

Instructions on Writing Lab Reports

Using a lab notebook

Lab notebooks are the first step to writing a lab report. Notebooks are used to record all data and observations made in the lab. Oftentimes, calculations done for prelab assignments may be useful for completing calculations in the lab, so this data must be recorded in the notebook as well. Carbonless duplicating lab notebooks are available for sale at the beginning of the semester. When turning in labs, the carbonless copy pages should be removed from the notebook, **never** the originals.

Lab notebooks should *always* be located on the bench top, never in the hood since chemicals spill and things can catch on fire (*this rarely happens*). It is also preferable to not place them near the balances as writing on the notebooks can disturb sensitive mass measurements.

Format

As mentioned earlier, all observations, calculations, and measurements are to be recorded in the notebook since this serves as a permanent record of your laboratory experience. For this reason, pencil is not allowed, only the use of a ballpoint pen. If mistakes are made, simply cross out the error with a single horizontal line (e.g. ~~mistake~~). Pages should be numbered sequentially for each lab and kept in order. Your notebook may not be formatted perfectly and be messy, but that is okay. Think of your lab notebook as your rough draft, not the finished, polished copy.

Beginning an experiment

Always use a new notebook page when starting an experiment. Clearly fill out the header, listing your name, date, experiment title, section, and TA's name at the top of the page. If you are working in pairs, enter the name of your lab partner as well.

Below this information, state the purpose of this experiment. It should be short, but clearly identifies what will be determined in the lab experiment.

For some labs, it will be your responsibility to determine an experimental procedure for the lab. This is a very useful skill as it can be applied to almost every area of science. For example, if you would like to confirm the ill effects of greenhouse gas emissions on climate change, you would need to determine an experimental protocol for testing your hypothesis. You need to know the steps you would take, the equipment you would need, and the data that needs to be recorded. Some labs in this course will have a very open format, one in which you have to come up with the experimental procedure and then carry it out. It is vital that this preliminary procedure be written down prior to coming to lab. It will be based upon reading the experiment and answering prelab questions.

Using the notebook during lab

The actions and calculations you do for each lab should be clearly and succinctly recorded in the lab notebook. This serves as a "work in progress", so measurements and data should be recorded as you observed them, not written according to the lab experiment. For example, you may write something like "9.88 mL of solution was added to a 50 mL beaker" when the actual procedure states to add 10 mL to a 75 mL beaker. Record what you actually did as you do it, as this may assist with any discrepancies in calculations or observations. It may seem inconvenient to write all of these steps down as you go, but waiting until you are finished with the lab or get back home may cause you to

forget to record some important steps. Take the time to write these things down, it is built into the time of the lab.

As mentioned, all data and observations should be recorded directly in your notebook. When working with calculations, write down each step of the calculation. This will assist in deciphering any odd results. Experimental observations should be as descriptive as possible including color changes, evolution of a gas, smells (noted by wafting only!!), precipitates, and temperature changes. It is easiest for data to be recorded in table form wherever possible.

The grade earned on the lab notebook section is based on your clarity and organization of material. Have you followed the guidelines listed above? Most importantly, could someone look at your notebook and repeat the experiment and get the same results? This should be the overall goal of recording data in your lab notebook.

Lab Reports

A lab report yields a final, polished version of all the data you recorded in your lab notebook. It is to be typed and include the following sections:

Name and title

At the top of the page, include your name, your lab partner's name, Section number, your TA's name and the due date for the report. The title of the lab should be centered between this section and the abstract.

Abstract

An abstract serves as a short synopsis of the purpose, experiment performed, results, and conclusions. Since it is only a summary, it will very likely be short, only 6-8 sentences. This section informs the reader of the purpose of the experiment and resulting conclusions without having to read the entire report to get this data. Since the abstract is a culmination and summary of the entire report, it should be the **final** section written in your lab report.

Experimental/Procedure

Include full details of what you did in your lab so someone else can repeat it. The experimental section needs to be in your own words and contain information about what **you did in lab**, not simply the procedure as written in the manual. Specific items to include would be any specific temperatures set during the experiment, pieces of glassware, form of materials (s, l, g, aq), and other experimentally useful observations like color changes. The experimental section needs to be in a paragraph, not bullet, format.

Results

Depending on the lab, this section may list any or all of the following:

- **Observations** and **tables** of data. Be sure to include headings for columns and rows.
- **Graphs.** All graphs should have the following format:
 - Title. Place the title at the top of the graph
 - Axes. Each axis, x and y, should be properly labeled with units. For example, if time was on the x axis, it should be labeled as time followed by the unit in parentheses (s, min, hr,...).

- Numerical values. Axis values should be a simple integer format. Units of 1, 2, 3, 10, and others are a good choice. Fractional and odd value units such as 2.33, or 7 should not be used.
- Show data points as circles, squares, or dots. Connect the points with a straight line or curve, whichever is appropriate. Do not use a smoothed line- it gives an artificial sense of the completeness of data.
- Use the full size of the graph by choosing axis values that don't overly exceed your data. For example, if your data includes values from 27°C to 48°C, do not use units that go from 1°C – 100°C, 20°C - 50°C would be a better choice.
- All plots should be done using some type of graphical software such as Excel. Training will be provided at the beginning of the semester.
- **Calculations.** Clearly show the work and steps for each different type of calculation. If multiple calculations of the same type are performed, you need only need to show the results after the first calculation. Complicated calculations can be written in *neatly* by hand after printing.
- **Balanced chemical equations.** Whenever a chemical reaction is involved, write the balanced chemical equation for each reaction. Unbalanced equations are not acceptable.

Discussion

This is probably the most important part of the lab report as it synthesizes all of the information from the lab and other sources into a cohesive report. Discuss the results of your data in a clear format. **What have you learned based on the data?** How does this compare to known sources (cited information)? What was the percent error? What are the known sources of the error? Make note of discrepancies from the lab procedure and the steps you took (as written in your lab notebook). If this experiment was to be repeated, what additional steps should be noted or redone?

Conclusions

Much like the abstract, summarize the results and discussion sections. What have you learned by doing this experiment? Are there relationships between two variables in the experiment (e.g. density and temperature)? What areas are worth further study? Answer any questions posed in the procedure.

Citations

Citations are required whenever an idea or concept is obtained from an outside source. You would not cite your own data within a report, but you would cite data from any other source. For example, if you determined the concentration of carbon dioxide in the atmosphere from a lab experiment you would report that as your own determined value. If, however, you wrote that the global concentration of CO₂ is 390ppm, you would need to cite the source. The citation style for this course is not as important as being consistent with one style. If you start with APA, stay with APA. If possible, use the style that is common for your discipline or any other style in which you are comfortable. The most important factor is that anyone else can easily locate the correct citation. Some styles include Modern Language Association (MLA), American Psychological Association, (APA), American Chemical Society (ACS), Chicago style, and others. Check out the Purdue OWL site for more info.



Final notes on writing reports

Each of these sections should be clearly labeled and flow from one section to the next. Although you may be working with a lab partner during the lab, it is your responsibility to write your own lab report and determine your own conclusions. Work not completed independently is a violation of Academic Integrity.

The grammar of science

Unfortunately, scientific writing is often thought of as being dry and boring. This is most likely due to the use of the passive voice in writing scientific reports. This removes the personal subjective nature of the experiment, thereby stating just facts and figures. It should not restate the procedure, but include the actual values you used in the experiment. For example, rather than writing, "I added 50 mL of NaOH to the beaker", proper scientific grammar would read something like "49.7 mL of NaOH was added to the beaker". Be clear and concise, stating just the facts and physical observations. Proper, grammatically-correct English is expected in your formal lab report and points will be deducted for improper grammar and/or spelling.

Due dates

- Prelab assignments are due at the beginning of each lab period.
- Lab reports are due one week from completion of your lab, unless otherwise noted. These are to be turned in during your lab session.

A sample lab report will be made available to you on Blackboard under FCH.151.Merged > Lab Resources containing all the applicable sections as described above.

Lab Drawer Inventory

The following table details the items that should be located in your lab drawer at all times. Reference this table if you seem to be missing equipment or have too much equipment.

| | |
|-----------------------------|---|
| 50-mL beaker (2) | Water bottle |
| 100-mL beaker (2) | Ruler |
| 250-mL beaker (2) | Large Crucible tongs |
| 400-mL beaker (1) | Clamp |
| 600-mL beaker (1) | Clamp holder |
| Watch glass | Metal scoopula |
| 125-mL Erlenmeyer flask (3) | Small glass stirring-rod |
| 250-mL Erlenmeyer flask (3) | Short plastic stir rod |
| 10-mL Graduated cylinder | Plastic stir rod with Policemen |
| 50-mL Graduated cylinder | Small plastic funnel |
| Small test tubes (12) | Larger Filter funnel (Glass or Plastic) |
| Test tube rack | White Buchner Funnel w/rubber stopper |
| Test tube tongs | Red marker |

