Overdue but submit:
Bring a related paper
&
Safety Training
(Very few of you have done. Don't stress that you are late but submit.)

Important Papers (2-5)
1-2 sentence summary and why relevant to your work? (Disuss later)

After today, you'll be more confident in finding papers. The next step is being able to talk about why they are important to your project.

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1-Sep	Project Planning: What Kinds of Magnetic Measurements	Syllabus Read/Agree
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8-Sep	Reading and Evaluating Papers	
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17-Sep	VSM Hands-On Demonstration	Important Papers. Why? (2-5)
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24-Sep	Planning Group Oral Reports and Peer Grading	Mini Reports (in class)
29-Sep	Group Project Planning and Refinement	Quality Reading on Perusall
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6-Oct	Best Practices with Graphing	Good/Bad Graphs
8-Oct	Fall Break (No Class)	
13-Oct	Introduction to Excel: Spreadsheets, Graphing and Fitting	
15-Oct	Understanding and Processing Your Data	Lab Notebook Check-In
20-Oct	Building a Story with Your Data When It Isn't Obvious	
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29-Oct	Peer Evaluation of Lab Notebooks (Bring Notebooks)	
3-Nov	Election Day (Vote If You Can)	
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12-Nov	Eight Minute Group Presentations	Presentations
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Switch

Not these assignments, but there are a few future assignments where I need to count off for being late. (I realize that you are currently still learning time management.)

- Project Proposal (feedback ASAP)
- Good/Bad Graphs (in class)
- Lab Notebook Check-In (feedback ASAP)
- Graphs of Your Data (in class)
- Presentations (in class)

I like to be flexible, but you turning these in on time is important for your feedback!

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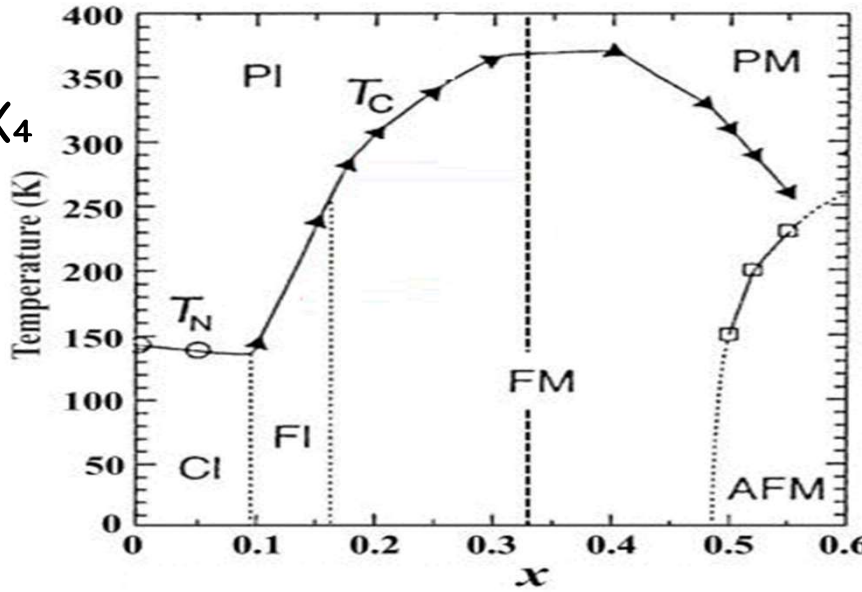
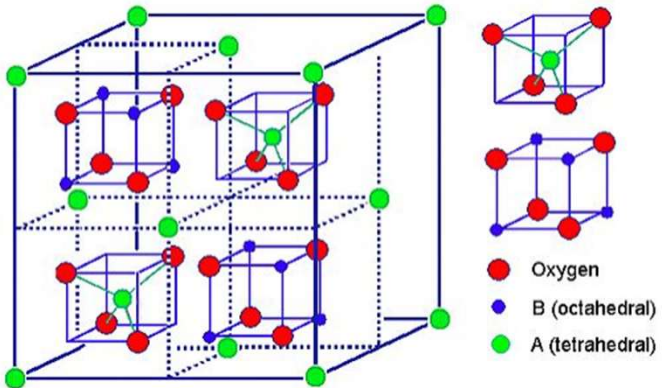
LSMO and/or PMA possibilities

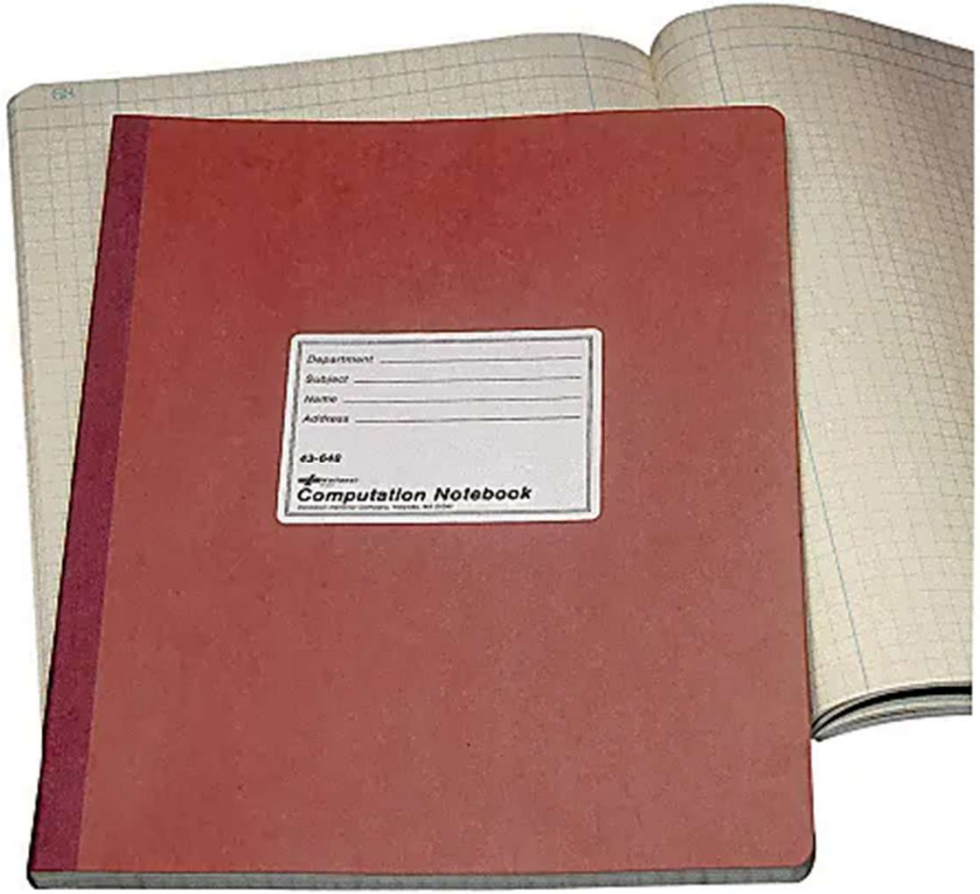
- We have a bunch of LSMO that we are measuring related to some other measurements we took. They need VSM measurements. Each group only has to do 1.
- Mapping out the phase diagram in Co/Mn spinels. AB_2X_4

(oxide magnet with PMA and no rare earth which are expensive)





Keeping a research notebook is often seen as a chore. Why is it important to dedicate sufficient time and effort to it?



A few reasons

- You'll forget what you did and what you were thinking…faster than you think. Trust me.
- Catching mistakes. You may not even realize that you did it wrong if you don't write it down.
  You don't want to publish inaccurate data! Embarrassing.
- Make your life easier. Abstracts/others easier if you've collected some thoughts already.
- It can help you come up with new ideas.
- Protecting your ideas.
- Your lab may want to publish things even after you leave (*easy papers for you!*), but that will not be possible if you don't leave clear notes!

Lab Hygiene

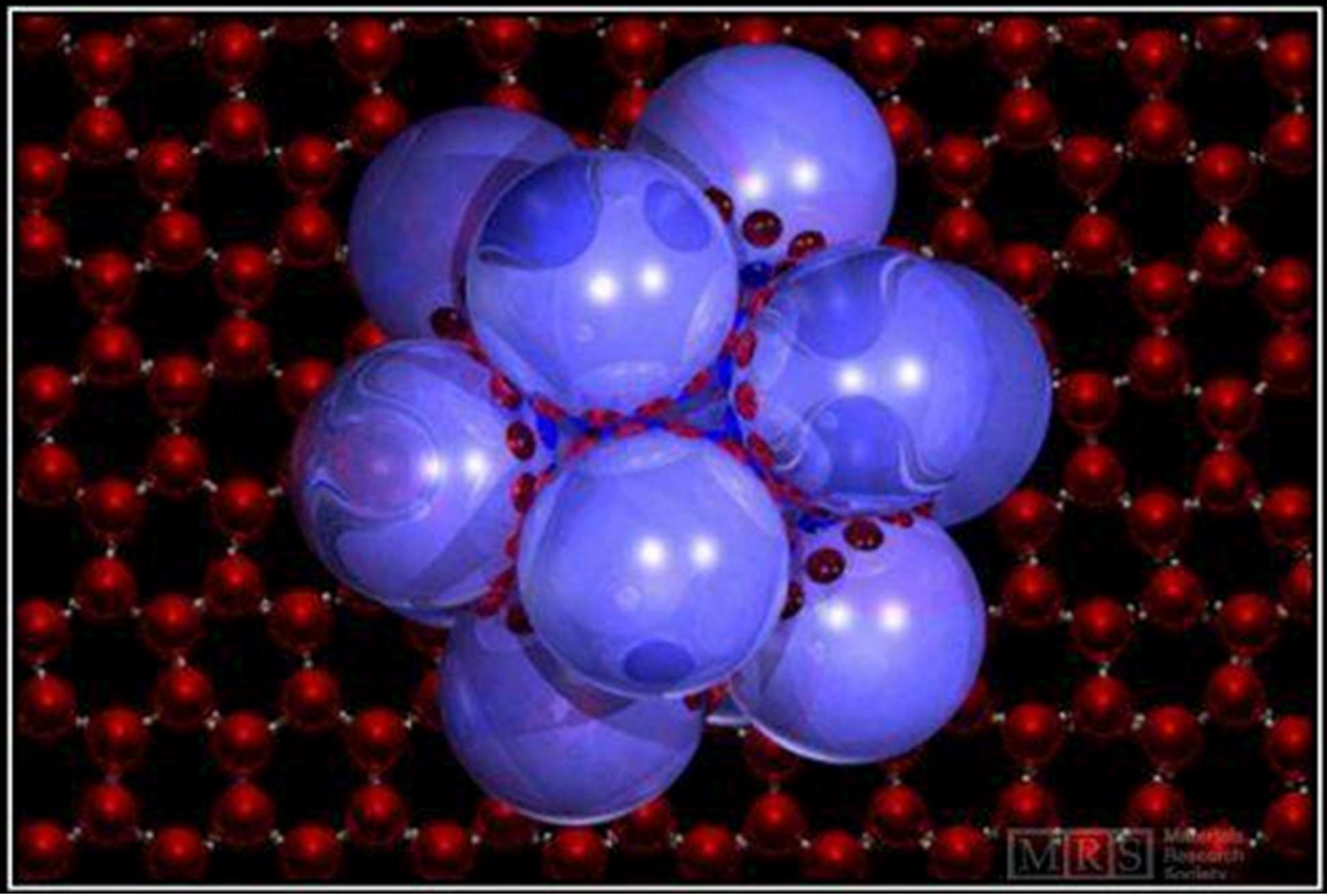
- Lab notebooks are like going to the dentist—an essential tool to prevent teeth from falling out.
- Lab notebooks are the most useful resource that you can create for yourself in the lab, and creating a good one requires a bit of effort every day.
- Once you get into the habit & have a system you like, it becomes easier and helps remember experiments, discussions, thoughts at a given time.

For those of you that have done research, what are some of the questions, you had after the research was done that you might not have thought to put in your lab notebook?

Driving metaphor when little research experience as will often be the case.

SCIENCE

If you don't make mistakes, you're doing it wrong.
If you don't correct those mistakes, you're doing it really wrong.
If you can't accept that you're mistaken, you're not doing it at all.



Best Practice in Corrections

~~PAST wrong logic in your notebook~~
This is lots of garbage but you didn't realize it at the time. It's ok! You are still learning. It's best to know you were wrong than publish something wrong and not realize you were wrong.

Correction: I previously thought that I needed to do XXXXXX, but I later realized that I really needed to do YYYYYY. Or, I previously had a misconception about ZZZZZ. (The more detail the better.)

Error realized on MM/DD/YYYY. I have corrected this mistake starting from page AA. Or, actually all of that data appears useless now, but I'm not deleting it because that's bad practice and I could later find out I'm wrong about being wrong. (It happens. It's easy to second guess yourself. You basically should be, right?)

From the experts

- **Don’t make it “clean.”** They left out the full story of the struggle. They assumed they would remember or that only the perfect result mattered.
- **The troubleshooting log:** During a tricky experiment, they spent days adjusting small variables—temperature, concentration, times. Instead of logging each change and its effect, they scribbled on scrap paper that were lost. Can't remember the exact parameters that worked!
- **What not to do is also useful to know!**
- **The missing context:** Years later, they find themselves looking at a cryptic note.
- Later, unexpected result opens up a new inquiry.

- “My lab notebook keeps track of all my research experiments and all my failures and optimizations. It's a great tool for maintaining rigor and reproducibility—if I don't remember how I did an experiment or how I analyzed the data, all of that information is in my notebook. It also makes it so much easier for your future lab mates who may need to do a similar experiment and want to see what you've already tried.”
  - *Maiko Kitaoka, Ph.D. candidate at UC Berkeley*
- “Having a diligent record of my experimental steps helped me make sense of certain results. Noting what happened on a specific day can give you an indication of whether some data are outliers because of environmental factors such as a temperature change. Over time, my lab notebook also evolved into a tool to keep track of my ideas. You might not want to change your design or method right in the middle of an experiment, but your notebook is the perfect place to note what you may want to try next.”
  - *Valentina Ferro, Ph.D.-holder in experimental physics*

Good Note Taking Should Avoid Common Questions Such As

- Where did I put that piece of paper that had my research notes?
- I remember I had a great idea. What was it?
- When did I do that experiment?
- Why did I decide to do the experiment this way?
- I remember I figured out something went wrong in my experiment, but I can't remember if that was before or after I took this set of data.
- I remember it was hard to figure out how to do X. Crap, I don't remember how to do it anymore.

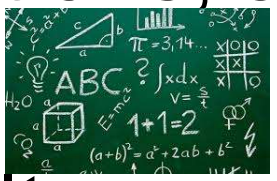
What should be included?

- Pre-data-taking prep that provides a plan for conducting the experiment that ties the background to the research question

- Information about your material and/or measurement technique with figures/captions
- Literature/internet references (cited when)

Equipment list with manufacturer-model# (pics?)

- Step-by-step activity including raw data taking, trouble-shooting logic, any calculations, and informative figures/graphs



- Post-data-taking synthesis of results, conclusion, discussion, and reference list

Differences Between Results and Discussion

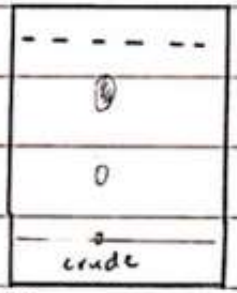
P.36

Method : START : 15/09/18 at 13:00 — E.0 III-35

The phosphonate and benzyl bromide were measured under inert atmosphere. Phosphonate (14.5mL) and benzyl bromide (43 mL). Both transfereed into a 3-neck round bottom flask, which was previously heat dried and flushed with Nitrogen. The mixture was left to stir under Nitrogen at 140°c ~~for 24hours~~ E.0 15/09/18. After 24hours, the mixture was cooled to room temperature and excess solvent removed using the rotary evaporator.

Yield : 16g as a yellowish liquid

Rf : 0.45 [2:1, EtOAc : cyclohexane]



Spectroscopic data:

IR: 1250 (P=O), 3034, 3090 (C-H and =CH-), — E.0 III-35-IR

^{1}H NMR (600 MHz, $CDCl_3$): 3.09 (2H, d, J= 21.9Hz, ~~2H~~ E.0 18/09/18), 3.95 (4H, m), — E.0 III-35-1HNMR

7.18-7.24 (5H, m, ArH)

Future work: STORE product E.0 III-35, while crude under N_2 air, use within 11hours for next reaction, to avoid degredation

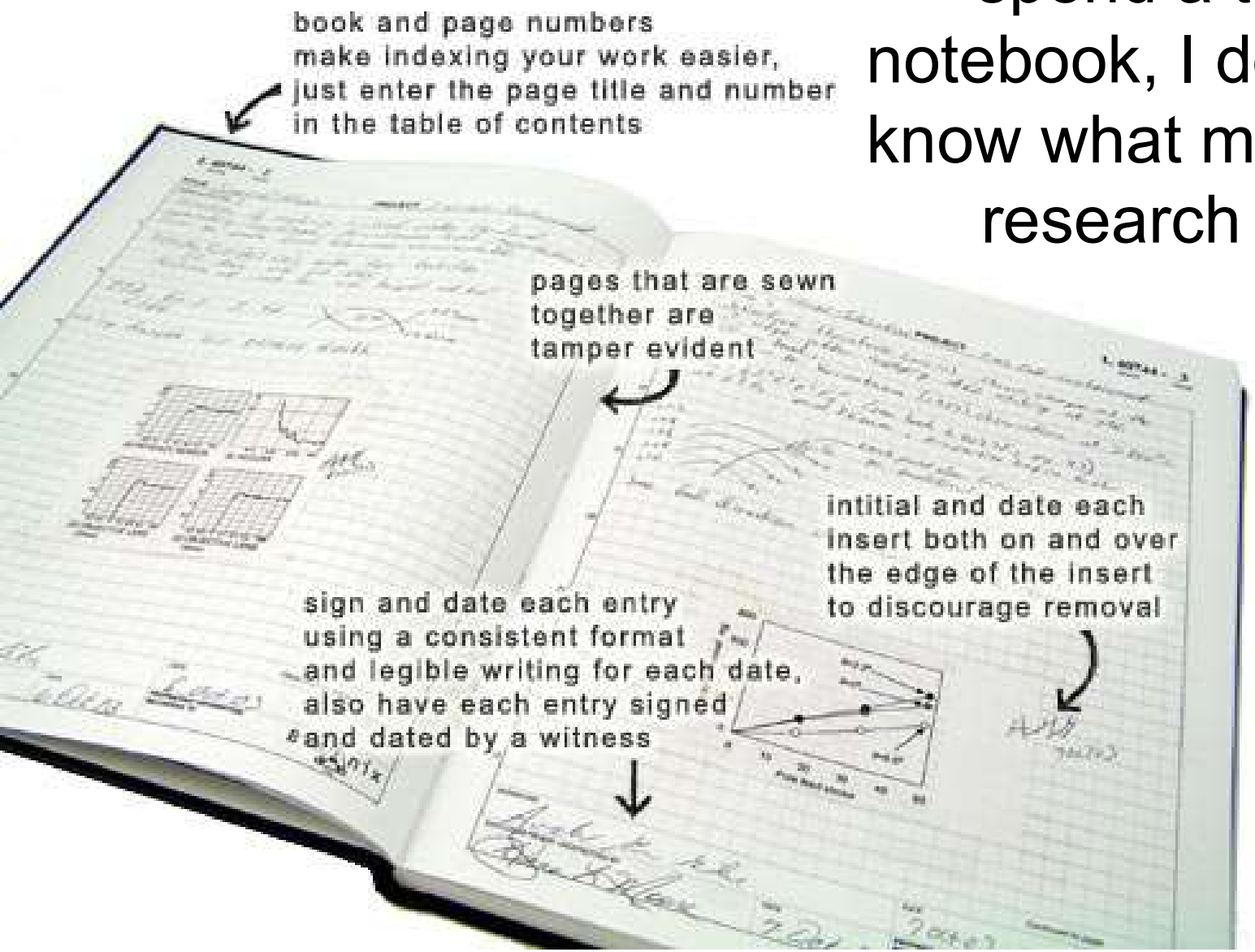
What to Include

Subtitles can help make it easier to find things

If you make a mistake, don't make it impossible to read. Sometimes we think we made a mistake and it turns out to be fine.

Ideal Lab Notebooks

While I didn't want you to spend a ton on this notebook, I do want you to know what makes an ideal research notebook



You WILL make mistakes. Just note that you've learned. Do not remove!

Signing overkill but dating is important

Electronic Note Taking

- Probably because of my age, I'm not a big fan. However, younger students often like it. It can be searchable, which is a bonus.
- I don't like it for some of the same reasons I don't like electronic books. Research shows that most people learn better from a physical copy, but not everyone.
- You still need to share it with your lab when you leave. Software changes.
- For more on notebook practices, see https://www.science.org/content/article/how-keep-lab-notebook

Let’s look at last year’s examples

- While these are far from ideal, but do represent what someone learning how to keep a notebook looks like
- Keep in mind this was from when the class was only 1 credit hour and I hadn’t yet emphasized the importance of the notebook as well.

First lab notebook assignment

(due Oct 15)

I'll grade four things in the first one:

- What are you trying to do? Why?
- What is the background needed to understand what you are trying to do? What you expect to find?
- What is unique about your material. Why is understanding whatever you are trying to understand important? What are at least two applications of your material, and why is that application important?
- You really should have other materials you have referenced. Cite them in such a way that I could easily look them up if I wanted to.
- Can give feedback on any other parts you have.

Notice the build up

1. Find a related paper
2. Talk about why papers are important for your work. Include DOI.
3. Discuss in class your research plan
4. Write a short project proposal
5. Elaborate on background and your proposal in your notebook.

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What is a DOI number?

is a permanent, unique string of letters, numbers, and symbols used to identify academic articles, books, and datasets

PHYSICAL REVIEW MATERIALS **9**, 124402 (2025)

Interface magnetism and anomalous Hall effect in $La_{0.7}Sr_{0.3}MnO_3/SrIrO_3$ bilayers

Andrea Peralta-Somoza,[1] Myoung Woo-Yoo,[2] Sandra Lopez,[1] Rafael Fuster,[1] Mariona Cabero,[3] José María Gonzalez-Calbet,[4] Javier Tornos,[1] Alberto Rivera ,[1] Federico Mompeán,[5,6] Mar García-Hernández,[5,6] Timothy R. Charlton,[7] Brian J. Kirby,[8] Stephan Rosenkranz,[9] Daniel Haskel,[10] Yongseong Choi,[10] Joerg Strempfer,[10] Xiao Wang,[11] Zouhair Sefrioui,[1] Carlos León,[1,6] Javier E. Villegas,[12] Suzanne G. E. te Velthuis,[9] and Jacobo Santamaría[1,6,*]

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(Received 7 March 2025; accepted 7 October 2025; published 4 December 2025)

Epitaxial interfaces combining 3d and 5d transition metal oxides are a fertile playground to examine the interplay between topology and electron correlations. In this paper, we explore magnetism and transport of bilayers combining ferromagnetic $La_{0.7}Sr_{0.3}MnO_3$ and the strong spin-orbit coupling material $SrIrO_3$. We have found an interfacial magnetic proximity effect driving an intrinsic contribution to the anomalous Hall effect of topological origin. The interfacial proximity interaction is enabled by the Mn-O-Ir bonding reconstruction and depends on layer sequence. While bilayers with the $La_{0.7}Sr_{0.3}MnO_3$ on top featuring a robust Mn magnetism at the interface show the intrinsic AHE contribution, it is absent in bilayers with the inverted layer sequence ($SrIrO_3$ layer on top) showing strongly suppressed magnetism at the interface. These results illustrate the leading role of interfacial atomic reconstructions on the interplay between topology and correlations at 3d/5d oxide interfaces. This finding may be of interest in future oxide topological spintronics and spin-orbitronics.

DOI: 10.1103/qxn3-5327

You can see the paper (not necessarily access it) @ https://doi.org/(insert DOI here)

Not always in this spot.

Citing References In Lab Notebooks

What do you think might be the most useful ways for both you and whoever is reading it?

There are only two things I can about in terms of citing in your notebooks.

How can you find references more easily in your notebook?

Let's study with these rubrics

These are the "cheat code" to getting a good grade.

Lab Notebook Rubric (Early lab noteobook focuses on experiment planning/ motivation.)

Category	Far below threshold (1)	Below the threshold (2)	Meets the threshold (3)	Exceeds the threshold (4)	Score
Communicate, Define Topic Introduction/ Motivation/ Goals	Does not include background or previous work. Does not identify the purpose, the project, the main question(s) or issue being addressed.	Gives very little background or information. May include the main question(s) or issue but does not identify the purpose for addressing them.	Gives a listing of the background information and previous work but does not tie them together well to show how they lead to the purpose of the present work and the questions being addressed.	Effectively ties background to the research question(s) and purpose that directly leads into the question(s) being addressed and the purpose of the research.	
Define Topic, Gather Sources, Analyze Figures explaining the background	Only one figure is provided that relates to the background of the experiment or material. The relevance of the figure is unclear or not explained.	One or more figures related to explaining the key concepts of the experiments are included. Only one is well discussed and related to the project.	Two or more figures related to explaining the key concepts of the project are included. One may not be explained well or relation clear.	At least two figures clearly illustrate and reinforce the key background concepts and are well integrated into the narrative.	
Gather Sources, Communicate Description of material uniqueness	The uniqueness of the material selected is not addressed, or is very general, **such as saying "it hasn't been studied before."** Why might we expect it to be interesting?	Attempts to explain the uniqueness of the material, but the rationale for its interest or value is unclear.	It is communicated what is unique about the material that was selected by the group and at least one application of the material is discussed.	It is well communicated what is unique about the material that was selected and potential material applications (and their importance) are discussed.	
Gather Sources References	Referenced information is insufficient to verify where the information was found.	While a reference list exists within the lab notebook, it's not always clear what information was taken from the sources. Formatting poor.	While references are in a nice list and near where the information is mentioned, it could be more clear exactly what information is taken from the reference.	References are cited inline with short names (such as "NIST"), enabling the reader to easily trace information and a full reference list occurs elsewhere.	

Many of these practice multiple skills.

Define Topic ⇔ Gather Sources ⇔ Experiment ⇔ Analyze ⇔ Communicate

Procedure Experiment	There is very limited discussion of the experimental procedure. It is not clear what was done and/or important steps are missing.	What parameters (e.g., temperature ranges, durations, etc.) were varied is clear, but the values where data was taken is not identified in the procedure.	The procedure is mostly thorough and all important measurement parameters are given. Some details of the measurement missing.	Step-by-step discussion of the procedure including sample mounting and the values and ranges of all parameters measured is listed.	
What did you learn weekly? Analyze	Reflections on weekly lessons learned are minimal or don't clearly explain what the prior misunderstanding was.	There is at least one good discussion of new things that were learned as a result of doing the experiment or preparation for it.	At least two days give a daily reflection about what was learned that day, and prior misunderstandings are mentioned.	Multiple entries include thought reflections that clearly identify what was learned that day, and misunderstandings are clearly discussed.	
Graphing of data Analyze Communicate	Figures are missing information or are inaccurate. Some axes are not labeled with units. Raw/unprocessed data may be missing.	Figures appear technically correct but not visually effective or easy to interpret. Too many gridlines or tick marks may be present. Too many/few sig figs may be used.	Data is accurate and presented in a clear fashion. Graph axes and numbers are large. The number of sig figs are reasonable. Raw data before analysis was also included.	Figures show progression from raw data to analyzed results, with attention to clarity and accuracy.	
Discussion of results Communicate Analyze	Discussion of the results is very limited, inaccurate or unclear how they same to their conclusions.	Some results are discussed, but the analysis lacks clarity, depth, or a logical connection.	The results from the figure are well discussed near the figure. Summarized in a conclusion section.	The results and broader implications from the figure are well discussed near the figure and conclusions.	
What would you do better if repeated? Define Topic	There is only a vague or few word discussion of improvements that could be made to the experiment, such as "more measurements."	Discussion of improvements is limited or unclear and/or it is unclear why the ideas discussed would be improvements.	There is a clear discussion of potential experimental improvements.	Not only was there discussion of why they expect identified changes to improve the experiment, includes attempted changes.	
Analyze	F: 0-7	C: 15-21 D: 8-14	A: 30-36 B: 22-29	**Total Score**	

These last columns are not graded until the end of class, where you will have practiced graphing and analyzing in later parts of the course.