GEOL 135 LAB SYLLABUS
Environmental Geochemistry

What: This document will give important information on your GEOL 135 Lab, which is not a traditional lab. Instead of completing experiments and writing lab reports, you will complete a research project as a group of up to 3 students. **The goal of this lab** is to complete a small research project precisely and safely. This means that you will chose from a list of research projects, do literature searches, develop hypotheses, collect samples in the field, collect data, analyze data and synthesize your findings to test your hypothesis.

Why: There are many reasons why doing research is very valuable for you, here are some:

- You will experience research in all aspects from beginning to end: an idea, literature research, hypothesis development, fieldwork, lab work, sample and data analyses. You will also synthesize this information and communicate it. This is the complete process and will be an important learning experience in itself.
- You will be trained in specific procedures and the use of a given instrument, which are important skill sets to have.
- You will do your own literature research and will gain quite a lot of factual knowledge. More importantly, you will practice to get reliable information.
- Working on your own project is much more engaging and motivating, which is important for your learning and the project.
- You will work in groups which is a great practice for teamwork. We always will have to work with others, often things go smooth, and sometimes they don't. That's actually where we have an opportunity to really learn something. How do I interact with others? What typical role do I play? What is my comfort zone? Why does the behavior of this other person drive me crazy? How do I communicate? We will do an exercise on roles in teams that will help you identify strengths of your team and create awareness of potential challenges.
- I will be able to observe you in a setting where you do all of these things and I will be able to report on self-motivation, team work, diligence, resourcefulness etc. it in letters of recommendation.

How: We will work with research milestones that will guide you through the semester. Here is a list and a rough timeline. Detailed information on each milestone is provided in section 2 of this document.

1. Identify primary, secondary and tertiary information sources (week 1)
2. Perform a literature research, identify 6 key sources and read them (week 2-3)
3. Write a summary of literature research and generate a testable hypothesis, send to Julia (week 3-4)
4. Receive training on instruments (week 3-5)
5. Get samples (week 6)
6. Perform sample analysis (week 7-10)
7. Plot and describe data as soon as you have data (week 7-10)
8. Interpret and analyze your data (week 11&10)
9. Synthesize your findings and generate a research talks or poster (work on it as soon as you have data, refine week 10 & 11)
10. Present your research (week 13-15).
11. Optional: present your group poster at the student research conference in Spring. Its fun!

Deliverables: Your first deliverable is a 1 page written summary of your project including research hypotheses. This summary is not graded but will be that basis for a discussion before fieldwork. Your final deliverable is a research presentation at the semester as either a talk or a poster. After your presentation you will be asked many questions by myself and the audience.

1. Requirements

Before you can begin your work in our labs you will have to complete the following lab safety trainings:

- Complete the following online lab safety trainings **before** beginning labwork: http://www.uvm.edu/safety/lab/safetytraining 1)Chemical Safety in the Laboratory, 2)Laboratory Ventilation and Chemical Fume Hoods 3) Laboratory Chemical Waste Disposal and 4) Laboratory Safety Roles and Responsibilities.
- We organize a classroom training during the second lab meeting time (second week of classes). If you miss it please complete the next available classroom training http://www.uvm.edu/safety/lab/safetytraining#Classroom and sign up for “Emergency Response” and “Keeping Your Lab Safe”.
- If you will use XRD or XRF in your research you will need to complete radiation safety training: http://www.uvm.edu/~radsafe/ . We typically combine the lab safety training and radiation safety trainings (second week of classes).
- Read the Lab rules and ask questions if anything is unclear (Appendix A)
- Read the Orientation Checklist for New Lab worker (Appendix B) and ask questions if anything is unclear during your first lab training (beginning 3rd week of classes).

Experience: No previous lab experience is necessary. You will receive training by myself and graduate students in all necessary procedures.

2. Research Milestones

As mentioned, “when” you do “what” and “how” depends on the research project, however all projects will strive to meet these general research milestones with detailed info in the following pages. I will send you reminders when the milestones should be reached (or if you need to hand something in):

1. Identify primary, secondary and tertiary information sources (week 1)
2. Perform a literature research, identify 6 key sources and read them (week 2-3)
3. Generate a testable hypothesis, send to Julia (week 3-4)
4. Receive training on instruments (week 3-5)
5. Get samples (week 6)
6. Perform sample analysis (week 7-10)
7. Plot and describe data as soon as you have data (week 7-10)
8. Interpret and analyze your data (week 11&10)
9. Synthesize your findings and generate a research talks or poster (work on it as soon as you have data, refine week 10 & 11)
10. Present your research (week 13-15).
11. Optional: present your group poster at the student research conference in Spring. Its fun!

1) Information sources: You will get an introduction on this during the first lab meeting time (week 1) where we will have somebody from the library to give you some info on resources. Especially at the beginning it might be difficult to know where to start and we suggest you begin with ternary (encyclopedia) and secondary sources (text books, review papers). For example if your project is about clays you may find your textbook helpful to start (this is a secondary source). Later you might be interested in clays in agricultural settings in the North Eastern US because you might have a hypothesis in this direction. In this case you should dive into the primary resources (peer reviewed articles).

2) Literature research: Literature research can feel a little bit like looking for the needle in a haystack. There is so much information available and it’s easy to get sidetracked or completely confused. Keep the tricks from the library resources in mind, you can limit your literature research quite effectively. But when do you know you’ve done enough?

Consider the following:

- **Did you research all main themes and keywords in your research project?** E.g. If your project is on soil aggregates you want to find out what aggregates are, how they form, what they are made of. If your research is on aqueous organic carbon you might want to find out about the properties of such carbon, does it change seasonally?
- **Did you check on the field site?** All projects have sites in Northern Vermont. You might want to check if you find anything specific about your field of interest in northern forests or in agricultural settings. Is there a difference between forest settings (in terms of aggregates, clays or aqueous carbon) and if yes why?
- **Did you check on your analytical techniques?** You will receive training on the "how" on using specific instrumentation but do a solid literature research on the "what" and "why". E.g. what is a particle size analyzer, what is its measuring principle and "why" are you going to use one?

Another important aspect is to make notes while reading and to keep the full reference in your records. The library has some good tools for keeping track of references. You will need it later for the intro and discussion of your research talk or poster.

It is very common to go back to the literature once you were in the field, made certain observations or start having data.

3) Generate a testable hypothesis: In science we often work with testable hypotheses. In order to have a good hypotheses you will need to know quite a bit about your project, hence it's important to do a literature research. This might be an iterative process, which means that you might come up with an idea, try to formulate the hypothesis, wonder if this has already been done, and decide to check the literature some more. While reading and doing a literature research you might get some good ideas, keep track of them!

Here is a quite simple tutorial (modified from https://explorable.com/how-to-write-a-hypothesis):

Step one is to think of a general hypothesis, including everything that you have observed and reviewed during the information gathering stage of any research design.

Example: A worker on a fish-farm notices that his trout seem to have more fish lice in the summer, when the water levels are low, and wants to find out why. His research leads him to believe that the amount of oxygen is the reason - fish that are oxygen stressed tend to be more susceptible to disease and parasites.

This could be a general hypothesis he comes up with: "Water levels affect the amount of lice suffered by rainbow trout."

This is a good general hypothesis, but it gives no guide to how to design the research or experiment. The hypothesis must be refined to give a little direction. "Rainbow trout suffer more lice when water levels are low." Now there is some directionality, but the hypothesis is not really testable, so the final stage is to design an experiment around which research can be designed, a testable hypothesis: "Rainbow trout suffer more lice in low water conditions because there is less oxygen in the water." From this hypothesis it is clear that in order to test the hypothesis he would have to measure oxygen concentrations at different water levels and compare with his observation on the rainbow trout.

I'll ask you for a short written introduction and a testable hypothesis in week 4. This will give us enough time to refine it, if necessary, before we do field work.

4) Training on instruments: The Environmental Biogeochemistry Lab (room 301) and the X-ray lab (room 317) house a range of state of the art analytical instrumentation for you to use such as a carbon analyzer, a fluorescence spectrometer, an X-ray fluorescence analyzer, a laser particle size analyzer and an x-ray diffractometer. Please note that all labs are shared facilities for teaching and research and the instrument cost as much as a new car (some of them as much as a house). Be very careful when handling them, pay attention during training and use your SOPs (standard operation protocols). I will provide them via BB for each task.

Which analytical technique you will use depends on your project and the hypotheses. You will learn how to perform selected geochemical analyses in the lab and collect analytical data independently and safely. I will provide you with standard operation procedures (SOPs), which are written step by step instructions. You'll find all of them on BB. Please bring your copy to each lab work session and take organized notes. Also during training sessions take notes. We will give you lots of information and you will not be able to remember everything.

5) Get samples: See also the general info on the field trip. I will bring hand shovels, augers, sampling bags, measuring tape, sharpies, and a GPS, all the rest has to come from you (notebook, pens, food etc). Bring a camera or your phone, the more pictures you take the better! How you will take samples, and where, really depends on your hypotheses and project but here are **some general thoughts:**

a) you may want to think about replication: for example your hypothesis is that the agricultural stream has more carbon than the forested stream, hence you take one sample from each location. Chances are that you will ask yourself forever if the results are really representative (most likely they are not). Better take duplicated (2) or triplicates (3), this allows us to do some statistical analysis later. A typical approach is to calculate the average and then the standard deviation and to represent the latter as error bars. We also have a couple of more tricks we can use.

b) you might want to think about trends: imagine you hypothesize that extractable soil carbon increases with proximity to the stream, hence you take a sample from the hillslope and one close to the stream. Is this enough? Probably not, you will not be able to say anything about the trend. Better to have several samples in between.

c) You may want to think about feasibility: for example you are interested in the difference between soil organic carbon vs. stream organic carbon and your group decides to take soil samples from the agricultural and forested stream in triplicate at 3 depth and 10 locations each. This totals to 60 samples, which would be fine for a yearlong project but would completely overwhelm you for this lab. Here are some guidelines for each analysis:

- For XRD try to limit your samples to 5-8 (each run can take 30-60 minutes and you may need to do additional tests…).
- For XRF you could have between 10 and 20 samples (but if you need to grind each of them this will be a time sink).
- For PSA 10-15 should work.
- Shimadzu C analyzer has an auto sampler but you will have to filter your samples. 20 should be no problem.
- Aqualog takes 10-12 minutes per sample, stay under 20 samples if possible.

You may get the drift that a lot of planning goes into this and you are right. You can use some of the lab meeting times where you are not scheduled to discuss with your group and I'd be happy to provide input. Before the fieldtrip I will need to see each group either during office hours or make an appointment.

Fieldtrip: We will have one mandatory day-long fieldtrip at the beginning of the semester on a weekend where you will collect samples for your project. We will leave from the Geology Parking lot (in the back) at 9AM using our Geology vans and will return the same day, probably quite late. Note that you may also need to take care of samples after the field trip (putting soils to dry, filtering water samples etc). In short it's going to be a long day. You will have to sign an "acknowledgement of risk" form before the field trip. **The goal for this fieldtrip** is for you to get samples that will be analyzed to test your hypotheses.

Fieldtrip What to expect:

- You'll be hiking through potentially rough terrain, it might already be cold and it might rain (or shine) all day long.
- You will tour both sites and then get some time to discuss your sampling plan amongst your group. Its quite likely that you will change your thoughts on sampling as soon as you are in the field (typically things look just different on paper).
- You will get all kinds of information about both sites including some of the science already happening there. Each group will also discuss your project with Julia and two researchers that know the sites well. These discussions will help you to further clarify what samples to take where to test your hypotheses. It may also happen that you change your hypotheses altogether.

Fieldtrip What to bring: bring a daypack, a notebook, pencils, appropriate clothing for the weather including raingear, solid footwear (e.g. hiking boots, rubber boots), bottled water, snacks and lunch. Bring medication as needed (e.g. asthma, allergies, bee sting meds etc). Tell me if you have had serious allergic reactions in the past.

5) Perform sample analysis. Bring your notes, have your SOPs, it's really difficult to remember everything. You have 2 labs scheduled where you analyze your samples. I will be there and typically 1 or 2 graduate students will be there for some time. This is where you really will get practice with the instruments. You might realize that you may need more time to finish analyses (or you have to redo a procedure). You can come in during additional lab meeting times (check the schedule) and you also can come in at other times with some restrictions:
- If your group wants to use the lab outside of lab meeting times you will have to be fully trained and comfortable working in the lab.
-You will also have to let me and graduate students know when you want to come it.
- I will have to be in the building (this excludes most Thursdays) and ideally somebody else should be in the in the lab. The lab is always locked, you will need to coordinate with us anyway.
- no work afterhours or on weekends.

<u>Important</u>: If you are in the lab without me and run into a problem or question that you cannot resolve alone or with help of a grad student, please come and see me in my office right away, you will not annoy me!

6) Plot and describe data: Making plots and graphs is a good way of making sense of your data, do this regularly (as soon as you have it). It might show you issues with data (e.g. one sample has 10 times the concentration of the other. You might rightfully wonder if this is correct and need to redo the analysis to be sure.
For this, compile your data in a format that you can use to plot. You may have many different data sources and I prefer to have everything in one big spreadsheet with the meta data (data on data, such as collection time and date, location, comments etc) and sample IDs in several columns. If you use replicates, consider calculating the average and standard deviations in another tab (Some useful EXCEL tutorials can show you, just google it).

Put some thought in data organization and never work of the original (copy it and play around with the copy). All this may take some time to set up but will make your life easier.
Label everything with ID and units, rule of thumb is that another person should be able to make sense of your spreadsheet without your help.

7) Analyze your data, compile results and interpret data: Have your hypotheses in mind and begin to make plots that contain data that can test your hypotheses. The type of visualization depends on the type of questions you want to answer.
For example, if you hypothesize that Sample A should have a higher carbon content as sample B (for whatever reason) a column plots could be a good choice because it allows for direct comparison.

I like to have the best plots (that may make it into your presentation) copy pasted on a ppt and annotated. E.g. you have a plot and underneath you write "correlation between x and y for montmorillonite suggests

increasing water content, in agreement with hypothesis 1". This will make your life easier when pulling this together for your presentation.
The difference between results and interpretation is very important. The results are what they are. Hence results are first described (e.g. carbon content in the stream is 4.5 mg/L). You may hit the books and peer reviewed publications again to check if such observations have been made before. Add a comment on your ppt (e.g. carbon in streams is in agreement with findings of Eimers et al. 2013).
With a good background knowledge (literature research) you will be able to give meaning to your results and interpret them (e.g. agricultural stream has less carbon than forested stream because less leaf litter in AG). In science we pay attention to keep results and interpretation separate because interpretation might change. This is an iterative process and we have lab meeting times set aside for you to work on analysis and interpretation where you can consult with me.

8) Synthesize your findings and generate a research talk or poster: You should work on this continuously (e.g. by keeping notes on your literature research, by having your data organized and by having annotated ppt slides with some plots).
Here is a more in depth tutorial on how to make a poster: modified *from http://guides.nyu.edu/posters:*

Posters are widely used in the academic community, and most conferences include poster presentations in their program. Research posters summarize information or research concisely and attractively to help publicize it and generate discussion.

The poster is usually a mixture of a brief text mixed with tables, graphs, pictures, and other presentation formats. At a conference, the researcher stands by the poster display while other participants can come and view the presentation and interact with the author.

- Important information should be readable from about 10 feet away
- Title is short and draws interest
- Word count of about 300 to 800 words
- Text is clear and to the point
- Use of bullets, numbering, and headlines make it easy to read
- Effective use of graphics, color and fonts
- Consistent and clean layout
- Includes acknowledgments, your name and institutional affiliation

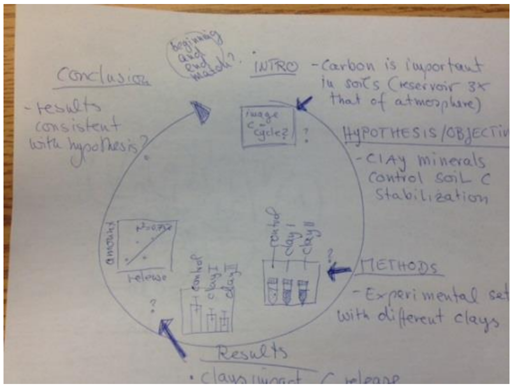
Answer these three questions:

1. What is the most important/interesting/astounding finding from my research project?
2. How can I visually share my research with conference attendees (our class)? Should I use charts, graphs, photos, images?
3. What kind of information can I convey during my talk that will complement my poster?

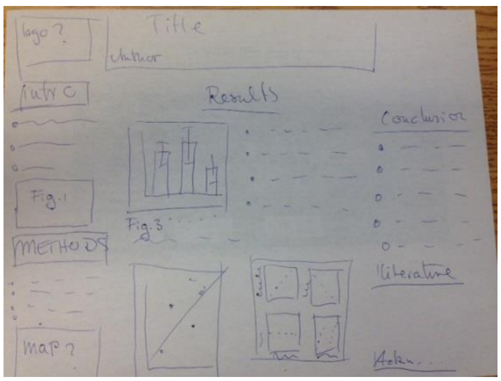
To begin: draw your story out on a piece of paper. Like any story, it has a beginning, middle part and end (keep it that simple)! When you think you have your story, check in with your adviser to discuss.

Think about what type of visualizations you need to tell your story. This is how I start:

Story draft:



Poster draft:



What belongs in each section:

(*modified from http://colinpurrington.com/tips/poster-design)*
Title: Convey the interesting issue, not more that 2 lines. Try to think of 5 keywords that are important in your research and swap these around until you have a title.

Abstract: I typically do not include an abstract on a poster. A poster is already an abstract of your research.

Introduction: Get your viewer interested in the issue or question while using the absolute minimum of background information and definitions; quickly place your issue in the context of published, primary literature (cite!); then pitch an interesting, novel hypothesis … then you can describe (briefly) the experimental approach that tested your hypothesis. Put a photograph or illustration that communicates some aspect of your research question. [approximately 200 words]

Materials and methods: Briefly describe experimental equipment and procedure, but not with the detail used for a manuscript; use figures and flow charts to illustrate experimental design if possible; include photograph or labeled drawing of organism or setup; mention statistical analyses that were used and how they allowed you to address hypothesis. [approximately 200 words]

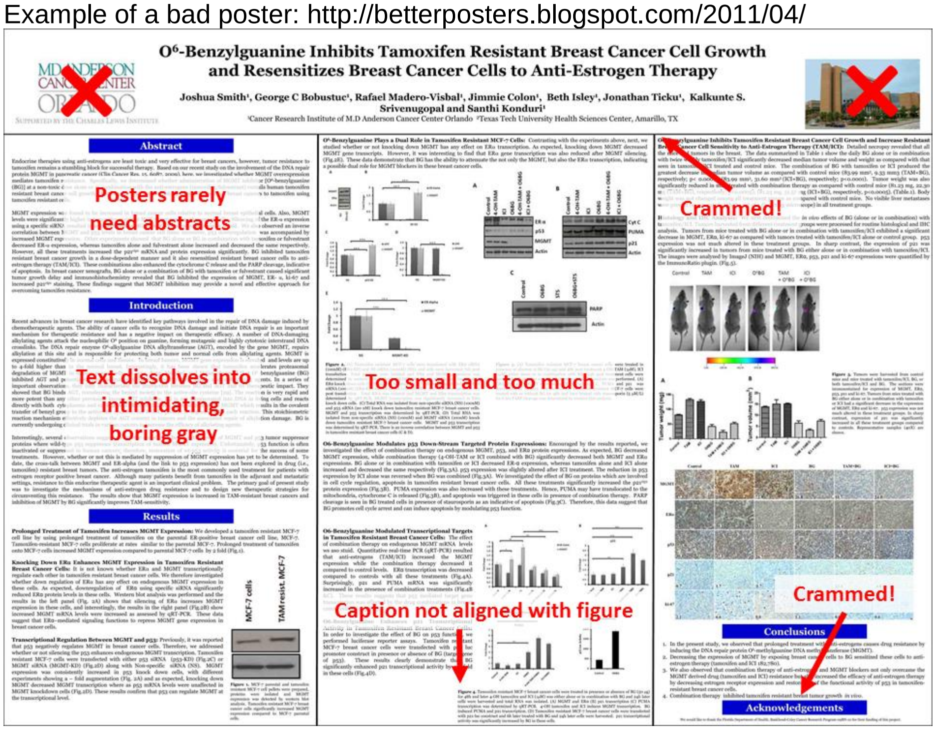
Results: I typically use big Figs with Figure captions, nothing else. If your results are preliminary, call the section “preliminary results”.

Conclusions: You want to bring this back to your hypothesis. E.g. “results indicate that organic matter is mostly protected by clay minerals”. Often our research is preliminary, wording like “indicate” or “our results are consistent with” is helpful in these cases.

Literature cited: Include them! Ref list can be very small and abbreviated but has to be there.

Acknowledgments: Thank individuals for specific contributions (equipment donation, statistical advice, laboratory assistance, comments on earlier versions of the poster); Always add UVM logo.
Example of a great poster: http://www.personal.psu.edu/drs18/postershow/

Example of a bad poster: http://betterposters.blogspot.com/2011/04/



Further information: add your email address so interested audience can contact you
DOs and DON'Ts:

- Aim for 300- 800 words
- Do not add bullets to section headings. The use of a bolded, larger font is sufficient for demarcating sections.
- Use bullet points
- Avoid dark backgrounds, which makes your poster hard to read. Also, designing graphics is harder. It's better to just use a white background. And you save on ink,
- Complete the entire poster on a single platform. Switching from PC to Mac or Mac to PC invites disaster, sometimes in the form of lost image files or garbled graph axes.
- Give your graphs titles or informative phrases. You wouldn't do this in a manuscript for a journal, but for posters you want to guide the visitor.
- Increase the font size of your axes labels in plots
- Always write, "data are," not "data is." "Data" is a plural noun ("datum" is the singular).
- This is probably obvious … but don't plagiarize.

Talks: Talks are another good way of presenting your research. Count ~ 1 slide per minute and keep the same guidelines as for posters in mind. E.g. try to avoid cluttered slides, use visualizations, and have a clear message.

9) Present your research: Practice your presentation, this is an important step and will impact your grade. If you decided to make a poster give me a heads up a week before it's due. We have a plotter in the department and I can print for you free of charge. The presentations will be during normal lab meeting times and you should anticipate questions (this goes back to your literature research). Either poster or talk, you should take ~ 20 minutes. We'll ask you questions for about 15 minutes.

10) Optional: Additionally you can present your group poster at the student research conference in spring (typically end of April). You can use the same poster. You will not receive extra credit but its fun, a great experience and looks great on your CV. You can find more info here: http://www.uvm.edu/~uvmsrc/. Let me know if you are interested and I'd be happy to help.

3. Assessment

Labs count for 40% of the total grade and I will evaluate your lab performance using the rubric below. Note that this assessment will vary with your academic level. I will take the trajectory of your performance into account, which means that I do not expect a "great" level at the beginning but a clear progress towards it. Note: "great"=A, "solid"=B, "not enough"=C or less in the rubric (= half of the lab grade).
You will also receive a group grade for your lab project presentation towards the end of the semester. As a group you can choose how you want to present your research: You could prepare either a poster or you could prepare a talk (= other half of the lab grade).

	Great	**Solid**	**Not enough**
Laboratory Safety	Knows and follows correct safety procedures in the laboratory; actively seeks training or information when necessary.	Knows and follows correct safety procedures in the laboratory after receiving training.	Needs to be reminded repeatedly to engage in safe laboratory procedures.

Knowledge	Independently seeks thorough knowledge of the background using peer reviewed literature research. Has motivation for project.	Has a developing knowledge of the background and motivation for project. Has some familiarity with scientific literature	Needs to be repeatedly reminded to improve knowledge of the background and does not have motivation for project. Has minimal familiarity with scientific literature
Technical skills	Practices and shows skill and care in technical procedures and instruments. Is able to consistently reproduce high quality results.	Practices to improve skill in technical procedures and instruments. Quality of results may be inconsistent	Does not display skill in technical procedures and instruments. Consistently fails to reproduce results.
Independence, time management, and planning	Works without close supervision; Actively manages time to push project forward; Manages project and produces results in a timely manner. Generates ideas. Seeks advice from mentors adequately	Sometimes requires supervision in the planning or executing of experiments. Does manage time and is usually efficient at completing experiments. Seeks advice	Unable to work without supervision; does not plan experiments or manage time. Inefficient at completing experiments in a timely manner. Does not seek advice or does so for information that is easily obtainable elsewhere
Collegiality and Collaboration	Works well with peers and supervisors; begins to mentor or train others; gives and takes constructive criticism well; respects differing backgrounds and points of view	Works well with supervisors; takes constructive criticism; respects differing backgrounds and points of view	Has conflict with coworkers and supervisors; does not apply constructive criticism for improvement of performance; does not respect differences
Record keeping	Keeps complete, organized, and legible records in project folder and data spreadsheets	Keeps complete records, but they may be disorganized or have legibility issues.	Does not keep complete records, or components are missing, inadequate, or have unexplained gaps

Letters of Recommendation: Working in a lab is a great way of gaining research experience but also provides you with a source for future letters of recommendation. This may seem far away but sooner or later you will need letters and I'm happy to provide them for employers, grad school admission etc. However, I can only report on something I was able to observe. For example, consider the difference between the two scenarios:

1) you don't know how to retrieve data from an instrument and you are not sure how to visualize the data, so you come and see me in my office and ask.

2) same scenario, you don't know how to retrieve data from an instrument and you are unsure how to visualize the data, so you check the instrument manual for information and also do a quick web search. You also check scientific literature to see how these types of data are typically visualized. Because you are not sure how to plot the data in excel, you do a quick online search and try it out. Then you come to me to discuss what you found and ask remaining questions.

Both approaches are fine but #2 gives me ample opportunity to write about your self-motivation, resourcefulness, and independence.

Check appendix for an example of a letter.

APPENDIX A

PERDRIAL Biogeochemistry Lab Rules *updated 12/10/2016*

Safety:

1. Everybody who works in this lab has to complete the online lab safety training:
   - - Chemical Safety in the Laboratory
   - - Laboratory Chemical Waste Disposal
   - - Laboratory Safety Roles and Responsibilities
   - - Laboratory Ventilation and Fume Hoods

They can be found at http://esf.uvm.edu/courses/

2. Complete the "Orientation/Training Checklist for New Laboratory Employees" to make sure you are ready to begin working in the lab. Copys are available in 301 or here: http://www.uvm.edu/safety/sites/default/files/uploads/documents/newemployeechecklist2013.pdf
3. Adhere to standard safety rules discussed in the training, particularly:
   - ALWAYS wear closed-toe shoes and clothes that cover legs. This is tricky in the summer time but you can bring a spare set of clothes/shoes and store in the grey cabinet.
   - When handling acids/ bases wear goggles, labcoat and gloves.
   - Don't work alone in the lab (except if approved by Julia or Nico).
   - Please label all vials, bottles vessels with the green or orange labels and use secondary containers.
   - Know what you are doing and plan ahead. If you don't, PLEASE ask.

Etiquette and cleanliness:

4. Don't create labware orphans: Take care of your own labware and label samples, vessels etc..
5. Please be a good parent to "orphaned" items such as dishes. It may not be yours but if you see a beaker etc sitting in the same spot for weeks, take care of it (wash it). Exception: item or content may be hazardous, ask Julia or Nico.
6. If you finish something, replace it (e.g. let us know).
7. Be a good lab citizen: empty trash **before** its overflowing, refill labelling tape dispenser etc. Inquire about items that don't seem to belong to anybody, inform Julia or Nico about problems (unsafe practices, issues with cleanliness etc).
8. If you break something, let Julia or Nico know. It's normal that stuff breaks in a lab but we need to know to be able to fix or replace it.

9. please clean up after yourself and wipe all lab surface daily. We have a mixed use lab with processes generating dirt and dust just beside experiments that need a clean environment and need to avoid cross contamination.
10. 10. Its ok to store dishes on your bench, but put them in a wash bin and label it. Its ok to get more washbins (with lid) if you need (Grad students can can order).
11. Please keep the hoods and sinks clean and empty the soil trap regularly (weekly to monthly).
12. Please remove boxes and don't store them in the area of the electric panel. When you have a box you need to get rid of, fold it and put it in front of the lab. The custodial team will take them away.

Other:

13. If you order chemicals (grad students only), send Nico an email. We need to update the chemicals inventory promptly.

UVM Risk Management & Safety
Orientation/Training Checklist for New Laboratory Workers

Employee's Name:_______________________________ Date checklist started:__________ completed: ___________

Trainer (PI/Supervisor/Designated Trainer): ____

I. General (www.uvm.edu/safety)

- ☐ Review Safety Website (www.uvm.edu/safety).
- ☐ Complete all required safety trainings. (http://www.uvm.edu/safety/lab/safetytraining)
- ☐ Complete Safety tour inside and outside of the lab including fire extinguishers, fire alarms, egress & exits, & safety equipment (PPE, showers, eyewash, chemical spill kit, telephone, cylinder restraints, disinfectants, etc).
- ☐ Review emergency response procedures specific to each lab, reporting procedures for accidents and injuries, and emergency phone numbers. (http://www.uvm.edu/safety/lab/prepare-for-emergencies)
- ☐ Review lab-specific and building-specific safety features (e.g. close lab doors, evacuation map & meeting site, gas shut-offs).
- ☐ Review the contents of Laboratory Safety Notebook and the Monthly Self-Inspection Checklist.
    - ☐ Review the location of Safety Data Sheets (SDSs).

II. Chemical Safety (http://www.uvm.edu/safety/lab/chemical-safety)

- ☐ Review or complete chemical hazard assessments, including Chemical Use Planning Forms, for the chemicals you will be handling in the laboratory.
- ☐ Understand what controls are required to minimize potential exposure to chemicals and other hazards in this lab. (http://www.uvm.edu/safety/lab/identify-and-control-hazards)
    - ☐ Engineering Controls: Fume hoods, biosafety cabinets, glove boxes, Schlenk line, snorkel exhaust, etc.
    - ☐ Administrative Controls: Standard Operating Procedures and lab-specific protocols
    - ☐ Proper Personal Protective Equipment: Lab coat, gloves, eye and face protection, respirator*

    **Must complete a Request for Respirator Use form and receive approval and instruction __before__ using a respirator.*
- ☐ Review procedures for operating equipment (e.g. power tools, autoclave, NMR, kilns, ovens, engineering controls). Do not operate unfamiliar equipment or materials without proper training and approval.
- ☐ Review proper labeling, segregation, and storage for all chemicals used in this lab.
- ☐ Review chemical waste procedures including labeling, storage, and disposal.

III. Biosafety and Bloodborne Pathogens (http://www.uvm.edu/safety/lab/biological-safety)

- ☐ Review and sign-off on all laboratory infectious agents Standard Operating Procedures (SOPs).
- ☐ Understand how to use the proper controls in order to minimize any potential biological exposure.
- ☐ Review biohazardous waste procedures including labeling, storage, and disposal, disinfection of liquid waste, proper set-up of aspiration flasks, and biohazard box disposal.
- ☐ All employees who work with human or primate blood, blood-products or other potentially infectious materials must:
    - ☐ be designated "at risk" with Infectious Materials Risk Designation Form,
    - ☐ be offered the Hepatitis B vaccine with the HBV Vaccination Consent/Dissent Form, and
    - ☐ review the UVM Exposure Control Plan. (http://www.uvm.edu/safety/lab/bloodborne-pathogens-0)

IV. Other Laboratory Hazards

- ☐ Receive and document necessary training for any highly hazardous material or process, including lasers, time sensitive chemicals, highly toxic or reactive chemicals, pressurized devices, etc).
- ☐ Review safe handling procedures for gas cylinders (how to check for leaks, proper restraining & transport, etc).
- ☐ Review safe operating and handling procedures for thermal hazards (e.g. Liquid Nitrogen, ovens, kilns, autoclaves, hot plates, Bunsen burners, etc).
- ☐ Review proper disposal procedures for other wastes including sharps, broken glass, uncontaminated lab waste, batteries, and light bulbs.

I understand that this checklist is intended as a safety-training guide for my laboratory; it may not be a comprehensive list of all the training I may need to be safe from the hazards in my specific laboratory.

Employee's Signature:____ Date Completed:__________ Revised 05/16

APPENDIX : Example letter of recommendation

Note, the best letters contain examples that back up each statement. This is a letter I wrote for one of my students but I took most of the examples out to ensure privacy (I just left the "XXX is very diligent, resourceful and responsible" as an example). These letters vary based on individual strengths and challenges, please note that this is just one example. Typically such letters can be 1-2 pages long.

Environmental Biogeochemistry

The University of Vermont

213C Delehanty Hall
180 Colchester Ave.
Burlington, VT 05405, USA

(802) 656-0665
Julia.Perdrial@uvm.edu

Date

Dear Dagobert,

It is my great pleasure to enthusiastically recommend XXX for XXX. **I have known XXX since XXX**, when he/she contacted me to work in my Environmental Biogeochemistry laboratory at the University of Vermont as undergraduate intern. As a research scientist and later assistant professor I've had the pleasure to work with over 30 talented students, however XXXs **enthusiasm, motivation, strong sense of responsibility and great attitude towards work are outstanding**. I would rate his/her performance in the top 3%.

XXX is **very diligent, resourceful and responsible** (Example: Soon after he/she began working in my lab he/she took over the analysis of XYZ samples after initial training. The fact that I entrusted XXX with this task speaks to the level of confidence I have in her capacities. He/she coordinated sample collection to ensure timely analysis of all samples, performed analyses, data QC, all in a self-motivated manner. He/she even improved SOP for analyses to **ensure the collection of quality data** in my lab. During this time he/she also learned many new techniques including XYZ analyses precise and self-organized on a suite of environmental samples. I was very impressed by his/ her ability to learn the science and procedures in a field that was new to him/her).

XXX is a very enthusiastic and focused learner with great interested in interdisciplinary research, especially water quality issues. His/her understanding and interest in environmental processes is impressive and so is his/her ability to apply learned materials to real world problems. (Example)

XXX is a **great team worker** and integrates will in a diverse group of students. (Example)

XXX contributed with own ideas to his research project (Example)

Finally, XXX has a calm but enthusiastic personality. He is good natured, outgoing and is really fun to work with. I have no reservations to give my highest recommendation for XXX, his curiosity and motivation are an outstanding addition to any program/business. It has been a delight to work with him/her, and I would be thrilled to do so again.

Sincerely,
Mickey Mouse