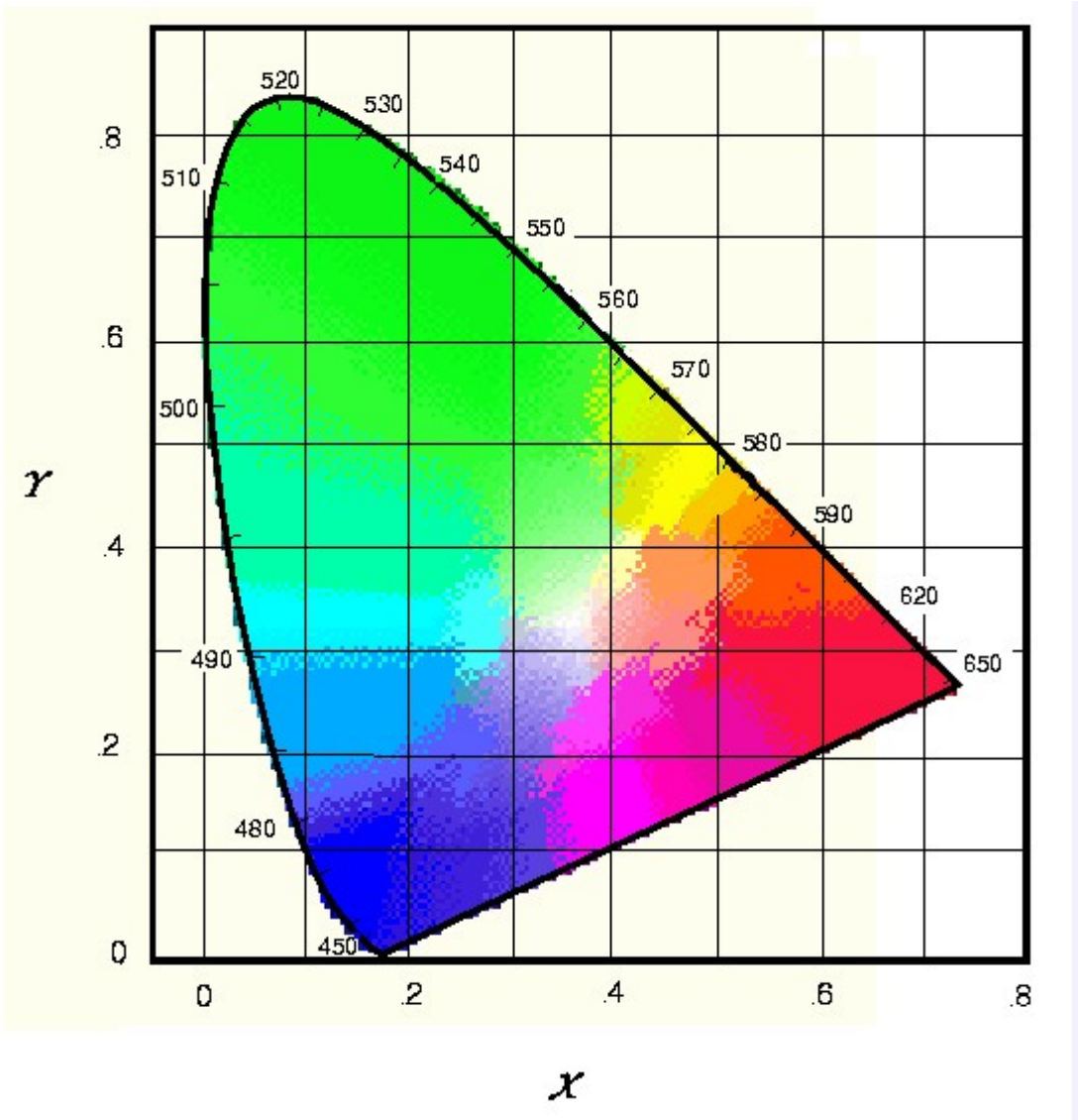
Colors in the Everday World Laboratory

Background:

In class we will talk about how combinations of red, blue, and green lights can produce all the colors that humans (with normal color vision) can see. To precisely describe colors, some people invented a C.I.E. diagram where every perceptually different color is described by two values x and y (a third number would be needed to specify the light's brightness). You will not have to know all of the details of this diagram, but here is a rough picture of how different colors are plotted in a C.I.E. Diagram.



For example, different shades of white have C.I.E. values in the middle of the diagram near x=0.38, y=0.32., while reds are near x=0.7, y=0.3. The x's and y's of pure (monochromatic) lights of different wavelengths (going from red=650 nm to violet=450 nm) are shown around the border of the figure. All lights that we can see fall within the

figure; lights with x's and y's outside of the figure would NOT BE VISIBLE to humans (for example infra−red light).

Purposes of the experiment:

In this experiment you will use a special instrument (a colorimeter) to measure colors found in the everyday world and plot the values on a C.I.E. graph. You will ask several questions:

- Where in a C.I.E. graph does one find 'everyday world colors'?
- Is there a different range of colors if I measure colors found in the natural world (flowers, trees, etc) versus colors of manfactured objects (boos, clothes, etc)?
- Does the type of lighting (indoor, outdoor, midday, sunset) make a difference in the color?
- What range of colors can I make on a computer monitor?
- Is there a difference between the colors I can make on a regular computer monitor (CRT) and on a laptop (LCD)?

Doing the experiment:

Student's choosing "Colors in the everday world" for their COSMOS project, will be the leaders of groups of students collecting the following data:

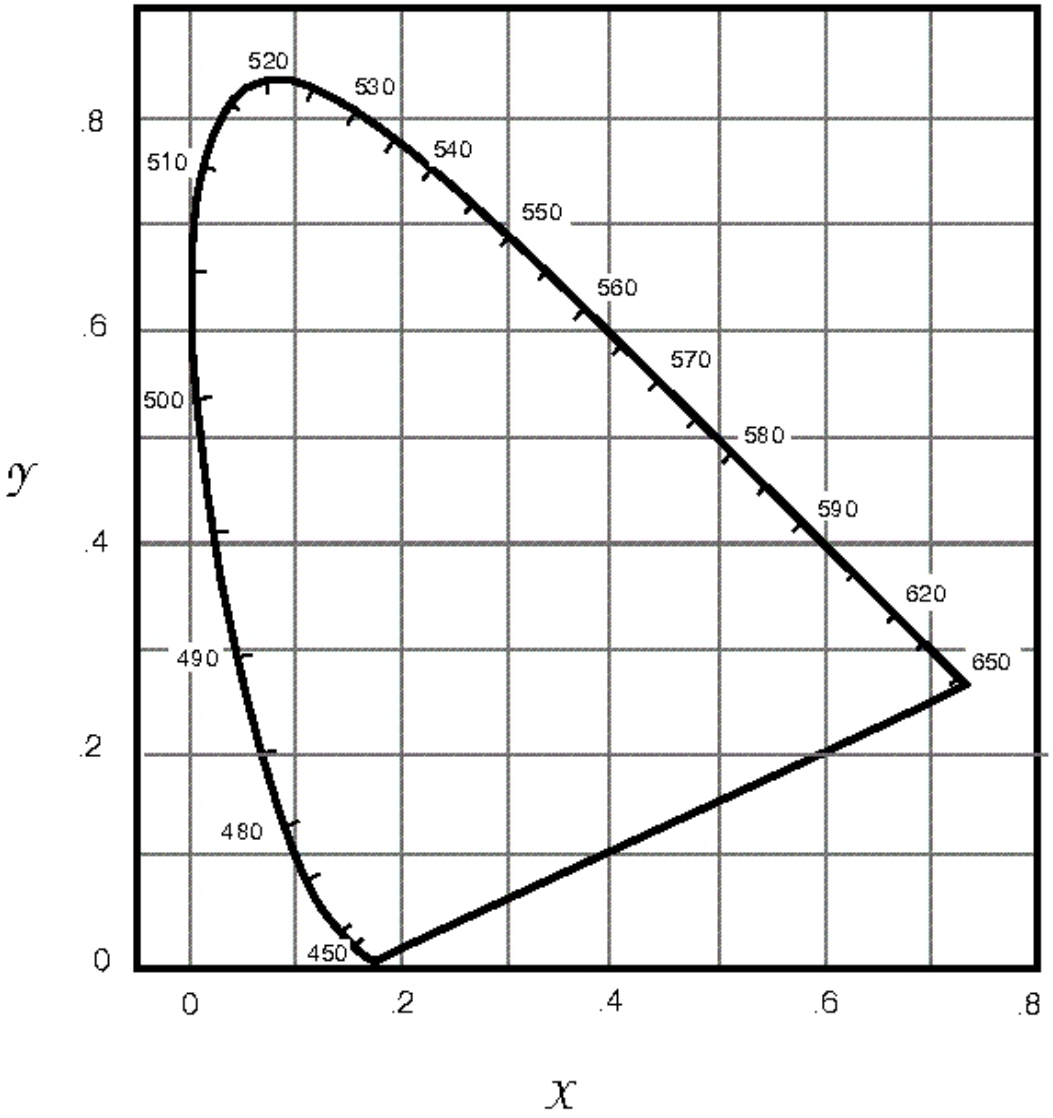
- Your TA will explain how to use a Minolta colorimeter. With this instrument you will be able to aim it at an object and record the C.I.E. x and y color values of the object (and its brighteness).
- You will choose 10−15 objects from "natural" outdoor scenes and record their colors under early afternoon light.
- You will choose 10−15 objects from "man−made" (indoor or outdoor) scenes and record their colors.
- You will use the same 10−15 objects from "natural" outdoor scenes measured earlier but then remeasure their colors under evening light.
- You will choose 10−15 objects from "natural" outdoor scenes and record their colors under early afternoon light.
- You will measure the color values for pure RED, GREEN, and BLUE on a computer monitor.
- You will measure the color values for pure RED, GREEN, and BLUE on a laptop computer.
- You will have a digital camera to take regular pictures of the scenes and objects whose color you measure (pictures for your COSMOS project presentation).

Analysis of data (for students doing "Colors in the everday world" for their COSMOS project); YOUR TA's WILL EXPLAIN ALL OF THIS TO YOU!!:

- Plot on blank C.I.E. graphs the x and y for the colors of the objects that you measure.
- Calcuate the *centroid* and *standard deviations* (TA will explain how) for the color data in each of the categories: natural objects (afternoon), natural objects (evening), man−made objects.
- Plot and compare the colors from a regular computer monitor and a laptop.

Questions and possible topics for presentation:

- Are all the colors humans can see found in objects the everday visual environment?
- Do natural objects or man−made objects have a greater range of colors?
- Does the color of an object (the color of light seen by the eye) change depending on the lighting (midday vs evening lighting). Do the colors of objects actually look different? [this is related to the topic of "color constancy" which might make be interesting to include in your presentation]
- Which can make a larger range of colors a CRT or laptop monitor?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