Using Google Forms to Receive and Grade Online Lab Reports

By Mark Ott

Abstract:
A method is described whereby students submit their entire lab report electronically, the instructor still has ease of grading pen-on-paper, and all students can review everyone else's submission (names are removed) such that they can learn from the other examples, albeit good or bad. The only software needed are freely available and simple to use.

Background

Lab reports are an essential part of the chemistry lab experience, forcing the students to reflect on the experiment, discuss errors and quality of data, and ultimately prove they understand the chemistry of the experiment. Traditionally, these lab reports are 1-3 pages, are each printed, and turned in by the student and subsequently graded by the instructor and then returned to the student.

With word processing and internet based technology, electronically submitted lab reports have potential to make things easier for students and instructors. Grading anything electronically requiring feedback, however, is difficult. A student puts one sentence in the wrong section and the instructors wants to just circle it and draw an arrow to where it should be. The Instructor might want to show how one sentence can be removed, an image needs more added to it, etc. These comments are easily done by hand with pen and hard copy, but electronically submitted pieces are much harder to work with. It can be done, but it takes much more time.

What is discussed here is a simple and easy to use method that is the same total amount of work for the instructor, and they have the same editing freedom, but the student can submit reports easier and get much more feedback from the instructor.

The Form and Report Submission

Google Forms is one of many Google online products that are free and easy to use. Google Forms allows one to make a online form whereby people submit individual answers. The instructor can ask any question they want. In this example, the students normally submit a 1 page document that has several sections (purpose, summary, procedure, results, commentary) The form that is built has one 'answer' for each section. Such that all responses can be publically posted, each student have a randomly assigned designation. In this example, each student has been assigned a chemical symbol.

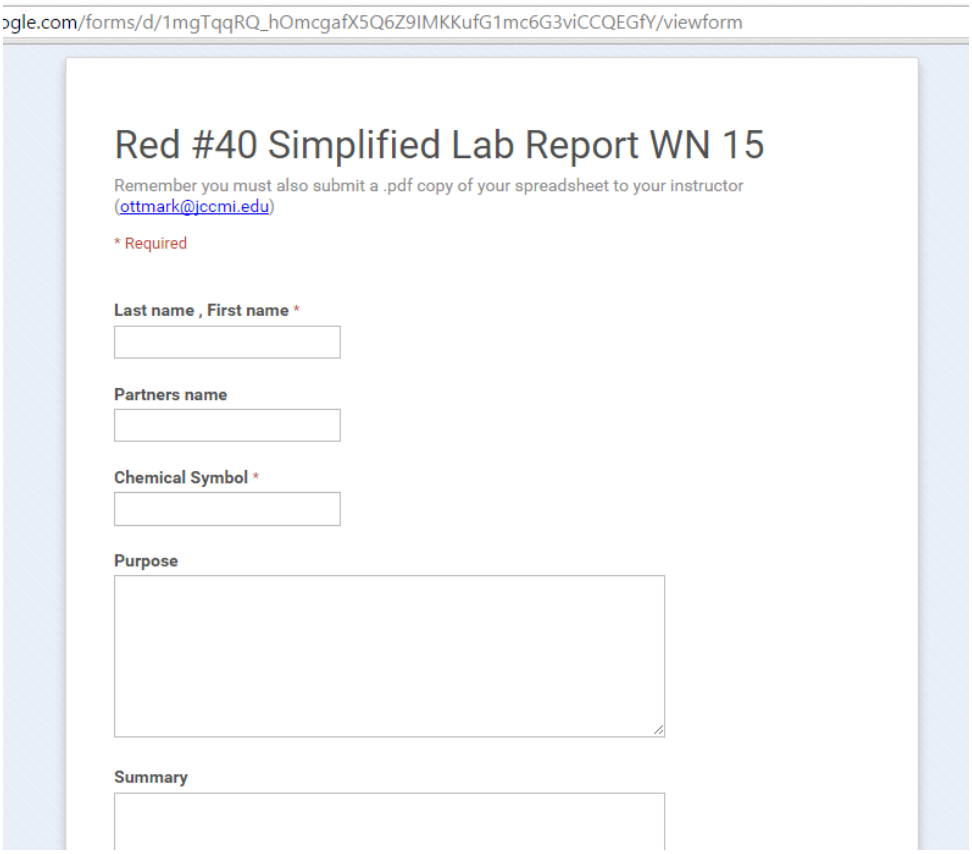


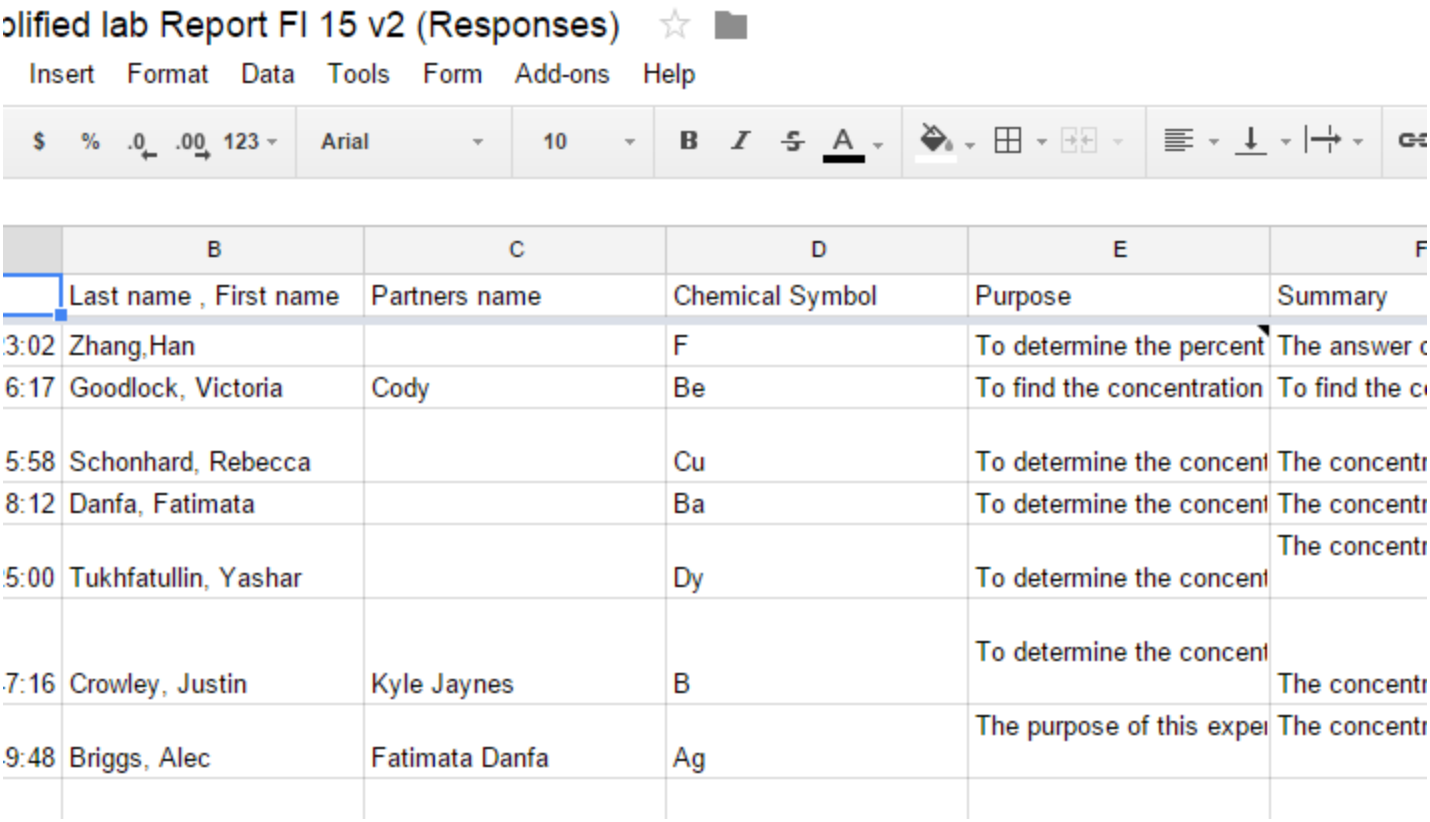
Figure 1. A sample submission form as seen by the student

The students write their 'report' as one might normally, in the word processing program of their choice. Once it is all complete (proof-read, spell-checked, etc) only then do they open the form and cut/paste individual sections into the form. Once complete, they click 'submit' to send the completed form. Google forms allows for the user to go back and change their answers once submitted, but only if they have a google account. Such an account is free and having one should be encouraged by instructors.

If you are not familiar with Google Forms, they are very easy to learn how to use. Here is one instructional video and other exist online.

The Grading

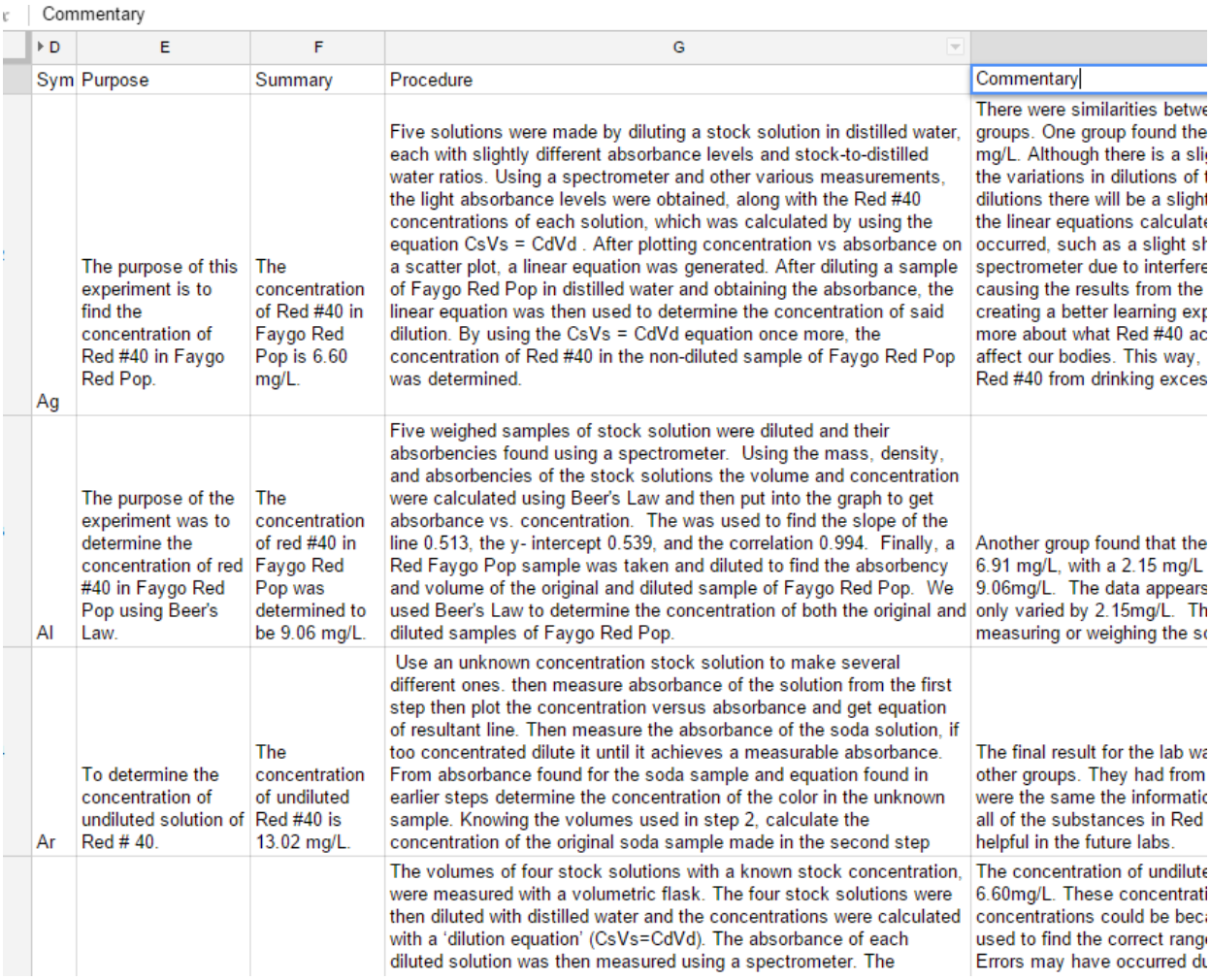
Once the deadline for submission is past (which can be whenever, even 11pm on a Friday night) the instructor then can print one copy of the entire classes' submissions. When a Google Form is made, the response spreadsheet is automatically generated. Figure 2 shows a portion of a sample spreadsheet.



	B	C	D	E	F
	Last name , First name	Partners name	Chemical Symbol	Purpose	Summary
3:02	Zhang,Han		F	To determine the percent	The answer c
6:17	Goodlock, Victoria	Cody	Be	To find the concentration	To find the c
5:58	Schonhard, Rebecca		Cu	To determine the concent	The concentr
8:12	Danfa, Fatimata		Ba	To determine the concent	The concentr
5:00	Tukhfatullin, Yashar		Dy	To determine the concent	The concentr
7:16	Crowley, Justin	Kyle Jaynes	B	To determine the concent	The concentr
9:48	Briggs, Alec	Fatimata Danfa	Ag	The purpose of this expe	The concentr

Figure 2: Example of populated response spreadsheet

Before grading is done, the spreadsheet needs to be manipulated. Sorting by random student designation (chemical symbol in this case) should be done to make it easier for students to find their graded response. The submission timestamp is automatically inserted by Google, and can be used to confirm the students have turned it in on time. It can be hidden (not deleted) as should the student's name. The width of the remaining cells can also be adjusted to make best use of space (less white) and reduce the number of pieces of paper printed. Figure 3 shows how the same example looks after it has been edited.



	D	E	F	G	
	Sym	Purpose	Summary	Procedure	Commentary
	Ag	The purpose of this experiment is to find the concentration of Red #40 in Faygo Red Pop.	The concentration of Red #40 in Faygo Red Pop is 6.60 mg/L.	Five solutions were made by diluting a stock solution in distilled water, each with slightly different absorbance levels and stock-to-distilled water ratios. Using a spectrometer and other various measurements, the light absorbance levels were obtained, along with the Red #40 concentrations of each solution, which was calculated by using the equation CsVs = CdVd . After plotting concentration vs absorbance on a scatter plot, a linear equation was generated. After diluting a sample of Faygo Red Pop in distilled water and obtaining the absorbance, the linear equation was then used to determine the concentration of said dilution. By using the CsVs = CdVd equation once more, the concentration of Red #40 in the non-diluted sample of Faygo Red Pop was determined.	There were similarities betwe groups. One group found the mg/L. Although there is a sli the variations in dilutions of t dilutions there will be a slight the linear equations calculate occurred, such as a slight sh spectrometer due to interfere causing the results from the creating a better learning exp more about what Red #40 ac affect our bodies. This way, Red #40 from drinking exces
	Al	The purpose of the experiment was to determine the concentration of red #40 in Faygo Red Pop using Beer's Law.	The concentration of red #40 in Faygo Red Pop was determined to be 9.06 mg/L.	Five weighed samples of stock solution were diluted and their absorbencies found using a spectrometer. Using the mass, density, and absorbencies of the stock solutions the volume and concentration were calculated using Beer's Law and then put into the graph to get absorbance vs. concentration. The was used to find the slope of the line 0.513, the y- intercept 0.539, and the correlation 0.994. Finally, a Red Faygo Pop sample was taken and diluted to find the absorbency and volume of the original and diluted sample of Faygo Red Pop. We used Beer's Law to determine the concentration of both the original and diluted samples of Faygo Red Pop.	Another group found that the 6.91 mg/L, with a 2.15 mg/L 9.06mg/L. The data appears only varied by 2.15mg/L. Th measuring or weighing the s
	Ar	To determine the concentration of undiluted solution of Red # 40.	The concentration of undiluted Red #40 is 13.02 mg/L.	Use an unknown concentration stock solution to make several different ones. then measure absorbance of the solution from the first step then plot the concentration versus absorbance and get equation of resultant line. Then measure the absorbance of the soda solution, if too concentrated dilute it until it achieves a measurable absorbance. From absorbance found for the soda sample and equation found in earlier steps determine the concentration of the color in the unknown sample. Knowing the volumes used in step 2, calculate the concentration of the original soda sample made in the second step	The final result for the lab wa other groups. They had from were the same the informatic all of the substances in Red helpful in the future labs.
				The volumes of four stock solutions with a known stock concentration, were measured with a volumetric flask. The four stock solutions were then diluted with distilled water and the concentrations were calculated with a 'dilution equation' (CsVs=CdVd). The absorbance of each diluted solution was then measured using a spectrometer. The	The concentration of undilute 6.60mg/L. These concentrati concentrations could be bec used to find the correct rang Errors may have occurred du

Figure 3: Example of edited response spreadsheet, now ready for grading

One printed copy of this edited version with all students answers included is made and is graded as normal, with all instructor comments and other markings done on the one printed copy. With all answers to a specific section in one column, spotting plagiarism is much easier.

The Feedback

Once the document has been completely graded, the **entire** printed document is then posted in some public place to let **all** students see **all** submissions. The students then can see what they did (as only they know their chemical symbol) but they also get to see what others did. As the instructor is grading, they can highlight individual section answers from specific students and to show what a 'perfect' submission for that portion is. That way, students can easily compare theirs to what was considered 100% correct.

Conclusions

With this method, the advantages are numerous, notably the timing of submission is highly variable, the students get more robust feedback being able to see submissions from other students. The additional work that needs to be done by the instructor is minimal, and the technology required is easy to use and free.

While the technology has advanced in education, the writing of lab reports remains a broad and valuable assessment of student learning. Here, we have used technology to once again make this long used method much easier and more robust in the modern age.