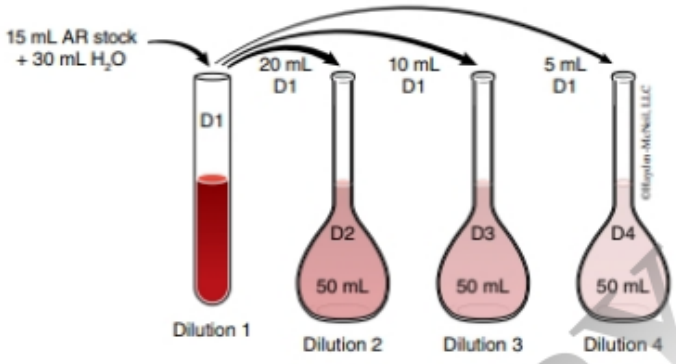

9. Pipet 15 mL of 1.0X • 10^{-4} M Allura Red dye solution into a large test tube labeled "Dilution 1." Add 30 mL of deionized water to the solution using the 10-mL pipet.

10. Pipet 20 mL of Dilution 1 into a 50-mL volumetric flask labeled "Dilution 2." Fill the flask to 50.00 mL by adding deionized water carefully to the flask until the bottom of the meniscus is at the exact height as the graduation on the neck of the flask. Note: if you overshoot the line, this dilution is invalid and **you will need to repeat this step**. See Appendix B for more information.

11. Pipet 10 mL of Dilution 1 into a 50-mL volumetric flask labeled "Dilution 3." Fill the flask to 50.00 mL by adding deionized water carefully to the flask until the bottom of the meniscus is at the exact height as the graduation on the neck of the flask. Note: if you overshoot the line, this dilution is invalid and **you will need to repeat this step**.

12. Pipet 5 mL of Dilution 1 into a 50-mL volumetric flask labeled "Dilution 4." Fill the flask to 50.00 mL by adding deionized water carefully to the flask until the bottom of the meniscus is at the exact height as the graduation on the neck of the flask. Note: if you overshoot the line, this dilution is invalid and **you will need to repeat this step**.

13. Rinse the cuvette **a minimum of three times**, and fill it ¾ full with bleach solution. Insert the cuvette into the spectrophotometer and "zero" it (see Step 4). After pressing the "CAL" button, record the absorbance at 505 nm in your notebook. Pour the bleach solution down the drain with plenty of running water.

14. Rinse the cuvette **a minimum of three times** with your Dilution 4 solution, then fill it ¾ full with your Dilution 4 solution. Take an absorbance reading at 505 nm and record the value in your notebook.

15. Repeat Step 14 with your Dilution 3, Dilution 2, then Dilution 1 solutions, being careful to rinse the cuvette well between solutions. Analyze your solutions in this order to ensure accurate measurements.

Waste Disposal

This experiment was designed with the tenets of green chemistry in mind. All solutions can be poured down the drain with plenty of running water. 75-mL test tubes should be cleaned and returned to your common locker. Remove all markings from the volumetric flasks with an alcohol wipe. Return the cuvette, volumetric flasks, and timer to your lab instructor.

DAY 2

As an OSU student, you have the ability to download Microsoft Office (this includes Word, Excel, and many other programs) on your laptop or iPad for free.

For help, please visit office365.osu.edu
Additional support may be found at the bottom of the webpage.

Complete the following tasks using the data from Day 1. A summary of the three graphs you need to create is in the Data Analysis section (page 25), but a more specific procedure is provided here. You may consult your peers as you work through these instructions; if you collectively have questions, ask your lab instructor for additional guidance. **All calculations must be done in Excel**, so be sure to download this program before arriving for Day 2. *You will not need to prepare your lab notebook for Day 2 of this experiment.*

1. Input the data you collected in Part C from Day 1 into a new spreadsheet in Excel, placing each set of values in its own column. Do not worry about formatting the column headers.

2. Excel does not automatically report the correct number of significant figures. Adjust the number of significant figures shown by changing the number of decimal places displayed; the cell format should be changed from "General" to "Number" to allow this. For very large or very small numbers, such as your dye concentration, use the "Scientific" format, which will display your values in scientific notation. Significant figure rules are provided in Appendix D.

3. Construct a Beer's Law plot with the data collected in Part C. The concentration of Allura Red should be on the x-axis and absorbance on the y-axis. To do this, select the x and y data you wish to plot by highlighting it in the spreadsheet. Then, in the "Insert" tab under the list of available charts, select the "scatter" plot option. Note: the scatter plot should display only data points, no lines should be in the plot at this point. A small graph (your "Beer's Law" plot) will appear.

4. Move this graph to a new sheet; to do so, select "Move Chart" and the "New Sheet" option to create Chart1. Your Beer's Law graph will now be a full page. Format your graph appropriately and add a linear trendline. Set the graph to display the equation of the trendline and R^2 value. You will need to manually set the intercept of the trendline to 0. Refer to the Guide for Success in the General Chemistry Laboratory and Appendix D for graphing requirements.

Your lab instructor must check your Beer's Law graph before moving on.

5. Open a fresh tab within the same Excel file. Using the suggested table in the Data Analysis section (page 25), create four separate tables—one for each solution—and input your time and absorbance data collected in Day 1.

6. In the next column, calculate the concentration of Allura Red at every time point, in molarity, using the equation from your Beer's Law graph. Excel will perform these calculations for you if you type the correct function. For example, if B2 is the cell that contains the first absorbance for solution 1, in cell C2 you could enter the formula below. Then, copy/drag the formula down to the other cells.

   = B2/(slope from your Beer's Law graph)

   Note that units are not in the formula command.

7. In the next two columns, calculate the *ln* $[Dye]_t$ and $1/[Dye]_t$ using Excel functions. Do not worry about formatting the column headers. Use the example in Step 6 to allow Excel to perform this calculation for you. Then apply the formula to all time points.

8. Adjust the significant figures for the values created in Steps 6 and 7.

9. Create your First-Order graph with time on the x-axis and *ln* [Dye] on the y-axis. Highlight the data for Solution 1, and create a scatter plot. We now need to add the other solutions as separate series to this graph. To add a second series, click on your graph, then under the "Design" tab go to "Select Data." Add a new series and highlight your Solution 2 x and y values when prompted. Repeat this process for solutions 3 and 4. When you are finished, all four series should be on the same graph.

10. Move the First-Order graph to a separate sheet; refer to Step 3 as a guide. Format your graph appropriately and add a legend and linear trendlines, displaying the equation and R^2 value. Refer to the Guide for Success in the General Chemistry Laboratory and Appendix D for graphing requirements.

11. Have your lab instructor check your First-Order graph (required). Incorporate their feedback as necessary.

12. Repeat Steps 9 and 10, instead plotting 1/[Dye] on the y-axis and time on the x-axis to create the Second-Order graph.

13. All three graphs will now need to be added to your Report Template for submission. All of your graphs display data most accurately in "landscape" orientation; this allows the data to be "spread out." Three pages of the Report Template will be turned to landscape orientation; add your graphs to these pages. Check that all formatting remains in your final graphs. It is best to paste the graphs as pictures, and not as Excel objects.

14. Have your lab instructor check your Second-Order graph before leaving (optional). Incorporate their feedback, if needed.

    If you leave lab more than 15 minutes before the end of the session, you will not be eligible to have your graphs checked by your lab instructor after your lab session ends. Students remaining in lab until 15 minutes or less remain in the session are eligible to have their graphs checked after the lab ends.