**Undergraduate Research**

**Environmental Biogeochemistry Lab**

This document willbe the basis for your research project and will help us to clearly establish expectations, goals, and communication plans between you and your mentors.

**Research focus**: Carbon dynamics in streams and soils, dissolved organic matter analysis, interactions between minerals and carbon, weathering

# General Information

**Student name**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Major**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Mentor name**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Reason for research**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Semester/Year**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Planned project duration**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# 2. Requirements

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

# 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.

# If you will use XRD or XRF in your research you will need to complete radiation safety training: <http://www.uvm.edu/~radsafe/>

# Complete the next available classroom training <http://www.uvm.edu/safety/lab/safetytraining>. If you begin in Fall you can join the annual training organized by Gaby Mora-Klepeis ([Gabriela.Mora-Klepeis@uvm.edu](mailto:Gabriela.Mora-Klepeis@uvm.edu)) in our Department. If you begin work in spring or summer please check the web site [http://www.uvm.edu/safety/lab/safetytraining#Classroom](http://www.uvm.edu/safety/lab/safetytraining%23Classroom) and sign up for “Emergency Response” and “Keeping Your Lab Safe” within 3 months of your starting date.

# 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 with your mentor.

# 3. Nuts and bolts

* **Communication:** Generally, the best way of contacting me is via email. If you would like to meet to discuss your project please schedule the meeting via email in advance. We should meet regularly and can do so upon your request or, if you prefer, we can decide on a fixed weekly meeting time.

**Important: If you are in the lab and run into a problem or question that you cannot resolve alone or with help of your grad mentor, please come and see me in my office right away!**

* **Advising**: You will be advised by myself but also by graduate students.

I greatly value the development of independence and therefore use a *hands off* advising style (after I ensured you are trained in all procedures). This does not mean that I don’t want to be engaged in your project. It means that I expect that you actively “drive” your project forward instead of waiting to be driven around. In practice this means, for example, that you actively seek me out (e.g. make appointments) to discuss your progress. If you are concerned that ”hands off” will be difficult during a busy semester, we can schedule regular meetings in advance. However, I expect you to manage the project the same way that you manage your other course work including respecting deadlines. We can work with milestones (see below) to facilitate the process.

* **Training**: You will receive training in all procedures by myself and graduate researchers. Please take organized notes during training sessions, you will not be able to remember everything. Bring your notes each time you come to the lab.
* **Meetings**: Please come prepared to our meetings that will last between 30 and 60 minutes. “Prepared” can mean many different things and depends on where you are in you project. For example at the beginning you may still be browsing for a precise research direction. In this case "prepared” means than you began a review of relevant peer reviewed literature (see the library web page for info) and that you generated own ideas that we can discuss. Have notes organized and bring them with you. An important aspect at this stage is to think about testable hypotheses, but in order to generate meaningful hypotheses you need to have the background info.

We will also meet to discuss progress with e.g. data collection. For this, have your data ready and organized on your computer, make plots in excel or come with ideas on how to use your data.

* **Time commitment:** If you get credits for your research (e.g. GEOL 198), your time commitment will be the same as for a regular course. For each credit, plan on spending 40-50 hours/semester on your project (3 credits = 120-150 hours total, >8 hours each week for 16 weeks).
* **Grade:** For credits you will receive a grade using the rubric in Appendix C. 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. During our meetings we may use self-assessment (i.e. you identify your strength and weaknesses based on the rubric) to help with progress. Note: “great”=A, “solid”=B, “not enough”=C or less in the rubric.
* **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 D for an example of a letter.

* **Presentations:** If you receive funds from the Hawley-Mudge Foundation, you are required to present your work either at the UVM student research conference, the VSG student meeting or any other conference. Applications for the Hawley-Mudge grant are accepted 3 times a year and I will bring this opportunity to your attention.

However, even if you are not applying for a Hawley-Mudge, I strongly encourage you to present your results at these venues. I will bring the conferences to your attention and will help you with the entire process. It is a great way of practicing abstract writing, poster and talk design and presentation.

# 4. Research Milestones

# Especially if you struggle with time management it may be helpful to keep a running log of research milestones with target dates. We can come back to these milestones during our meetings. Examples are:

* *Identify and read six articles- end of January*
* *Generate a testable hypothesis- end of January*
* *Independently operate instruments- February*
* *Complete analyses –End of March*
* *Plot and describe data, -April*
* *Submit abstract to a research conference, April 15th*
* *Synthesize data into a presentation etc. April 25th.*

**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/>

1. 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
2. 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:

1. Don’t create labware orphans: Take care of your own labware and label samples, vessels etc..
2. 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.
3. If you finish something, replace it (e.g. let Alyson, Jenny, Nico or me know).
4. 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).
5. 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.
6. 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.
7. 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).
8. Please keep the hoods and sinks clean and empty the soil trap regularly (weekly to monthly).
9. 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:

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

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**APPENDIX C**

**Undergraduate research rubric**

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| --- | --- | --- | --- |
|  | **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 |
| **Communication** | Prepares oral or written reports that are complete, clear, formatted appropriately, and include appropriate citations. | Prepares oral and written reports that may have minor errors in completeness, format, grammar or delivery, or citation; improves with feedback and revision. | Prepares reports that are incomplete, poorly formatted, poorly written or delivered, or missing references. Shows little improvement after feedback |

**APPENDIX D: 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.*

