



## Small TLEF Project – Final Report

Report Completion Date: (YYYY/MM/DD)

### 1. PROJECT OVERVIEW

#### 1.1. General Information

Project Title:	Integrating Analytical and Physical Chemistry: A Modern Approach to Chemical Analysis		
Principal Investigator:	José Rodríguez Núñez		
Report Submitted By:	José Rodríguez Núñez		
Project Initiation Date:	May, 2015	Project Completion Date:	May, 2017

#### 1.2. Project Summary

In 2015, the Department of Chemistry underwent major curriculum changes affecting courses from 1<sup>st</sup> to 4<sup>th</sup> year. One important change was the inclusion of physical chemistry concepts in the 2<sup>nd</sup> year Analytical Chemistry laboratories. The goal of this project was to modernize the Analytical chemistry labs by developing experiments that combined Analytical and Physical Chemistry concepts with the help of undergraduate students hired using funding from TLEF.

Four new experiments have been developed over the last two years and three of them have been implemented to date. The experiments have served over 600 students in the last two years and will continue to be used in the 2<sup>nd</sup> year Analytical Chemistry curriculum for years to come. In addition, videos to provide feedback on laboratory activities were developed in the summer of 2016 and implemented in term 1 and term 2 of the 2016-2017 academic year.

Student feedback on the experiments developed with TLEF funding has been largely positive. Also, students have reported using the videos regularly and consider them to be a useful learning tool.

#### 1.3. Team Members – (Please fill in the following table and include students, undergraduate or graduate, who participated in your project).

Name	Title/Affiliation	Responsibilities/Roles
Jose Rodriguez Nunez	Instructor I / Department of Chemistry, Faculty of Science.	Supervisor
Guillaume Bussiere	Instructor I / Department of Chemistry, Faculty of Science.	Co-supervisor
Emily Hopkins	Undergraduate student / Faculty of Science.	Developed one guided-inquiry experiment in the summer of 2015.
Sophia Ly	Undergraduate student / Faculty of Science.	Developed one guided-inquiry experiment in the summer of 2015.



Yi (Andy) An	Undergraduate student / Faculty of Science.	Developed one guided-inquiry experiment in the summer of 2015.
Kathryn Irwin	Undergraduate student / Faculty of Science.	Developed one guided-inquiry experiment in the summer of 2015.

**1.4. Student Impact** – Please fill in the following table with **past**, **current**, and **future** courses and sections (e.g. HIST 101, 002, 2017/2018, Sep) that have been/will be impacted by your project, including any courses not included in your original proposal (you may adapt this section to the context of your project as necessary).

Course	Section(s)	Academic Year	Term (Summer/Fall/Winter)
CHEM 211	L13, L14, L15, L16, L22, L23, L24, L25	2015-2017	Fall and winter
CHEM 211	L13, L14, L15, L16, L22, L23, L24, L25	2016-2017	Fall and winter

The experiments developed as part of this project will be used in future offerings of the lab and will serve a population of approximately 350 – 400 students every year. Students in Chemistry, Biochemistry, and Cellular and Physiological Sciences will be impacted by this project.

## 2. PROJECT EVALUATION

**2.1. Project Outcomes** – Please list the intended outcomes or benefits of the project for students, TAs and/or instructors.

- Develop new guided-inquiry experiments to improve student’s scientific inquiry skills.
- Develop videos that will provide uniform feedback.
- Improve students’ technical abilities when working in an analytical laboratory.
- Improve students’ scientific inquiry skills.
- Improve students’ attitudes towards physical and analytical chemistry.
- Optimize TA time inside and outside the laboratory.

**2.2. Findings** – Briefly describe the methods and findings of your project evaluation effort: to what extent were intended project outcomes achieved or not achieved?

**Develop new guided-inquiry experiments to improve students’ scientific inquiry skills.** Four new guided-inquiry experiments have been developed using the funds from TLEF. For logistical reasons, three of these experiments have been implemented to date. The fourth experiment is expected to be implemented in the Fall of 2017.

**Develop videos that will provide uniform feedback.** Over 20 videos were created in the summer of 2016. These videos provide students with generalized feedback about the guided-inquiry projects. Videos are released on a weekly basis and clarify key concepts that will be needed in future weeks. Students reported using these videos regularly and provided positive feedback on content, helpfulness, and duration.



**Improving student’ technical abilities.** Students technical abilities were assessed by grading their accuracy and precision. These grades suggest that students’ performance in this new laboratory format is at least equal as in the past. Further analysis of students’ grades will be performed in the coming months.

**Improve student’s scientific inquiry skills.** After the new laboratory format was implemented, students were surveyed at the end of term. Students stated that they believed these laboratories helped improve their ability to research a topic and learn independently.

**Improve student’s attitudes towards physical and analytical chemistry.** Students reported high level of enthusiasm towards these laboratories despite the heavy workload. Students also stated that these laboratories were useful for their professional practice.

**Optimize TA time inside and outside the laboratory.** One of the major differences in this new laboratory curriculum is the use of oral assessments. In previous offerings of the laboratory, students completed written reports for every experiment they performed. In this new format, students are assessed via oral reports. During lab time, TAs spend about 10 minutes with each student discussing the experiment performed the previous week. Students have stated their preference for this type of assessment. Moreover, TAs have less grading to do outside of laboratory time.

**2.3. Dissemination** – *Please provide a list of scholarly activities (e.g. publications, presentations, invited talks, etc.) in which you or anyone from your team have or intend to disseminate the outcomes of this project.*

**Oral presentations.**

Title	Conference or Event	Location	Organization	Date
Why Can’t You Just Tell Me the Answer! Giving the Responsibility of Learning to Students in the Analytical Laboratories.	100 <sup>th</sup> Canadian Chemistry Conference and Exhibition	Toronto, Ontario	CSC	Jun, 201
Modernizing Laboratory Teaching in 2nd Year Chemistry laboratories	Science Supper Series	Vancouver, British Columbia	UBC Faculty of Science	Mar, 2017
Technique vs. Scientific Inquiry: Finding Balance in 2 <sup>nd</sup> Year Analytical Laboratories.	99 <sup>th</sup> Canadian Chemistry Conference and Exhibition	Halifax, Nova Scotia	CSC	Jun, 2016

**Peer-reviewed publications.**

My colleagues and I intend to write at least one publication detailing the changes in the laboratory curriculum. This publication will likely be submitted in 2018 after more student data is collected.

**3. TEACHING PRACTICES** – Please indicate if ***your*** teaching practices or those of ***others*** have changed as a result of your project. If so, in what ways?

My teaching practices have drastically changed because of this project. For example, TA training now involves a discussion on best practices regarding oral assessments. In addition, because the laboratories are not expository (cookbook), I spend more time answering students' questions in the online discussion board. As a result of the oral reports, I spend more time answering students' questions about laboratory issues. This is because TAs are occupied performing oral reports when issues arise in their laboratory group. I enjoy having more face-time with students as we discuss how to troubleshoot issues. Because TA time is used more effectively, TAs are able to hold office hours to help clarify in-class concepts. This helps TAs hone-in their teaching skills outside of a laboratory setting.

In addition, many of my colleagues have been encouraged by the success of the oral reports as an assessment tool. Oral reports are now used in some of our 3<sup>rd</sup> year Chemistry laboratories.

**4. PROJECT SUSTAINMENT** – Please describe the sustainment strategy for the project components. How will your work be sustained and/or potentially expanded (e.g. over the next five years)?

Laboratory changes due to this project do not require additional funding or TA resources compared to the previous model. Because there are no further resource requirements as a result of this project, the Department of Chemistry will continue to fund the running of the laboratory as it has done in the past. In addition, TAs will be assigned to the course in the same student/TA ratio as in previous years. Further curriculum development may be performed by the teaching staff with the help of the existing laboratory technician.