Experiment 11
Chem 1062 Independent Laboratory Project

OUTCOMES

After completing this experiment, the student should be able to:

- design an experiment to test a hypothesis.
- independently collect and analyze data.
- present results both in a presentation and in a written report.

DISCUSSION

The final laboratory activity that you will have in Chem 1062 is a multi-week independent project. During this project you will have the opportunity to utilize some of the skills that you have developed over the course to design an experiment that is of interest to you, collect and analyze data, and report the results in both a presentation to your classmates and a written report.

The independent project will cover four to five weeks, depending on the semester. Before the project actually begins, you will spend a week selecting groups and topics, planning your experiment and preparing a list of supplies that you will need. Once the project begins, you will have three to four weeks to prepare chemicals, begin experimenting, collect and interpret data, perform calculations, make modifications, and prepare reports. The final week of the laboratory project will be for presentations by each group to the laboratory class as a whole.

There will be some projects which will require data collection during times outside of your scheduled laboratory period. The laboratory in S220 will therefore be available for open laboratory hours during other scheduled laboratory periods on a space-available basis throughout the week. You may find those additional times here.

PROCEDURE

Guidelines

You will work in student-selected groups of 2 to 4 students. Individual projects may be approved by the instructor if there is a compelling reason to do so. Even though you will be working in groups, each person will be accountable for ALL of the data, reports, presentation, etc. in the event that a group member is unable to finish the course. You are encouraged to

swap email addresses and/or phone numbers to facilitate the sharing of information. It is recommended that each person save a copy of all data files and reports on their own M:drive or flash drive and that every file used by the group is saved each week.

This is NOT a library research project, but rather a laboratory research project that will require you to collect and analyze data. You will be expected to use the computer for data collection and/or data analysis using programs such as *Logger Pro* and *Excel*. While this is not a library research project, you will be required to analyze your results and discuss what they mean in the context of chemical principles. Thus, you should find references that support your results and conclusions and help you to figure out what they mean. Consider your resources carefully, though. Experiments carried out by other freshman chemistry students are generally not considered a reliable source.

Selection of Project Topic

The project topic is your choice, as long as it conforms to the guidelines set forth for the lab. You will need to present the topic for approval to your instructor. The goal is to answer a question to a problem posed by the group, not just to make a bunch of measurements. You will select a theme from a list provided by the instructor and then use it and the literature to develop the experiment that will be carried out. Any particular theme may only be chosen by one group in each laboratory section and must be reserved with your laboratory instructor. Reserve your topic today.

Experiment Design

In this project you will be conducting a *real* experiment – one for which the outcome is hypothesized, but is still unknown. Thus you will have to design the experiment from the ground up. The first step after choosing a topic is to *develop a statement of hypothesis/hypotheses*. This is an important step because it defines the variables that you will be studying. For example, if your hypothesis is that an increase in temperature will affect a luminol reaction by making it glow longer, you have established that the variables you will be studying are temperature and time.

Once you have developed your hypothesis, you may design the experiment. Some things to consider are *which variables* you are studying and how you are measuring them. It is possible to study more than one set of variables for an experiment; however, you will want to only study one set at a time. For example, you could look at the effect of temperature on the luminol reaction mentioned previously and then look at the effect of pH. There are a wide variety of probes and instrumentation available on the Coon Rapids Campus for you to use when collecting data. Here is a list of the equipment that we have. Another important consideration in any experiment is whether or not *controls or blank runs* will be used to establish a base line for comparison. In addition, you will want to determine if *multiple trials* will be necessary or if reliable conclusions may be drawn from a single trial. These principles will guide you in designing your experiment to gather useful, meaningful data.

As you develop your procedure, you will generate a list of the equipment and chemicals that you will need so that they can be gathered for you prior to the start of the projects. You will be required to prepare all solutions for your analyses. For example, if you determine that you will need 250 mL of 0.10 M Na_2SO_3, you will need to prepare it yourself using the solid and deionized water. You will be assigned a space to store any chemicals that you need to prepare. Equipment or chemicals that must be shared with other groups must be kept accessible for all groups and will need to be stored in an area designated by the instructor or laboratory manager.

Safety and Disposal

You are expected to work in a safe manner at all times while in the laboratory. Safety glasses or goggles must be worn for all experiments unless otherwise directed by your instructor. Keep in mind that other groups may be working with chemicals even if you are not.

All waste must be disposed of in a proper manner. Your instructor or the laboratory manager will inform you as to how your waste should be collected. You may access the Material Safety Data Sheets (MSDS) and the Chemical Waste Disposal Codes for your chemicals here. Additional questions regarding safety and disposal may be directed to your instructor or the laboratory manager.

⚠ ***Wear safety glasses or goggles at all times for this experiment.***
⚠ ***Dispose of all chemicals in the proper waste container.***

DATA ANALYSIS

You will be responsible for analyzing your data and arranging it in a meaningful way to present it to the class and in your written report. Thus, you will want to consider if the data is easier to interpret with tables or with graphs. In either case, you will want to make sure that table headings and graph axes are labeled and have proper units. All data in tables sure have correct significant figures. If you don't know the accuracy of the instrument or probe that you are using, ask your instructor. You cannot assume that because the computer gives you seven decimal places that they are all significant. Formulas and balanced equations should be correct and use subscripts and superscripts appropriately.

You are also responsible for interpreting your data and explaining the "why" behind what happened using chemical principles as appropriate. This is where the library research comes into play. Sometimes, you will need to apply principles that have not been covered in 1062. While you responsible for finding information on your own, your instructor can aid you in understanding the principles that are new to you.

POSTLAB ACTIVITY

Presentation

You will be presenting your data to your class during your assigned laboratory period during the last week of the projects. As presentations like this use visuals to convey information, items presented should be figures, graphs, tables and pictures. When presenting written information, try to use bulleted lists or short sentences, NOT paragraphs. If you use presentation software, it must be done with *Microsoft* Powerpoint. You may also consider developing a website for presentation using some type of publishing software. In your presentation, you should include many of the same components that will be in your report including:

- your research topic or question with relevant background information and hypothesis
- a brief summary of your procedure
- significant results, making sure to have properly labeled tables and graphs and correct significant figures
- discussion of your findings, including explanations of the results based on relevant chemistry
- uncertainties in measurements with possible sources of error and suggestions for improvement
- conclusions based on your research
- citations of sources used to complete the project

The presentation is worth 20 points and you will be graded by both the instructor and your peers. The instructor and student grades will be weighted 50/50. Here are the guidelines by which you will be evaluated, as well as some suggestions for a good presentation.

Go here to submit your evaluation of your peers.

Written Report

You will be turning in a group lab report. Only one report will be collected from each group. The report should include all of the components of a lab report that you have prepared to date (title, abstract, introduction, procedure, results, discussion, and references). You may use this checklist to ensure that all of the components have been included in the report. Lab report guidelines for how to write the various components are found at http://webs.anokaramsey.edu/chemistry/Chem1062.

The written report is worth 30 points and will be graded solely by the instructor. The group must prepare a pie chart that weights each individual's overall contribution to the project (data collection and analysis, presentation, and writing). The project score will then be adjusted to reflect each person's contribution. This means that if you do less work than your peers in the

group, you will get a lower grade. If you do half of the work of your peers, your grade will be significantly lower than the rest of the group.

Follow your instructor's directions for submitting the report. If you are submitting electronically, please submit a single file with all of the required information. Use the following convention for naming your files: *Lastname1 Lastname2 Etc Lab Project*. If you are emailing the report, use a subject line of *Chem 1062: Lab Project*.