Tested Studies for Laboratory Teaching
Proceedings of the Association for Biology Laboratory Education
Volume 39, Article 41, 2018

No, It's Not about Pipetting!

Stephanie F. Mel[1] and Stanley M. Lo [2,3]

[1] University of California San Diego, Section of Molecular Biology, 9500 Gilman Dr #0355, La Jolla CA 92093-0355 USA

[2]University of California San Diego, Section of Cell and Developmental Biology, 9500 Gilman Dr #0355, La Jolla CA 92093-0355 USA

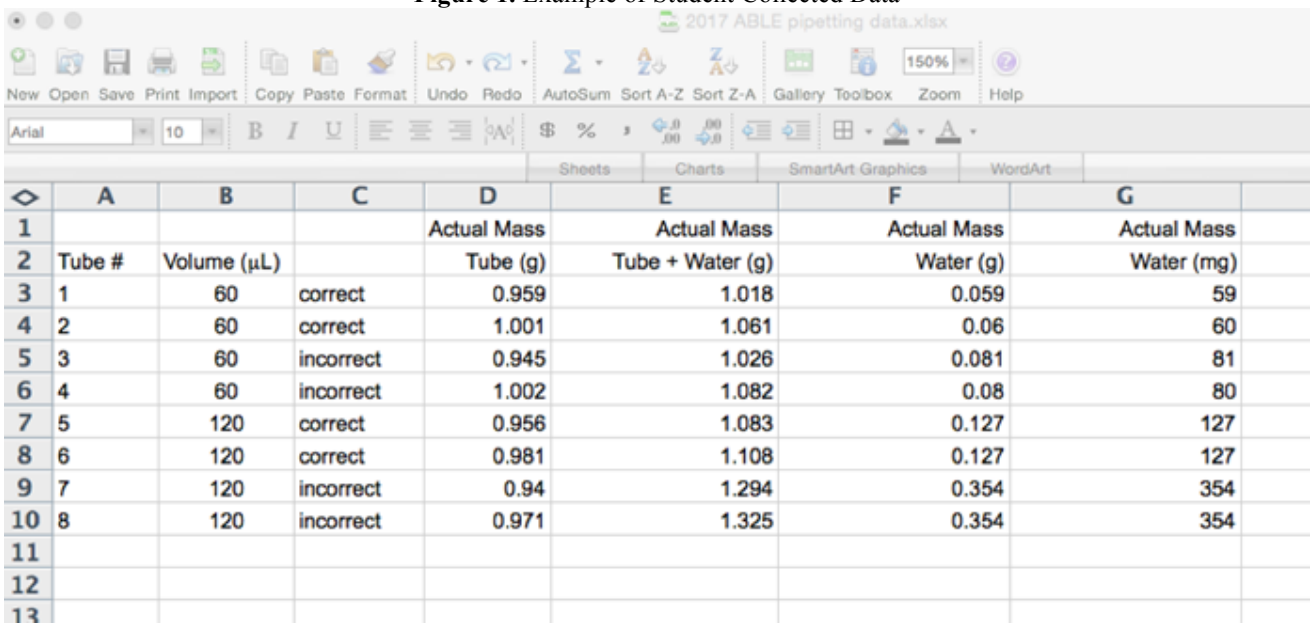
[3]University of California San Diego, Program in Mathematics and Science Education, 9500 Gilman Dr #0355, La Jolla CA 92093-0355 USA

(smel@ucsd.edu; smlo@ucsd.edu)

Extended Abstract

This lab exercise integrates a basic lab skill with simple math functions and statistical analysis using Excel. At the conclusion of the exercise, students will have determined that pipetting correctly vs. incorrectly results in statistically different volumes (masses) of water. In the first lab meeting, students are taught how to use micropipettors correctly, by depressing the plunger to the first stop to draw up liquid, and then depressing to the second stop to release the liquid. Each group of students correctly pipettes two specific volumes in duplicate (60 µL, 120 µL) into separate pre-weighed eppendorf tubes. They also pipette the same volumes incorrectly, by depressing the plunger to the second stop and drawing up the liquid. Students then determine the mass of water in each of the eppendorf tubes. To do this, they enter their data into a shared Google spreadsheet and they learn to use simple math functions in Excel to subtract the mass of the empty tubes from the tubes + water (see Figure 1). The data for the entire class is entered into the same shared spreadsheet so students can sort and align the four sets of data (60 uL correct and incorrect, 120 uL correct and incorrect) using the Sort function on Excel. They then calculate the averages and standard deviations of each of the four data sets using the AVERAGE and STD (Standard Deviation) functions in Excel. Finally, they perform t-tests (again using Excel) on the 60 uL and 120 uL data sets. The resulting p-values clearly show that pipetting incorrectly leads to significantly larger volumes than pipetting correctly. This exercise is very accessible to beginning students and is used in a lab class for incoming freshmen. Typically the students have no experience with lab skills, statistical analysis or Excel. Our students work in groups of 4, so each student within the group pipettes water for one of the data points (i.e. 60 uL correct, 60 uL incorrect, 120 uL correct, 120 uL incorrect). They work together to weigh the tubes, enter the data into the shared spreadsheets, and do the calculations. A more detailed protocol is available upon request by emailing the author at smel@ucsd.edu.

Figure 1. Example of Student Collected Data



	A	B	C	D	E	F	G
1				Actual Mass	Actual Mass	Actual Mass	Actual Mass
2	Tube #	Volume (µL)		Tube (g)	Tube + Water (g)	Water (g)	Water (mg)
3	1	60	correct	0.959	1.018	0.059	59
4	2	60	correct	1.001	1.061	0.06	60
5	3	60	incorrect	0.945	1.026	0.081	81
6	4	60	incorrect	1.002	1.082	0.08	80
7	5	120	correct	0.956	1.083	0.127	127
8	6	120	correct	0.981	1.108	0.127	127
9	7	120	incorrect	0.94	1.294	0.354	354
10	8	120	incorrect	0.971	1.325	0.354	354
11							
12							
13							

Mission, Review Process & Disclaimer

The Association for Biology Laboratory Education (ABLE) was founded in 1979 to promote information exchange among university and college educators actively concerned with teaching biology in a laboratory setting. The focus of ABLE is to improve the undergraduate biology laboratory experience by promoting the development and dissemination of interesting, innovative, and reliable laboratory exercises. For more information about ABLE, please visit **http://www.ableweb.org/.**

Papers published in *Tested Studies for Laboratory Teaching: Peer-Reviewed Proceedings of the Conference of the Association for Biology Laboratory Education* are evaluated and selected by a committee prior to presentation at the conference, peer-reviewed by participants at the conference, and edited by members of the ABLE Editorial Board.

Citing This Article

Mel SF, Lo SM. 2018. No, It's Not About Pipetting! Article 41 In: McMahon K, editor. Tested studies for laboratory teaching. Volume 39. Proceedings of the 39th Conference of the Association for Biology Laboratory Education (ABLE). **http://www.ableweb.org/volumes/vol-39/?art=41**