LAB: Fluorescent Brightening Agents in Laundry Detergent

In this lab, we will qualitatively (that means no calculation—but VERY detailed observations) apply and review what you have learned about light, color vision, and fluorescence.

INTRODUCTION:

Fluorescent brightening agents are added to most laundry detergent (except Seventh Generation or another all-natural detergents) to brighten/ whiten clothing. Typically, they brighten clothing by absorbing light in the UV region of light and re-emitting it in the visible region, most usually as blue light.

How does this "whiten" clothing? Recall what you learned about absorption, reflection, emission, and color with red, green, and blue light.

1. A yellow object reflects what color lights (recall what is yellow light made of?)?_____

2. What color does a yellow object not reflect (absorb)?_____

3. If a yellow or yellowing object were dyed with a fluorescent substance that converts UV light to blue light (assume that the fluorescent substance doesn't change the yellow objects own absorption/ reflection properties), what color lights would the dyed yellow object now emit?

   _____

4. What color is perceived by the combination of the lights in question #3?_____

Resource if you're stuck: http://www.sas.upenn.edu/~kimg/mcephome/chem507/spec1HOME.html

PROCEDURE:
In this lab, you will:

1) make up solutions of various laundry detergents and place them on a blacklight to determine the color of the light emitted by the fluorescent brightening agent in each detergent.
2) take several strips of colored cotton and qualitatively compare their appearance (when dry) after having been hand-washed in either distilled water or your laundry detergent solutions.

PART 1:

In a normal washing, people use about 1 cup of laundry detergent, which is about 250 mL, and a home machine uses about 30 gallons (conservative estimate) of water per load (2.5 gallons/ lb of clothes), which is about 110-115 L of water. Let's assume that 2/3 of that water is used for rinsing as opposed to actual washing/ cleaning. (Water usage info taken from: http://www.a1laundromats.com/)

Let's fudge things a bit to create a similar, but more concentrated solution for ourselves—**about 15 mL of detergent for 1 L of water.** Each group should make a 1 Liter solution of their laundry detergent—bring them in from home—try to get ones that indicate "brighter whites and colors." There will be a FWA-free detergent that I make up as a control (Seventh Generation). Observe the emitted colors of the controls and four of the solutions on the blacklights. Record your observations neatly in the data section.

PART 2:

Pick up two samples of each colored cloth (white, yellow, navy) and proceed to "wash" one cloth in FWA-free detergent and one cloth in **your laundry detergent** (not all of the detergents).

You will handwash each cloth for one full minute by holding the fabric loosely between your hands and rubbing it between your hands while they are submerged in the liquid. Squeeze/ wring the fabric to get rid of excess liquid after each wash.

After 8 consecutive washings for each sample, set your sample on the rack to dry, making sure you label or tag the fabric so you know which was washed in what. You will compare the appearance of each pair after they are dry. Record the data in the data section.

DATA:

Table 1. Colors emitted by laundry detergent solution on blacklight.

Control 1: Distilled water	
Control 2: 7th Generation	
Detergent A: _____	
Detergent B: _____	
Detergent C: _____	
Detergent D: _____	

Table 2. Comparison of clothes washed in FWA-free detergent and regular detergent with FWA after 8 consecutive washings.

Color of cloth	In FWA-free detergent	In FWA detergent
white		
yellow		
Navy		

CONCLUSIONS:

In a brief, well-thought out paragraph, explain how fluorescent brightening agents brighten clothing:

Check it out (for fun):

Laundry detergent paintings: http://www.woostercollective.com/2007/10/07-week/