

Formal Laboratory Report Guidelines

Chemists get the chance to experiment and make new discoveries, but they also have a duty to share their experimental results with other scientists and the general public. Take a look at journals like Science, Nature, or the Journal of the American Chemical Society to see research articles written by scientists and chemists to communicate their results. These journal articles are examples of scientific writing, essentially technical writing for scientific fields. Different fields and even different journals in those fields have their own specific requirements for the articles they publish, but there are some formats and styles that are common, or at least very similar in most scientific publications.

For this chemistry course, you will be completing your own technical writing composition in the form of a formal laboratory report. The report will start with an introduction and an overview of the procedure to provide context for the experiment, next the data is presented, and then the results are summarized and connected back to the original purpose of the experiment.

Writing Style

- 1) **Use the third person, passive voice.** Do not use the first person, active voice. For example, instead of “I mixed the two solutions”, use “The two solutions were mixed”. This choice of impersonal writing voice is used to take the focus away from the scientist and place it on the experiment itself, implying that people do not cause an experiment to turn out a certain way. A good habit is to go through your report to find and replace every use of “I”, “she”, “he”, “we”, or “they”. Also, avoid using the phrase “the student”; keep the emphasis on the experiment!
- 2) **Use past tense for everything completed in the past.** This includes procedure and data sections especially, as these sections refer to procedures already performed or data that has been collected. For example in a procedure, “The two solutions were mixed” is preferred over “Mix the two solutions”. The other sections that state facts or draw conclusions from the data, like the discussion, can be written in the present tense.

Formatting

- 1) **Type it.** Professionals, in any field, are expected to produce professional reports, and that means a typed report! Use 1.0 (single) to 1.5 line spacing and use a standard, clean font; both of these choices will make the report easier to read and not waste space. Use headings to highlight the different sections of the report. Keep paragraphs to a reasonable length.
- 2) **Introduce abbreviations at their first use.** For example, “the sodium ion (Na^+) is different in many ways than a methane (CH_4) molecule” and “infrared (IR) radiation is a form of light”.
- 3) **Use the correct notation for chemical symbols and formulas.** The first letter of an element is capitalized, the second letter is not; for example, Na. Use the subscript operation in your word processing program to write the subscript numbers in formulas like CH_4 . Use the superscript operation for ion charges like Na^+ or Cl^- .
- 4) **Insert symbols when needed.** Word processing programs have character sets that include commonly used symbols, including Greek letters like alpha (α), beta (β), gamma (γ), lambda (λ), mu (μ), nu (ν), and measurement symbols like the degree ($^\circ$) sign.

Report Sections

- 1) **Experiment Title, Your Name, Course/Section, Date** – Put the name of the experiment at the top of the page. Write your name, the course, your section, and the date in an upper corner.
- 2) **Purpose/Introduction** – There are two options here: 1) state the purpose of the experiment or 2) introduce the experiment by providing some background information along with the purpose. The purpose must be written in your own words; do not plagiarize from the lab handout/manual. A couple of sentences are typically sufficient. The purpose is the goal of the experiment; it is not simply *what* was done in the experiment, but more importantly, *why* the experiment was performed. Background information typically describes scientific concepts or techniques that are relevant to the experiment with related mathematical or chemical equations, similar to the coverage of a topic in a textbook. (Future scientists: For reports on research experiments, the introduction discusses the work that has been completed to date in the research field.)
- 3) **Procedure** – Briefly summarize the procedural steps performed in the experiment. Use complete sentences in paragraph form to state what was done in the experiment. It should be comprehensive enough for someone else with experience to reproduce the experiment, but do not provide a list of detailed instructions like the lab handout/manual. Include information about amounts used (masses, volumes, etc.), but do not include routine steps like washing glassware or taring balances.
- 4) **Data** – Present all data observed and collected during the experiment. Insert tables to display the data in an organized fashion. Use captions to label the tables numerically and provide a descriptive title. Use a header row to identify the contents of each column and their relevant units. Write some text to go along with the data tables that discusses the data (*e.g.* number of trials performed, type of measurements made, etc.) and refers readers to the data tables (*e.g.* “See Table 1”). Include data for invalid trials as well and explain the error that occurred during the experiment. For example, “Trial 2: Too much titrant was added; the endpoint was exceeded.”

Table 1: Volume of titrant required to reach endpoint.

Trial	Volume (mL)
1	25.55
2	39.15

- 5) **Calculations** – Show all calculations used to analyze the observed data. Any values not directly observed should be represented by a calculation here. This section can be handwritten neatly if necessary, but you are encouraged to learn how to insert equations using word processing software. Include any error/statistical analysis calculations, such as determining averages, standard deviations, etc. One sample set of calculations is sufficient for experiments involving multiple trials. For multi-step calculations, carry one to two extra digits throughout the intermediate steps and then only round at last step. If an experiment did not require calculations, omit this section.
- 6) **Results** – Analyze the collected data and summarize the results. Report the results of any calculations performed on the data, including error/statistical analysis. Summarize the results by listing the average and standard deviation of multiple trials, list the ranges of values obtained and comment on outliers, state the identity of the unknown, report percent yields, use calibration plot equations to solve for unknown values, etc.
Determine whether tables or graphs would help present the results. Tables can be inserted in the document to display the results. Always label the contents of the rows/columns clearly using headings. If the presentation remains clear and concise, calculated results can be included along with raw data in

tables in the Data section, just refer readers to the table (e.g. "See Table 1"). Graphs are useful for experiments that involve variables controlled over a range of values, such as calibration plots. Remember that the controlled variable is always plotted on the x-axis. Label graph axes with descriptive names and relevant units (e.g. "Mass (g)"). Give the graph a number and descriptive title by inserting a figure caption. If using the axes labels for the graph title, the format should be 'y-axis' vs. 'x-axis'. Write text that states the results and refers the reader to any included summary tables or graphs.

- 7) **Discussion** – Explain the meaning of the results of the experiment and answer any postlab questions. What do the results mean? Interpret the results for your reading audience and discuss what you learned from the experiment. Comment on accuracy (% error) and precision (standard deviation), make comparisons, or discuss results obtained from graphs, etc. Here are some brief examples of discussion topics: "All samples involving X did not produce Y." "Three out of five trials indicated a positive result." "The calculated standard deviation indicates low precision likely caused by..." "The graph implies a directly proportional relationship between the variables." "The calculated average is different than the accepted value; the percent error is ..." "These values are higher than..." "The results indicate that X is not effected by Y."
- Do not just list the postlab questions and your answers; instead, make it a discussion by incorporating the postlab questions into your answers, thereby giving context to your reading audience. Logically connect concepts and be thorough with your answers. For example, instead of "No, it does not affect the result", a better answer might take the form of "If extra X was added, the measured amount of Y would not be affected because X is not part of the chemical reaction; only the amounts of the reactants A and B are relevant to the stoichiometry of the reaction used to produce Y".
- 8) **Conclusion** – Restate the major results of the experiment and connect back to the original purpose of the experiment. Think of this like reporting your final answer to the problem you originally set out to solve with the experiment. A couple of sentences should be sufficient.