white box so that it will stand out better. It is important to use a text color that contrasts strongly with the background. For example, a medium green text on a pastel green background might be very difficult to see for someone who is less sensitive to green light. It is easy to put a black shadow on any text, and the shadow may help to clarify the text letters. Perhaps most important, be sure to consult with the audience and ask if they are having any problems reading the material.

As noted in earlier tutorials, one of the real advantages of presentation software is the ability to insert images in close proximity to the text. The ease of inserting images is not, however, totally without educational liabilities. All of us have had the experience of seeing an image for the first time and requiring some interval to become oriented and understand what the image shows. The instructor brings to any image a great deal of experience that the students lack, as well as a better understanding of what is important. (This is why the instructor chose the image!) This period when comprehension develops can be slow for all students but even more difficult for those who are color blind. As is demonstrated on the Colorfield site mentioned earlier, some students will not see images in the way that the instructor expects. For this reason, it is always a good rule to verbally describe what the students are seeing when showing an image, and with a complicated image, it is helpful to point out the main features of the illustration. Do not assume that any students will completely comprehend an image at the first viewing! A picture may be worth a thousand words, but usually at least a few words of explanation are helpful for all students.

Perhaps the most important aspect of attempts to improve educational access for students who have special problems is the knowledge that these changes may be beneficial even to those who do not appear to need any help. Too often, educational materials are provided in a way that seems to be easiest for the instructor but is not really ideal for any of the students. With a little forethought, an instructor will often find that easily accomplished changes in the way he or she teaches can make the instructional process much more accessible and enjoyable for all students. Probably nowhere is this more true than in the efforts expended to make text and images clearer and easier to understand.

## **Addenda**

During the discussion of an earlier tutorial in this series, I received several suggestions that I carefully set aside for use in the current tutorial. As is often the case, my efforts to insure that these references wouldn't be lost caused me to file them away so well that I couldn't find them when I needed them. Fortunately,

they have recently returned to the light of day, and so I will provide them as addenda.

Fred Senese was kind enough to point out an excellent [site on Print Legibility and Partial Sight](#) sponsored by Lighthouse International. This discussion includes the basic recommendations for making all types of printed material more legible. Many of these suggestions, such as color contrast, font selection, and font size, have been discussed in these tutorials, but the site also includes useful ideas about paper finish, margins, etc. that expand the discussion. Lighthouse International also offers an excellent site on [Effective Color Contrasts](#), which supplements much of the current discussion.

On a similar topic, Walt Volland suggested a site titled [Color Matters -Vision](#), which includes some additional exercises that may be of interest. In a separate communication, Liz Dorland pointed out the contradiction that this site does not seem to follow its own recommendations. Walt also pointed out that people with dyslexia may have a different type of color problem, they find black text on white background to cause eye fatigue. He suggests a site entitled [Dyslexia - reading through colored filters](#) to better understand how a simple filter can make text more readable.

Finally, during the on-line discussion of this paper, Jim Diamond has pointed out that someone who is red-green color blind may find that the red light of a HeNe laser pointer is almost invisible.

Many thanks to Fred, Walt, Liz, and Jim for their input.

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