Informal Laboratory Reports

Unit: Laboratory & Measurement

NGSS Standards: N/A

MA Curriculum Frameworks (2006): N/A

AP Physics 2 Learning Objectives: SP 6.1, SP 6.2, SP 6.4

Knowledge/Understanding:

- Understand how to do a basic write-up of an experiment

Skills:

- Write up an experiment in an appropriate format that conveys all of the necessary information.

Language Objectives:

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

Notes:

Every lab you work in, whether in high school, college, research, or industry, will have its own preferred format for laboratory write-ups. It is much more important to understand what *kinds* of information you need to convey than it is to get attached to any one particular format.

Most of the write-ups you will be required to do this year will be informal write-ups as described in this section. The format is meant to follow an 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 experimental design needs to explain:

- the process of *determining* what you need to measure (starting from the quantity you are looking for, and using equations and other relationships to relate that quantity to quantities that you can measure)
- the specific quantities that you are going to vary (your independent variables)
- the specific quantities that you are going to keep constant (your control variables)
- the specific quantities that you are going to measure or observe (your dependent variables), and how you are going to measure or observe them
- how you are going to calculate or interpret your results.

Note that your background is different from your experimental procedure. Your background is a much higher-level description of how you set up your experiment and why, whereas your procedure is a specific description of exactly how you took the data points. Your background lays the groundwork for your analysis in the same way that your procedure lays the groundwork for your data and observations.

Procedure

Your procedure is a detailed description of exactly what you did in order to take your measurements. You need to include:

- A step-by-step description of everything you did. The description needs to include the actual values of quantities you used in the experiment (your control and independent variables). For a repeated procedure, write the steps once, then list the differences from one trial to the next. *E.g.,* "Repeat steps 1–4 using distances of 1.5 m, 2.0 m, 2.5 m, and 3.0 m."
- A *labeled* sketch of your experimental set-up. This is required even if the experiment is simple. The sketch will serve to answer many questions about how you set up the experiment, and will show most of the key equipment you used. All important items must be labeled, and all relevant dimensions must be shown.

Use this space for summary and/or additional notes:

- A list of any equipment that you used other than what you labeled in your sketch.

Data & Observations

This is a section in which you present all of your data. Be sure to record every quantity specified in your procedure, including quantities that are not changing (your control variables), quantities that are changing (your independent variables), and what happens as a result (your dependent variables).

For a high school lab write-up, it is usually sufficient to present one or more data tables that include your measurements for each trial and the quantities that you calculated from them. 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 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 Background 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) 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

Use this space for summary and/or additional notes:

- A carefully-plotted graph showing the data points you took for your dependent *vs.* independent variables. Often, the quantity you are calculating will be the slope. You need the graph to show the region in which the slope is linear, which tells the range over which your experiment is valid. Note that any graphs you include in your write-up must be drawn accurately to scale, using graph paper, and using a ruler wherever a straight line is needed. (When an accurate graph is required, you will lose points if you include a freehand sketch instead.)
- Quantitative error analysis. You need to:
    1. Measure or estimate 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 uncertainty (±) for each one.
- Sources of uncertainty: this is a list of factors *inherent in your procedure* that limit how precise your answer can be. ***Never include hypothetical human error!*** 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 we say in this report." (You will lose points if you include "we might be stupid" statements.)

  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 calculate an estimate of the effects on your results.

Conclusions

Your conclusion should be worded the same way as 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.

Use this space for summary and/or additional notes: