

**General Guideline for Laboratory Reports**  
**CH424**  
**Instrumental Analysis Laboratory**

**General Requirements for the Lab Report**

- The lab report must be typed using a word processor. Handwritten lab reports will not be accepted. You are expected to be able to properly subscript and superscript. You are expected to be adept at using the Microsoft Equation Editor (or equivalent).
- When submitting lab reports electronically (email, Blackboard, or Moodle), please use the following format for naming the file: CH424Lab[#][your last name].doc Please be sure to avoid symbols, including characters such as # and [, in the file name if submitting the lab report in the Digital Dropbox on Blackboard.
  - EXAMPLE: CH424Lab1Smith.doc
- The text should be double spaced (this allows some room for the instructor/reviewer(s) to add comments). All pages should be #'d in the (header or footer) margins. Please employ at least a 0.7 inch margin on all sides of the page.
- You are expected to thoroughly double-check the fundamental mechanics (such as spelling, grammar, paragraph structure) of your writing prior to submitting any laboratory report. You may have friends or the Writing Lab help you on this if you wish. A failure to write on the level of a college junior/senior will adversely affect your grade.
- The figures and tables should be done electronically using word processor, spreadsheet, and/or graphic program (such as ChemDraw or PowerPoint) as appropriate. All of these figures and tables should be incorporated into the master document that comprises your final lab report.
  - **Mathematical Equations** used anywhere in the lab report should be prepared digitally using the Microsoft Equation Editor software (or equivalent). Equations should be LR centered on the page and labeled as Equation # in order of appearance.
  - **Tables** must have a *descriptive* title which includes Table # (in order of appearance), as well as a caption "footnote" at the bottom that includes enough information for the reader to be able to tell what information is being presented. Tables and their corresponding Captions should never be "broken" by a page break. Please feel free to adjust line spacing, font size, margin size, etc. in order to accommodate the complete Table on a single page if at all possible.
  - All graphic **Figures** should be labeled as Figure # (in order of appearance) with a descriptive title. A more complete caption may or may not be required (see below). During this semester, your graphic figures may include several subtypes listed below, for which additional directions are provided.
    - **Chemical Equations/Schemes** should be drawn using ChemDraw software (or equivalent). ChemDraw should already be installed on all computers in GH313. ChemDraw is available to all Butler University students/faculty/staff due to our site license with the commercial vendor for this software.
    - **Plots** should always have a caption, which in addition to the Figure # and title should include enough information for the reader to be able to tell what

information is being presented. Plots should only have a legend displayed if there is more than one variable being presented in a single plot. The x- and y-axes of all plots should always be labeled as Parameter (units). Note that some parameters, such as absorbance, may not have units. Do not use pen or pencil to draw or write on any portion of the plot. If it is a calibration curve:

- Do not connect the dots, instead use the software to draw the best fit line (*e.g.* 'add trendline' in Microsoft Excel). Do not force the line through zero. Except otherwise requested, first order, linear least square fit should be used.
- Display the regression equation. Be sure to display an appropriate # of significant digits!
- **Imported Graphics from Outside Sources**, such as pictures of a protein structure obtained from the Protein Data Bank online, should be labeled as a figure and must contain a reference to the source.

The lab report should be formatted into the following sections:

### **Section I: Cover Page**

The cover page should contain:

- The title of the experiment. The best titles are **complete sentences** that concisely state the purpose and main technique(s) involved in the experiment.
- A one paragraph abstract (An appropriate abstract very briefly defines the problem, the experimental approach, and the quantitative results - see some peer-reviewed journal articles, especially in Analytical Chemistry or Bioanalytical Chemistry for examples)
- Your name (and your partner(s), if applicable)
- Date(s) of experiment
- Date of submission. For resubmitted lab reports, both the original and resubmission dates should be listed)

### **Section II: Introduction**

- Give a brief statement of the problem or the experiment. State the parameter to be determined and the method(s) to be used. Discuss the chemistry involved in the analysis/procedure. Make sure to describe or indicate the relevance of each chemical equation to the chemistry. Chemical equations, where appropriate, are best drawn using ChemDraw. It is insufficient to write the chemical equation alone. A preceding or succeeding statement of its relevance to the overall chemistry must be presented.
- Discuss appropriate prior published research on the topic.
- A brief presentation of the theory operation of the instrumentation/equipment used for analysis is necessary (you may exclude instrumentation used in prerequisite classes, such as burettes, pH meters, Spec-20's). For example, if a fluorescence spectrometer is used, you will be expected to concisely describe the processes of absorption, electronic excitation, and emission, their effects on Quantum yield, and the basic

configuration of the fluorimeter. Other information, such as detection limit or sensitivity, *etc.* can enhance your write-up, but are not always required.

- Descriptive Subheadings may optionally be used to begin each paragraph. You may find this technique very useful in organizing the "flow" of your lab report. A common convention in scientific journals is to italicize the text of these descriptive subheadings.

### **Section III: Procedure**

- This section should be written in past tense, passive voice as an observation of what was done. Example – The unknown protein was analyzed by polyacrylamide gel electrophoresis under denaturing conditions. The intent of each procedure should be clearly described, in phrases begun by "because", "in order to", etc.
- Descriptive Subheadings should be used to begin each paragraph.
- You must concisely, yet completely write out the procedures in a clear and logical manner. There are certain artful exceptions: for example, a table format may be used to outline the procedure employed to describe a series of dilutions of a standard solution used for the construction of a calibration curve. In general, you must format your procedure using the style(s) represented in the journal articles you are reading for this class.
- Be sure to credit, by appropriate referencing, any journal articles that inspired/aided the development of your procedure.

### **Section IV: Results and Discussion**

- This is the section where you report your experimental data clearly and concisely. A table, picture, or plot can be worth a thousand words here. Please do NOT include tabulated data here that also appears in a plot: the redundancy is not only unnecessary, but annoying.
- Descriptive Subheadings should be used to begin each paragraph and/or subsection.
- While this section should contain several plots and figures, it should be written, from the very beginning, in paragraph form. It should contain an analysis of your results along with any conclusions that you can draw from the experimental results. This text should include specific references to individual figures and equations, embedded within the text.
- Calculations of values derived from the raw experimental data should also be presented in an appendix, not in this section. See below for more guidelines.
- When available/appropriate, provide the interpretation of your data here by comparison with literature values or expected results.
- Discuss accuracy, precision, sensitivity, selectivity and possible sources of error.
- You should also suggest ideas for refinements and/or further work here.
- In the concluding paragraph of this section, state your final determination(s) reached from your results and discussion. Do not present any new material here. Before you write anything here, ask yourself the following questions:
  - What did I (we) set out to do?
  - What did I (we) expect to get?
  - What result did I (we) get?

## Section V: Bibliography

- For formatting this section, including the in-text references within the previous sections of the lab report, choose a scientific peer-reviewed journal format that is to your liking and "stick with it".
- The Wikipedia Rule:
  - The internet is great. We keep up with friends living far away and like to read about and see images of different places and things. Wikipedia is great for this. Wikipedia and other web sites can introduce you to something new or unfamiliar. Wikipedia might even point you in the direction of more authoritative research. Wikipedia, though, does not constitute an appropriate source for academic research. Research that has been peer-reviewed, edited, and accepted for publication is more credible than the often capricious efforts that appear on a blog or web page. When a web site *does* offer credible research, it is because it is reproducing something that already has been published in peer-reviewed journal form and *that* (the journal version) is what you should seek out and cite, not the web page. Note here the difference between a web page and a secured reference database that you access *from* a web page. Sources found within a scientific database like the Protein Data Bank or NIST, for example, often are likely to be more credible sources. **So, the Wikipedia rule is simple: don't cite web sites...including Wikipedia.**

## Appendix A: Calculations

- All complex calculations should be shown in an appendix. All should be typed (Use Microsoft Equation Editor!!!) and should be explained in written form.
- Do not just list line after line of equations. Explain what each step shows. Combine multiple steps if appropriate.
- Tabular descriptions of the math are also acceptable when appropriate.

## Appendix B: Comments

- This section of a laboratory report is always *optional* and may contain constructive criticism on the pedagogical value of the experiment. These kinds of comments are always welcome, but are *not* part of the **Results and Discussion** section defined above.