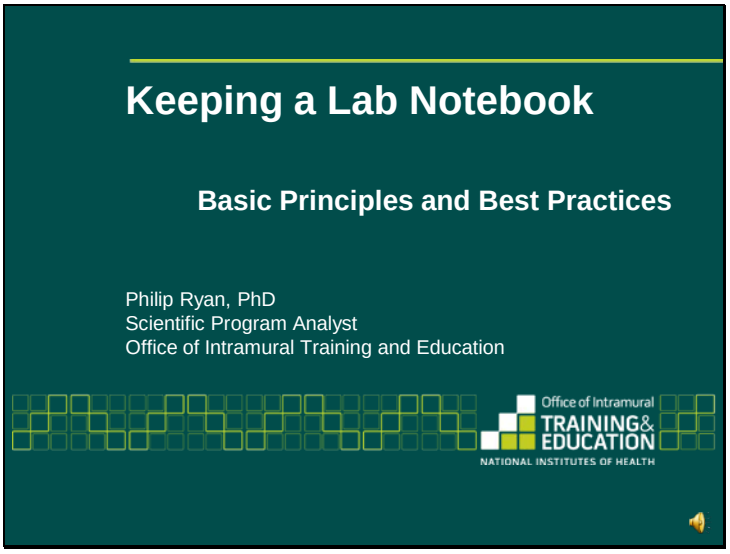
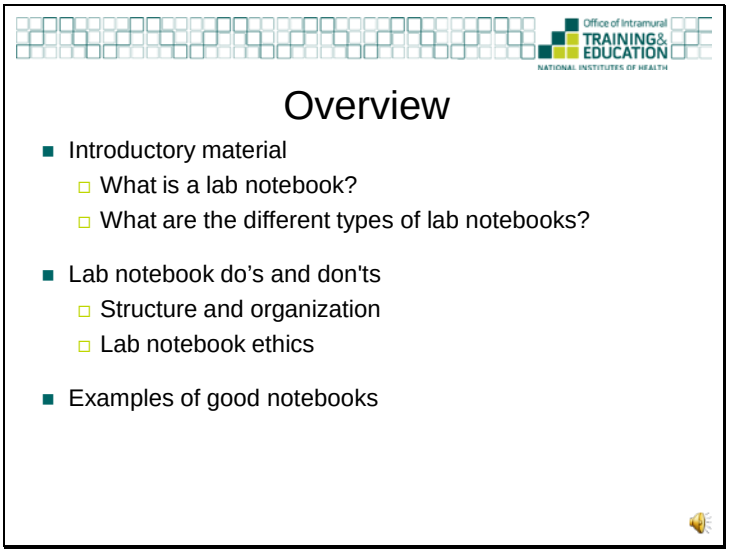
Slide 1



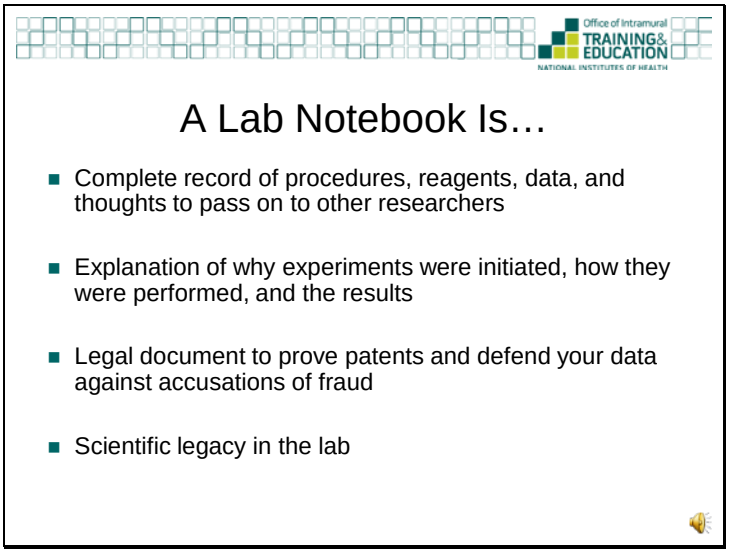
Welcome to the National Institutes of Health, Office of Intramural Training and Education's Webinar on Keeping a Lab Notebook. This is intended to be a first step in understanding the basic principles and some of the best practices for keeping a sound scientific notebook. While these are widely considered to be the basics, the ultimate decision on what kind of lab notebook, the format, and the content will be determined by the principal investigator for whom you work.

Slide 2



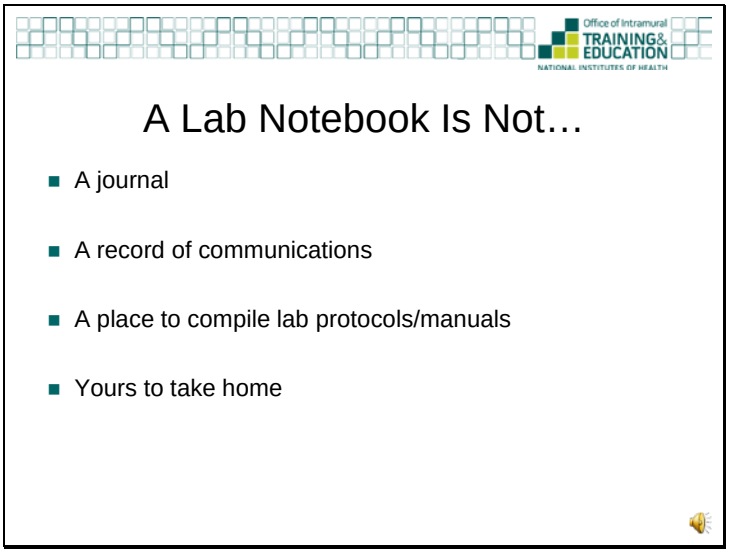
In this Webinar, we will define what a lab notebook is both practically and philosophically. We will discuss the different types of notebooks and the advantages and disadvantages of each. We will cover some of the basics do's and don'ts in keeping a lab notebook including appropriate content for the notebook, how much detail you should include, and some of the ethical considerations in keeping a notebook. Finally, we will show some examples of what a good lab notebook looks like.

Slide 3



To get started, we need to understand what a lab notebook is, what it is not, and why it is important to keep a good notebook. A lab notebook is a complete record of procedures (the actions you take), the reagents you use, the observations you make (these are the data), and the relevant thought processes that would enable another scientist to reproduce your observations. This generally includes an explanation of why the experiments were done, including any necessary background and references, how the experiments were performed and the results of the experiments. It is important to understand that your lab notebook is a legal document. In the case that your research contributes to the issuing of a patent, it will be closely scrutinized because it documents your group's claim to the discovery. Also, if any allegations of fraud are brought against your published work, your lab notebook is used to validate your findings and defend your claims. Another way to view your notebook is that it is your scientific legacy for that lab. Long after you have moved on from the lab, your notebook will remain and be referenced. Others will be building on the research that you are doing now and it is imperative that they can replicate what you have done. A proper notebook will allow those who come after you to do that. A poorly kept notebook will not. Ultimately, your lab notebook is how you will be remembered during this time in your career.

Slide 4

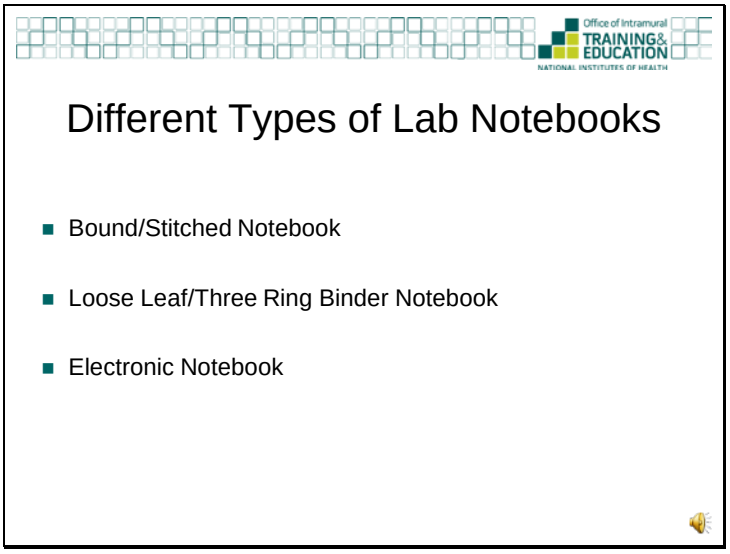


A common misunderstanding about a lab notebook is that it is a journal for your scientific or personal musings. It is not. There is a difference between recording a hypothesis to be tested by a specific experiment and writing down ideas about how things might work. Thinking about the possible directions of your research and theorizing about how a system works is often how scientific breakthroughs are made. However, these thoughts and ideas should not be kept in your lab notebook. Likewise, your lab notebook is not where you should keep a record of conversations or communications you have with your boss or labmates.

Your lab notebook is also not the place to copy or store protocols from commercial product manuals. By documenting the company and product, you can reference the manual in your procedures.

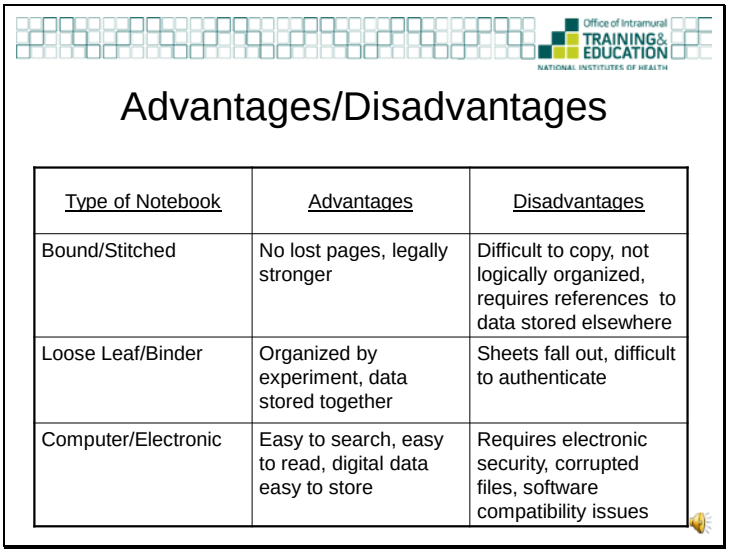
Most importantly, your lab notebook is not yours. It belongs to the institution for which you are working. You should not take it home for any reason. You do have the right to make photocopies of all your work and in many cases this is strongly encouraged.

Slide 5



There are three main types of lab notebooks: the bound or stitched notebook, the loose leaf or three ring binder notebook, and the computer based electronic notebook. Each of these notebooks has advantages and disadvantages as well as having supporters and detractors. While you may be more comfortable with one type of notebook over the others, ultimately, the type of lab notebook you will keep will be decided by the principle investigator for whom you work.

Slide 6

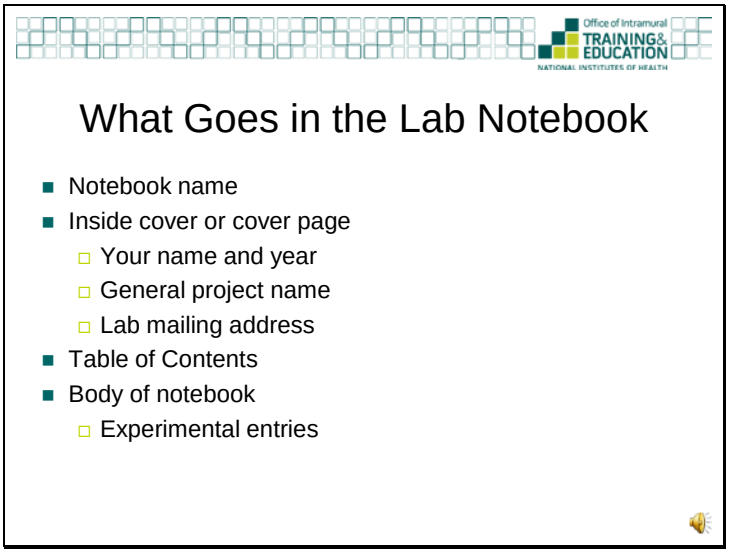


The bound or stitched notebook is the traditional lab notebook. The pages are numbered and all bound together, which lowers the likelihood of losing pages. Since the numbered pages make it easy to see if any pages have been removed, the bound notebook is still considered to be a legally strong notebook that is trusted to protect against allegations of fraud. However, it is difficult to make copies of bound notebooks and you must record the things that you do in the order that they are done, which makes organizing your notebook by experiment difficult. Also, since there is no way to insert bulky data records such as developed film, you must keep the data stored elsewhere and reference it in the notebook.

The loose leaf or three ring binder notebooks help address the last two disadvantages of the bound notebooks. Because you can enter sheets in any order, you can organize your notebook by experiment and you can keep more of the data in one place. Three ring binders can also hold more bulky data adjacent to the written records to which they relate. However, it increases the chances of losing sheets from your notebook and provides the opportunity for sheet removal. Because of this, it is difficult to authenticate the data in the notebook as not having been altered.

Electronic notebooks are rapidly increasing in popularity because of their ease of use, legibility and ability to be easily searched. Also, if you can convert your data to a digital file, the electronic notebook has a large capacity for storing data. However, having an electronic notebook requires more advanced technological protections, and requires frequent system backups of the digital information. As is the case with all software, there are often compatibility issues as new versions of the software are released.

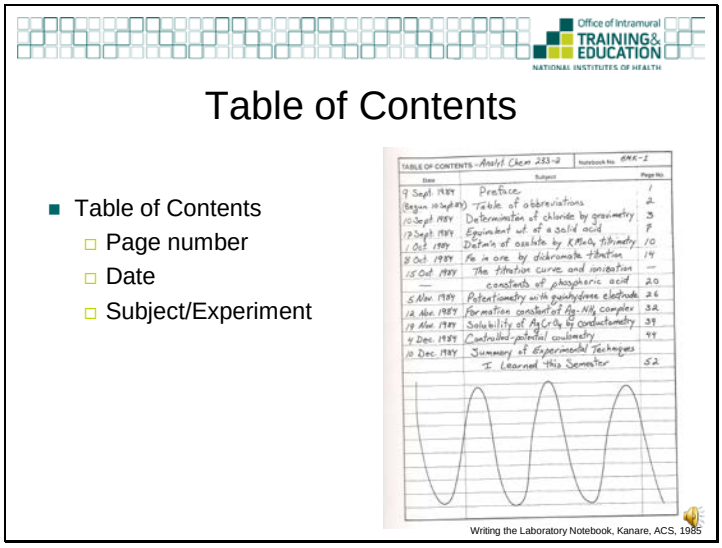
Slide 7



Now that we have an understanding of the different types of laboratory notebooks, we need to know the important components that all notebooks should contain. Each notebook should have a name that is on the cover. This allows for easy identification of the lab notebook. Either on the inside cover or on a separate cover page, you should write your full name and the year you are starting the notebook. Along with your name should be the name of the project associated with the lab notebook, and the lab's mailing address with your principal investigator's name.

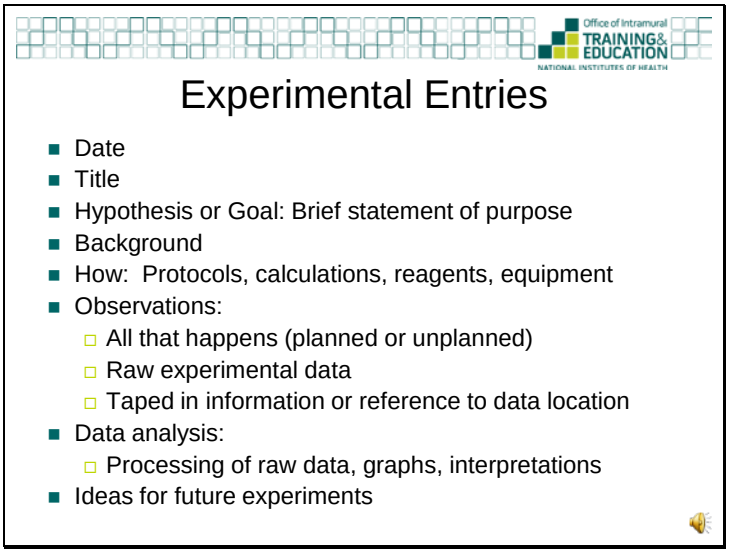
At the front of each notebook you should keep a running table of contents for ease in searching the notebook and finding the necessary information. Finally, the lab notebook will have multiple entries for your experiments. The contents of these entries will be discussed in a later slide.

Slide 8



You see here an example of a table of contents from a lab notebook. It is taken from the book, “Writing the Laboratory Notebook” by Howard Kanare. While formats vary for Tables of Contents, the important information remains the same. The date the entry was made, the subject of that entry, and where in the lab notebook that entry can be found. With this information, someone needing information from your lab notebook can find it quickly.

Slide 9



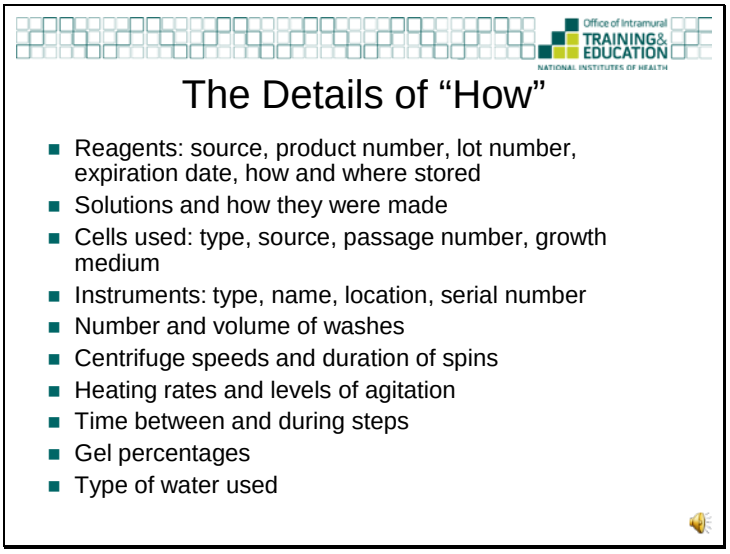
Each entry should contain the date it was made, a title for the experiment and a hypothesis or goal for the experiment. Enough background should be included to explain the logic behind the experiment. This may include references to published literature or scientific talks, a short synopsis of your thought process, and references to previous experiments in the lab. The entry should include either the written protocol that was followed or a reference to one previously used or published, all calculations performed, and a list of reagents and equipment used. In the next slide, we will go into more detail on what needs to be included in this "How" section.

The heart of the experimental entry is the observations made. In short, this is where you record everything that happens during the experiment. This means any deviation from the protocol, whether it was planned, an accident, an error or a mistake needs to be written down. This is also where you record any raw data you collect, such as numerical readings from a piece of equipment or qualitative observations such as the reaction solution becoming cloudy or changing color. You never know what will be important once the data are analyzed, so write down everything. Also remember to tape in any data that you either print out or write on a separate piece of paper. If the data cannot be entered in the notebook, be sure to include a reference to where it is stored.

Often times, data need to be processed before they can be fully understood or presented. This processing should be recorded in your lab notebook. Be sure to mention any software that you use, and the location of digital files.

Finally, if your observations suggest any changes to the protocol or a follow-up experiment that might be pertinent, be sure to write that down at the end of your entry so you can reference it in the background of the next experimental entry.

Slide 10



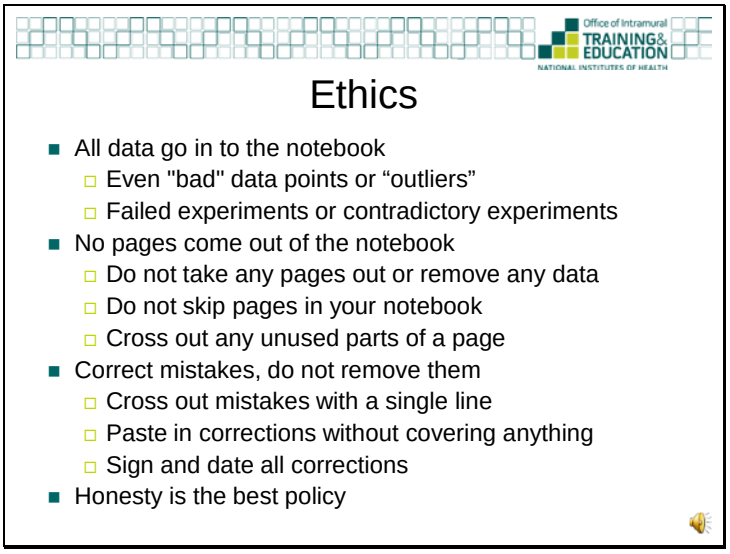
When recording your entries in your lab notebook, include as much detail as possible about what you used and did. A reagent is more than just the name of the chemical or enzyme. You will want to record the source of the reagent: The company, lab or person who provided it. Writing down the product or catalogue number will make reordering the same thing much easier. Also include the lot number, expiration date and how and where the reagent is stored. All of these will help you interpret your data and reproduce them more easily.

When you use a solution, you want to record what it is and how it was made. If you are using a one X running buffer, did you make it from scratch or dilute it from a five X or ten X stock? If you diluted it from a stock solution, be sure to include the lot number of the stock solution or how it was made and by whom or a link to this information.

Some other examples of things to include would be the cell type or cell line you are using, the source, passage number and what growth medium you are using. When using instruments, write down the type, name, location and serial number if available. Often times you will find that an instrument was not working properly only AFTER you have analyzed your data. Knowing exactly which machine you used, and when, helps explain anomalies.

The list on this slide is intended to show some examples of information to include, but is in no way intended to be all inclusive. A simple rule to follow when deciding to write down information in your notebook is this; it is better to write it down and not need it, than to need it and not have written it down

Slide 11



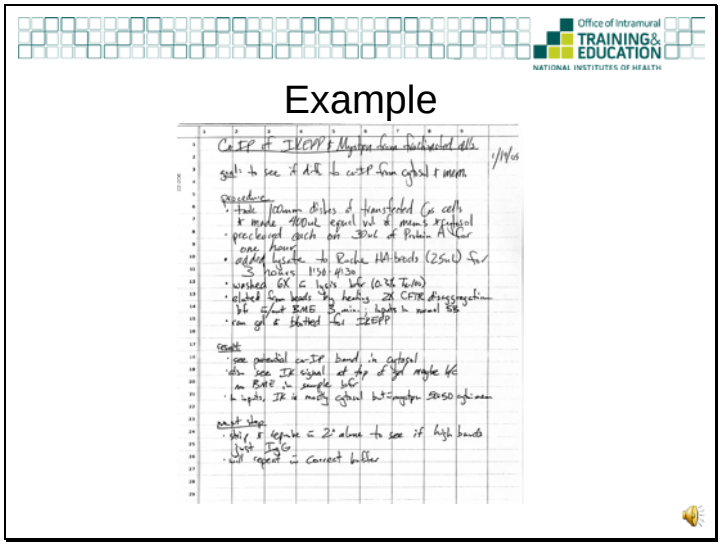
Earlier we stated that one of the purposes of keeping a good lab notebook is to protect you from allegations of fraud. There are ethical standards you must follow to allow your notebook to act as a form of protection. These are a few of the more important guidelines and most commonly made mistakes. It is important that all your data be recorded in your notebook. This includes data that are hard to interpret, contradictory to previous data, or just plain ugly. Even if your experiment fails completely, you need to record the negative data and/or describe what happened.

As a means of assuring the integrity of your notebook, no pages should ever be removed for any reason. In bound notebooks, it is important to not skip pages in your notebook and to cross out any unused parts of a page. This prevents you or someone else from going back and adding things after the fact.

It is important that your notebook be accurate, but mistakes happen. When keeping your notebook, remember to correct your mistakes, but never remove them. To correct a mistake, cross it out with a single line. If you pasted the wrong thing in your notebook, cross it out and paste in the correct item without covering up anything already in the notebook. You need to sign and date all corrections so that they can be authenticated.

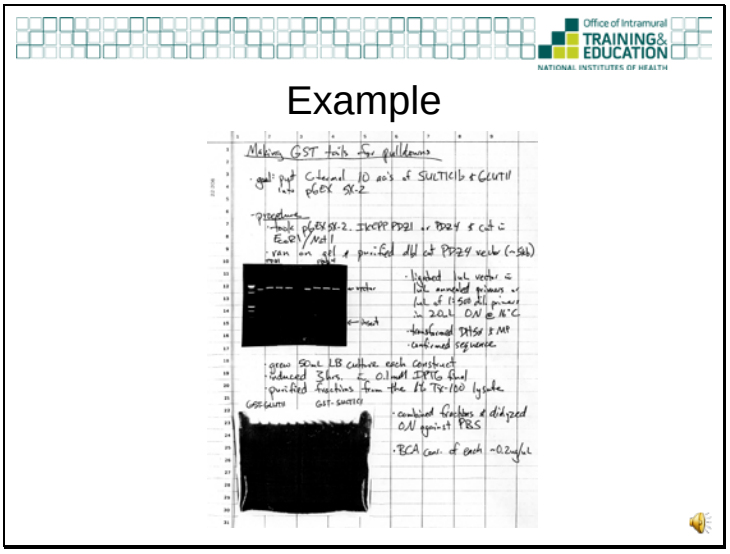
Remember, no matter how bad the data or embarrassing the mistake, honesty is always the best policy.

Slide 12



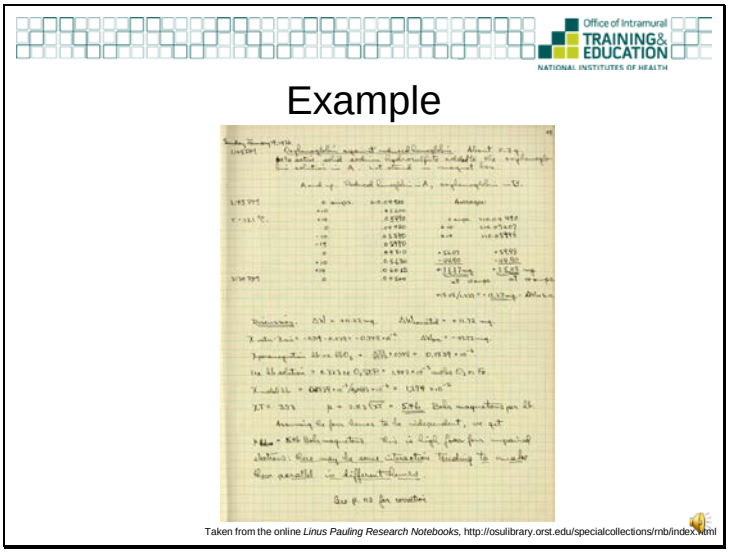
This example is taken from the notebook of a graduate student. This is a good representation of a page for a short experiment. It contains all the components of a complete entry. Notice the date and project title. Notice also the Purpose or Goal section that indicates why the experiment is being done. The date for the procedure is written before the section entry and then details of the procedure are recorded including the source of the reagents, time of incubations, volumes and concentrations. Also note the section at the bottom that indicates what steps will follow and what changes to make for a repeat experiment.

Slide 13



This example is taken from the notebook of the same graduate student. Again, notice the project title, goal and procedure sections. In this example, also notice the data that is pasted in the notebook. It does not cover anything up and it is labeled well. Also note that even the negative data is placed in the notebook.

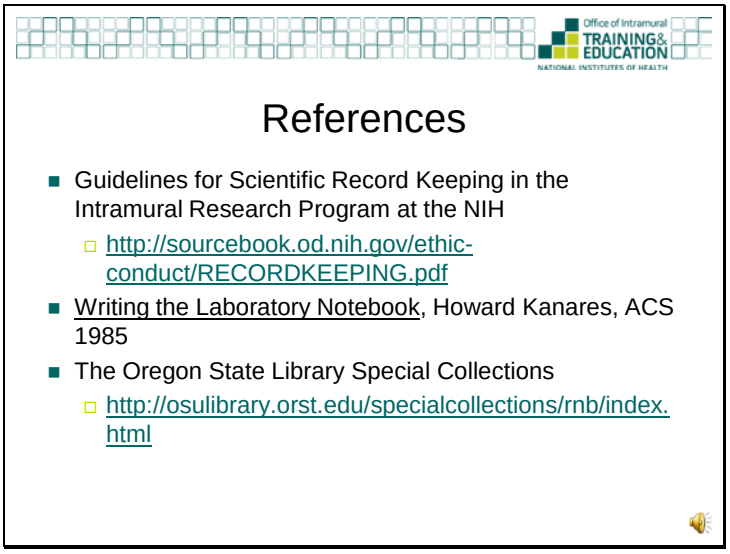
Slide 14



The final example is this page, taken from the notebook of Linus Pauling. It is a good example of a Results section. It is a continuation of an entry for an experiment, and thus does not contain the goal and background information. Note again the date before the entry, the page number and then the record of the observations and readings made. Also, the exact time each reading was made is recorded along the left hand side of the page and all the calculations performed are recorded in the lab notebook. At the bottom of the page you will see a reference to a page number in this book where corrections have been documented.

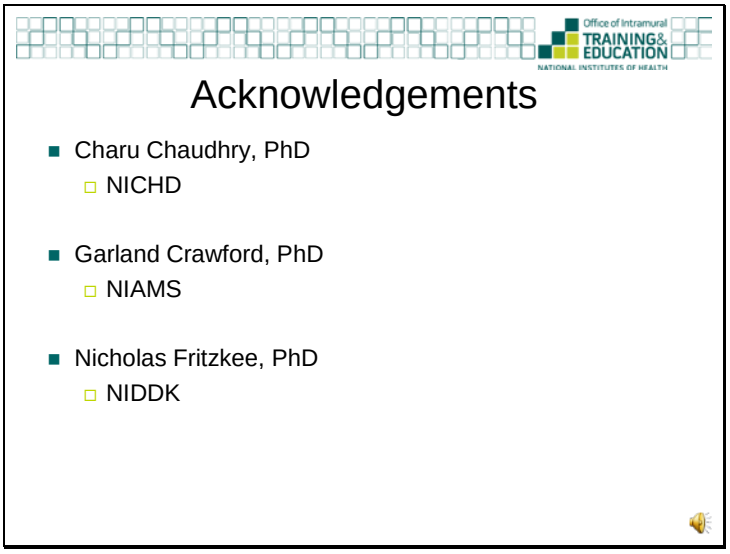
These examples are meant only to show the basic requirements for your lab notebook entries. As mentioned before, the ultimate decision on the type and style of lab notebook you keep will be made by your principle investigator, but the basic requirements and best practices discussed here can be applied to all lab notebooks. Good luck with your experiments!

Slide 15



For more information on keeping a lab notebook, with specific guidelines for record keeping at the NIH, you should download the “Guidelines for Scientific Record Keeping in the Intramural Research Program at the NIH” by clicking on the link on this slide. You may also find the book, “Writing the Laboratory Notebook” by Howard Kanares to be a useful resource for more detailed information.

Slide 16



The content for this webinar was adapted from previous seminars on keeping a lab notebook that were presented by Dr. Charu Chaudhry from the National Institute of Child Health and Development, Dr. Garland Crawford from the National Institute of Arthritis, Musculoskeletal and Skin Diseases and Dr. Nicholas Fritzkee from the National Institute of Diabetes and Digestive and Kidney Disease.