

## LAB NOTEBOOKS

### Background

Keeping a proper lab notebook is one of the most important practices when performing experiments. The purpose of the notebook is to create a permanent record of what was done, why it was done, how it was done, and the outcomes. This record can become important in the future for many reasons. Primarily, it serves to prevent you, your team, and your company from forgetting. It is important to keep this institutional memory so that work does not need to be replicated and you can profit from the experimental results. Another reason for the notebook is to protect intellectual property. Having a proper lab notebook is invaluable when writing patents. Finally, the notebook serves to document your rationale, assumptions, data, analysis, and thoughts on future plans. In this function, the notebook becomes an organizational tool so that future experiments may be planned. It also allows you to question previous assumptions, obtain the raw data so that analysis can be done again or in a different way, and results can be validated.

### Mechanics

Many companies now use electronic lab notebooks rather than the traditional bound paper versions, and this trend will continue to expand in the future. Therefore, in this class, we will use an electronic notebook. The software used in industry for this purpose is fairly expensive, so we will not use the commercially-available versions in this class. Instead, we will keep the notebook using Microsoft OneNote which is part of the Microsoft Office Suite.

One of the key principles of keeping a lab notebook is that it is a daily, permanent record of the experiment. An important part of this is that the experimenters “close out” the log of each day as an affirmation that the information recorded for the day is true. In paper, this is done by signing and dating each page. Moreover, to ensure the integrity of the timeline, lab books are bound, pages are numbered, blank pages are not left, and no writing is added to previous entries. In digital notebooks, “signing” is done electronically, and the daily entry is logged on the server and cannot be changed later.

OneNote doesn’t have the capability of daily logging of entries, so in this class you will “sign” the log for each day and then export the daily log to a PDF. This PDF will be emailed to the TA each day at the end of class. This is to simulate the permanent logging of the daily activities. Each daily log should end with the names of each teammate.

### Setting Up Your Lab Notebook

You will set up the lab notebook so that it is stored on a group on the CAEDM J drive. By saving the OneNote to the J drive, you can give all members of your group access to the document. This is useful if a teammate is absent from class.

Follow the steps below to set up your lab notebook on the J Drive.

1. Create a group on the J drive.
  - a. Navigate to <https://caedm.et.byu.edu/cms/>.
  - b. Hover over Groups and click Create A Group.
  - c. Log in using your CAEDM credentials.

- d. Follow the prompts and input a group name. Click **Next**.
- e. Select **Fast Space** and click **Next**.
- f. In the box labeled “Full Access Members” type the CAEDM ID’s of each teammate. Separate them by commas. Click **Next**.
- g. In the box labeled “Managers” type the CAEDM of at least one member of the teammate. Click **Next**.
- h. Click **Create Group**.

The group will be created on the servers within the next 15 minutes. Once it is there, you access this file through your J drive. A folder called `groups` will appear. Inside this folder will be another folder with the name given to the group.

## 2. Create a Notebook in OneNote

- a. Open OneNote.
- b. Click **File/New**. (Note, you may need to click through some default settings the first time you run OneNote.)
- c. Under the “New Notebook” menu, click **Computer**. You will be prompted for a name for the note book. Enter a descriptive title like *Shell and Tube HX Lab*.
- d. DO NOT click the **Create Notebook** button. Rather, click **Create in a different folder**. This will open up a dialog box. Navigate to the group folder you created on the J drive and click **Create**.

### Keeping the Lab Notebook

Each notebook created in OneNote can have multiple *sections* and multiple *pages* within each section. The sections identified by Tabs at the top of the notebook. The pages are found in the right of the navigation window. By default, the name of the first section is *New Section 1*. This name can be changed by double-clicking on the name itself and entering the desired label. By default, the name of the first page is *Untitled Page*. This is changed by typing a title for the page directly onto the line at the top of the workspace. See Figure 1 for an example of the default setup.

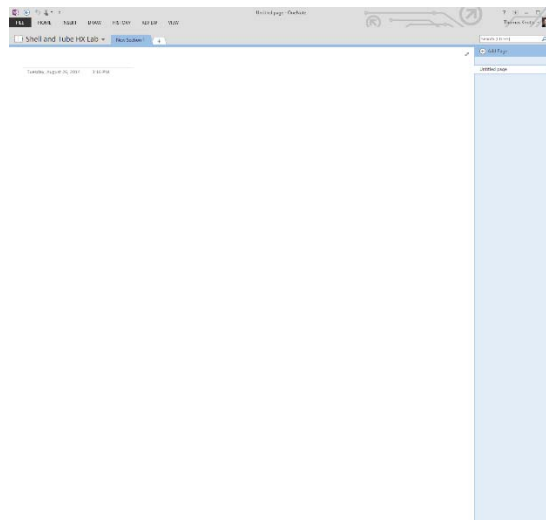


Figure 1 Default OneNote Setup

For this class, you will use both *sections* and *pages* for your lab notebook. Each notebook should have the following sections.

1. Overview
2. Experimental Record
3. Key Conclusions

#### *Overview Section*

You will have one page under the *Overview* tab. You can entitle this page *Overview*. This page should have a brief description of the project and a summary of the objectives. This section may seem unnecessary when you begin an experiment; its value is found in a year or two from now when you have ended the project. This overview will remind you why the experiment was performed in the first place. You should create this section of the lab notebook the first day you get the problem statement from the instructor.

#### *Experimental Record Section*

The experimental record section will contain several pages. These pages should be entitled “Day 1,” “Day 2,” “Day 3”, etc. On each day, you will give the details of each experiment or activity that was performed that day. Remember that the purpose of the lab notebook is to be the official, permanent record of the activities. As such it should contain the following information for each day.

1. The ambient temperature and pressure.
2. A brief statement of objective for the day.
3. Detail of each experiment such as temperature, pressure, flow rate, concentration, pipe sizes, etc.
4. A brief reason for each experiment so that you can place its purpose in the context of achieving the objectives of the projects. For example, you could say, “We are doing this run to calculate the fouling factor at a flowrate of 10 gpm. This is part of a series of runs where we keep the steam pressure fixed but change the flowrate to see the effect flowrate on heat transfer.”
5. All of the raw data you collect. A nice thing about OneNote is that you can copy/paste Excel tables and figures directly into the worksheet. Make sure the data are clearly labeled with units.
6. Any pertinent observations. You should be making observations and noting things about the experiment that surprised you.
7. Samples of each calculation you do. Make sure these are easy to follow. Also make sure to note the reasons for the calculations.
8. Graphs created to analyze the data, and the key conclusions.
9. A short summary of the day that should include ideas on where to start next time.
10. Signatures of each team member.

Day 1 of the Experimental Record section is the first day you get the problem statement from the instructor. As mentioned above, you should create the Overview section on this day, but you should also have an entry for Day 1 in the Experimental Record section. This page will not have any experimental data, but it should have an explanation of your theoretical research on the subject and how you are going to solve the problem. Things to include this first day are:

1. A schematic of the apparatus including a description of what and where measurements are taken.
2. A clear explanation on what you will use the apparatus to measure.
3. A clear explanation on what calculations you will perform on the data you take. This should include equations and text descriptions.
4. A clear explanation on what quantities you are ultimately trying to obtain from the apparatus, and how these will help you achieve the objectives of the project.

Note that you may have more than one day of “theory.” This is OK. Just make sure your notebook contains all the record of your thoughts, calculations, and activities for the day. Noting things like “spent most of the time writing the report” could be part of the lab entry on some days.

#### *Key Conclusions Section*

The Key Conclusions section should have one page. You may entitle this page *Conclusions*. If you were doing research for eight hours a day, you would likely have several key conclusions at the end of each day and could have separate pages for each. In this class, where you only spend six hours a week, you may not have any significant conclusions on some days, so we will keep all of the key conclusions on one page. When you write these key conclusions, make sure to list the day on which you made the realization. This will help you be able to go back and determine why you made such a recommendation.