Materials used

Pasco spectrometer, McCormick assorted food colors, Ball® Fruit Fresh, bleach, 100-1000 µL micropipette.

Preparation of solutions

- **Yellow 5 solution**: in a 100 ml volumetric flask, add 80 ml of distilled water and 1 drop of yellow McCormick food dye. Give it a good mix and bring the volume up to 100 ml with distilled water.
- **Yellow 5 + Fruit Fresh solution**: Get 50 ml of Yellow 5 solution and add 0.5 g of Ball® Fruit Fresh; stir it vigorously until completely dissolved.

Note: *The solutions should be filtered. However, if you just want to do this experiment as a demo, that is not necessary. The terms Tartrazine, food dye and Yellow 5 are going to be used interchangeably (both here and in the original ChemEd X post). Commercial bleach was titrated and diluted in order to get a concentration of 0.425 M.*

I used Yellow 5 food dye because it is quickly oxidized by bleach. This ensures a quick demo of about 10 minutes. The other food dyes tend to be oxidized quickly as well but they require more minutes to undergo an adequate decolorization.

Execution

In order to get the best results, all the reactions should be carried out in the cuvettes.

Add 3 ml of the solution you want to test into the cuvette; place that into the spectrometer and start recording the absorbance at 427 nm over time. Make sure that the absorbance is stable and there are not significant fluctuations.

In the meantime, by using a micropipette, get 100 µL of bleach. I titrated the bleach I used but is not necessary. *Though, I would suggest not to use too much concentrated bleach; it oxidizes the dye very quickly, thus data could be sloppy and inaccurate. 1:1 diluted bleach works well.*

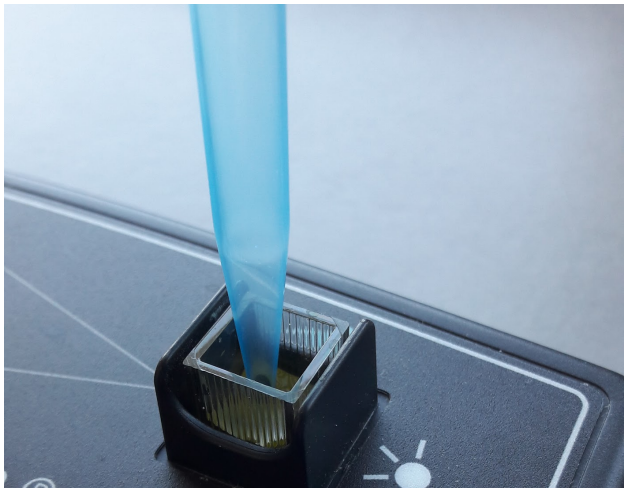

Figure 1 - *adding bleach to cuvette*

As soon as you are ready, *partially immerse* the tip of the micropipette into the solution contained in the cuvette and rapidly add the bleach. Holding the tip inside the liquid and injecting that will give a nice mixing of the solutions (see figure 1).

Record data until you get a *plateau* in the absorbance values; that means that the dye either has been almost totally oxidized (solution in the cuvette will be colorless at the end of the

process) or, depending on the solution you are testing, the bleach has totally oxidized the Vitamin C from Fruit Fresh.

Your time zero will be taken immediately before the injection of the bleach; absorbance data is taken every 5 seconds and converted in concentration values by the following relation (*Lambert-Beer law*):

$$\mathbf{A = \varepsilon l c}$$

(ε *for Yellow 5*[1] *is 27300 L mol*$^{-1}$ *cm*$^{-1}$)

A sample of the spectra you could record is shown in figure 2.

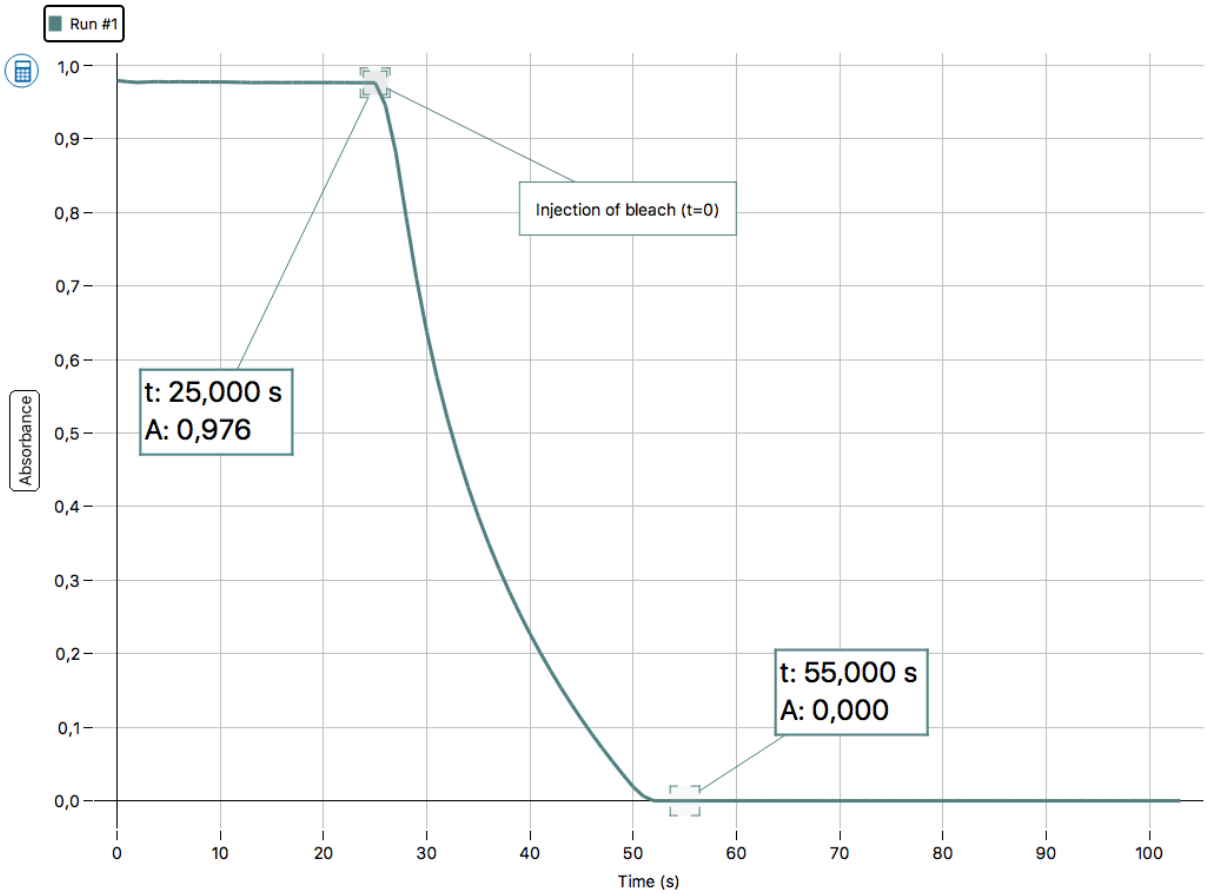

Figure 2 - *sample spectra data*

1 - Samuella B. Sigmann and Dale E. Wheeler, The Quantitative Determination of Food Dyes in Powdered Drink Mixes. A High School or General Science Experiment, *Journal of Chemical Education*, 2004, 81 (10), p 1475.

Report all data in the table below:

Time [s]	*Absorbance*	*Concentration [M]*	*lnC*
0			
5			
10			
15			
20			
25			
30			

Now, you can plot two graphs:

- Concentration [M] over time [s]. Best trendline for this graph will be an *exponential one.*
- lnC over time [s], where lnC is the natural logarithm of the concentration value. Best trendline for this graph will be a *linear one*.

From the slope of the *lnC vs time* line you get the rate constant (k) value. Half-life ($t_{1/2}$) can be calculated by using the following equation for a first-order reaction:

$$t_{1/2} = \frac{\ln 2}{k}$$

You should expect a lower value of the rate constant and a higher value of $t_{1/2}$ for the reaction carried out in presence of the antioxidant. You can also plot this difference on a bar graph.