Internal Laboratory Reports

Unit: Laboratory

MA Curriculum Frameworks (2016): SP3, SP8

Mastery Objective(s): (Students will be able to…)

- Write an internal laboratory report that appropriately communicates all of the necessary information.

Success Criteria:

- The report has the correct sections in the correct order.
- Each section contains the appropriate information.

Language Objectives:

- Understand and be able to describe the sections of an internal laboratory report, and which information goes in each section.
- Write an internal laboratory report with the correct information in each section.

Notes:

An internal laboratory report is written for co-workers, your boss, and other people in the company or research facility that you work for. It is usually a company confidential document that is shared internally, but not shared outside the company or facility. Every lab you work in, whether in high school, college, research, or industry, will have its own preferred internal report format.

It is much more important to understand what *kinds* of information you need to report and what you will use it for than it is to get attached to any one format. The format we will use in this class is based on the outline of the actual experiment.

Title & Date

Each experiment should have the title and date the experiment was performed written at the top. The title should be a descriptive sentence fragment (usually without a verb) that gives some information about the purpose of the experiment.

Objective

This should be a one or two-sentence description of what you are trying to determine or calculate by performing the experiment.

Use this space for summary and/or additional notes:

Experimental Design

Your background or experimental plan needs to convey your plan for carrying out the experiment. This section should follow the design process as described in the Experimental Design section on page 31, and should include:

- an overview of the experiment, including any relevant equations that will be used to calculate the desired quantity
- a description of the independent variables
- a description of the dependent variables
- a description of the control variables
- a brief description of how you will calculate the desired quantity/quantities once you have performed the experiment.

Procedure

This is a detailed description of exactly what you did to set/measure the values of each of the variables. You need to include:

- A *labeled* sketch or photograph of your experimental set-up, even if the experiment is simple. The sketch will serve to answer many questions about how you set up the experiment and most of the key equipment you used.
- A list of any significant equipment that you used other than what you labeled in your sketch. (You do not need to mention generic items like pencils and paper. Basic lab safety equipment is assumed, but mention any unusual precautions that you need to take.)
- A description of how you set up the experiment, including the values of your independent variables and how you set them.
- A description of your control variables, including their values and how you are ensuring that they remain constant.
- A description of your dependent variables and how you are measuring their values. (Do not include the values of the dependent variables here—you will present those in your Data & Observations section.)
- Any significant things you did as part of the experiment besides the ones mentioned above.

Use this space for summary and/or additional notes:

Data & Observations

This is a section in which you present all of your data.

For a high school lab, it is usually sufficient to present a single data table that includes the values of your independent, control, and dependent variables for each trial. However, if you have other data or observations that you recorded during the lab, they must be listed here.

You must also include estimates of the uncertainty for each measured quantity, and your calculated uncertainty for the final quantity that your experiment is intended to determine.

Analysis

The analysis section is where you interpret your data. (Note that calculated values in the table in the Data & Observations section are actually part of your analysis, even though they appear in the Data & Observations section.) Your analysis should mirror your Experimental Design section (possibly in the same order, possibly in reverse), with the goal of guiding the reader from your data to the quantity you ultimately want to calculate or determine.

Your analysis needs to include:

- A narrative description (one or more paragraphs) of the outcome of the experiment that guides the reader from your data through your calculations to the quantity you set out to determine.
- One (and only one) sample calculation for each separate equation that you used. For example, if you calculated acceleration for each of five data points, you would write down the formula, and then choose one set of data to plug in and show how you got the answer.
- Any calculated values that did not appear in the data table in your Data & Observations section
- For some experiments, a carefully-plotted graph showing the data points you took for your dependent *vs.* independent variables. Note that ***any graphs you include in your write-up must be drawn accurately to scale, using graph paper, and using a ruler/straightedge wherever a straight line is needed***. (When an accurate graph is required, you will lose points if you include a freehand sketch instead.)

Use this space for summary and/or additional notes:

- Quantitative error analysis. In general, most quantities in a high school chemistry class are calculated from equations that use multiplication and division. Therefore, you need to use relative error:
  1. Determine the uncertainty of each your measurements.
  2. Calculate the relative error for each measurement.
  3. Combine your relative errors to get the total relative error for your calculated value(s).
  4. Multiply the total relative error by your calculated values to get the absolute uncertainties (±).
- Sources of uncertainty: this is a list of factors ***inherent in your procedure*** that limit how precise your answer can be.

  You need to list *one source of human-derived uncertainty* (*e.g.,* "It was unclear exactly when the reaction was finished. We declared it to have finished when nothing appeared to be changing."), and *two sources of non-human uncertainty* (*e.g.,* "The graduated cylinder was marked in 1 mL increments, so the volume was estimated to ± 0.1 mL.")

  Never include mistakes, especially mistakes you aren't sure whether or not you made! A statement like "We might have written down the wrong number." or "We might have done the calculations incorrectly." is really saying, "We might be stupid and you shouldn't believe anything else in this report." (Any "we might be stupid" statements will not count toward your required number of sources of uncertainty.)

Note, however, that if a problem *actually occurred*, and if you *used that data point in your calculations anyway*, you need to explain what happened and give an estimate of the effects on your results.

Conclusion

Your conclusion should be worded similarly to your objective, but this time including your final calculated result(s) and uncertainty. You do not need to restate sources of uncertainty in your conclusions unless you believe they were significant enough to create some doubt about your results.

Your conclusion should also include 1–2 sentences describing ways the experiment could be improved. These should specifically address the sources of uncertainty that you listed in the analysis section above.

Use this space for summary and/or additional notes:

Summary

You can think of the sections of the report in pairs. For each pair, the first part describes the intent of the experiment, and the corresponding second part describes the result.

- **Objective**: describes the purpose of the experiment
  - **Experimental Design**: explains how the experiment was decided
    - **Procedure**: describes in detail how the data were acquired
    - **Data & Observations**: lists the data acquired via the procedure
  - **Analysis**: describes in detail what was learned from the experiment, including calculations and uncertainty.
- **Conclusions**: addresses how well the objective was achieved

Use this space for summary and/or additional notes: