Essentially, all life depends upon the soil. "There can be no life without soil and no soil without life; they have evolved together." - Charles E. Kellogg, USDA Yearbook of Agriculture, 1938

"Whatever our accomplishments, our sophistication, our artistic pretension, we owe our very existence to a six-inch layer of topsoil – and the fact that it rains."

Anonymous, The Cockle Bur
Introduction

Welcome to the lab for Introduction to Soil Science! In the lecture for this course, we talk about soils concepts; in the lab, you will have the opportunity to perform chemical and physical analyses and see soils in the field. Not only will these experiences help you understand the concepts, we hope they will increase your appreciation of soil as a valuable, and essentially irreplaceable, natural resource.

To really understand soils, you have to get your hands (and, maybe, your clothes) dirty. For our trips to the field, you should dress appropriately. Our experiments and analyses inside the lab may sometimes include the use of chemicals that require special safety equipment such as goggles and gloves. For those labs, you should be sure your skin is appropriately protected. Shorts and open-toed shoes are prohibited at all times (UD policy).

How will we determine your grade? The syllabus (supplied separately) shows the percentages assigned to the various graded exercises. This lab only meets once each week, so attendance is critical; you will lose 5% off your point total for each unexcused absence. In addition, it is important that you read the lab BEFORE coming to class. To encourage this, we will give quizzes at the beginning of class covering the procedures for that day.

Our goal is to make this course fun and useful. If you have questions or suggestions, please let us know!

Jeff Fuhrmann, Anna Jurusik, Cat Meholic
Laboratory #1: Syllabus and Orientation (no quiz)

PURPOSE: To introduce you to the course’s policies and expectations.

OBJECTIVES:
1. Review the course syllabus provided below.
2. Outline the importance of the group soil in determining your course grade.
3. Become aware of the weekly quizzes in the course.
4. Establish groups for the semester.
5. Review the laboratory policies regarding cleanliness and safety.
6. Be apprised of how your course grade will be determined.

Laboratory Syllabus Supplement: Course Policies, Laboratory Requirements and Presentations

Preparation for Laboratories:
Successful completion of laboratory exercises is dependent upon two factors:

1. Preparation before the lab. Quite simply, this means read the laboratory manual before coming to the lab. Have a good idea as to what you will be doing and the sequence you will follow. There will be a quiz at the beginning of each laboratory on the material (introduction, objectives, and procedures) for that day, to ensure that you are preparing for the lab. Additionally, there will be follow-up questions from the previous week’s lab. Read the lab manual before you get to the lab; it would behoove you to read the material a day or two in advance and then skim over the laboratory material again, an hour or so before the beginning of the soils lab.

2. Proper laboratory technique. This is discussed below but can be summarized in two words: organization and concentration.

Laboratory Technique:
Laboratory technique refers to the operations and procedures required to successfully complete the desired analytical procedure within a reasonable time frame. To eliminate errors due to carelessness or misunderstanding of the objectives or procedures of the lab, it is absolutely essential to carefully prepare ahead of time. Read the laboratory manual before you come to the lab so that you are familiar with the general approach to use to accomplish the required objectives. If you are unfamiliar
with terminology in the manual, discuss this ahead of time with the instructor or teaching assistant(s) so that you do not lose time or make unnecessary mistakes.

Once you proceed with the laboratory, concentrate on each step so that you do not have to repeat any of the procedures. Although this is a teaching laboratory, the habits and skills you develop now will unquestionably be of importance at later dates when you may have to be more precise in your techniques. If you develop good laboratory techniques now, it will be much easier to obtain more advanced skills later. **After completing the laboratory, clean up your work area and return all supplies and equipment to the appropriate storage location.** You will be working in groups of two. Each group may be assigned a laboratory drawer in which you will return all supplies and equipment, washed and dried, and the end of each laboratory. Also, please use a sponge to properly clean up your lab area.

**Laboratory Participation:**

1. You must attend each laboratory in order to submit the final lab report or problem set for grading. Unexcused absences will result in points being deducted from your laboratory grade. This lab only meets once each week so attendance is critical; you will **lose 5% off your point total for each unexcused absence.** You are responsible for collecting, organizing, and maintaining all data generated during the laboratory exercises and presenting the information in your *Group Soil Management Report* (see pg. X, X). There will be a quiz at the **beginning of each lab**, except as otherwise noted, on the laboratories procedures that you will be covering that day and procedures and concepts from the previously lab. Be sure to read the lab manual before you come to class to be prepared for a quiz and to be able to complete the lab in the allotted time!

2. You are responsible for completing the **Study Questions** at the end of each laboratory exercise. This can be done in or out of class but must be finished before the next lab meeting. You may submit your questions via email to your TA or via the course website (e.g., Canvas).

3. The laboratory manuals will be turned in at the end of the semester for grading. This will entail checking the that the data that was collected over the course of the semester and that all Study Questions have been submitted (via email or course website).

**Laboratory Safety:**

*You must complete the Occupational Health and Safety PLSC Right to Know Training available on-line.* Please complete the online exam, print out the certification, sign, and return the form to the Instructor or TA by the second lab meeting. You may also email your certificate to your TA. See **https://delaware.bioraft.com/**. The training you must complete is titled “Basic Right-To-Know Safety for Undergraduates in Lab Class Sections” on the BioRaft website. You must complete the exam even if
you have done so for another class already. If you have difficulty accessing the online training, please notify the instructor or TA as soon as possible, and the appropriate steps will be made in order to complete your certification.

The Introduction to Soil Science Laboratory uses a range of substances throughout the semester. It is very important that you follow safe work practices in each laboratory. Material Safety Data Sheets (MSDS) are available upon request. This information is stored in a binder which can be found close to the laboratory door. Be aware of the location of the eye wash station, the shower, the first aid kit, the sharp box for any material that is sharp in nature (i.e. broken plastic or glass), the red emergency phone in the hall way, the fire extinguisher in the hall way, and the UD Occupational Health and Safety booklets in each of your laboratory drawers. Also, please adhere to the following laboratory rules:

1. No shorts, skirts, or open toed shoes in the laboratory.
2. Please dress appropriately for field trips (sneakers or hiking shoes, etc.)
3. Lab coats are suggested, but not required.
4. You must wear eye protection at all times when performing the laboratory exercises.
5. Always neatly label any equipment or laboratory supplies that contain substances.
6. Use the provided ethanol to wash the permanent marker labels from your test tubes and flasks.
7. Do not flush soil, or substances, down the drain. Appropriate containers will be provided.
8. No food or drink in the lab. You may leave food or drink outside in the hall.
9. Do not taste, lick, huff, snort, or waft any of the substances used in this laboratory!!!

**Group Laboratory Reports and PowerPoint Presentations:**

One laboratory report, per group, is required for this class (see next page). One PowerPoint presentation, per group, is required on your group report (see next page). To successfully prepare the report you must record your data from each laboratory procedure, and field trip, in your laboratory manual during each exercise. Do not write notes, numbers, calculations, etc. on scrap pieces of paper. Keep all of your data and observations in your lab manual. This will greatly facilitate the writing of your laboratory report which requires you to organize, summarize, and interpret the results of a series of laboratory experiments. You may electronically submit rough drafts of the report and presentation to the TA for review. The TA will use the track changes function of Word which will help you make corrections more easily. Help us help you. 😊
In conclusion, you are responsible for a quiz at the beginning of lab each week (except as noted), a group final report at the end of semester, as well as a group PowerPoint presentation of the report, completion of the Study Questions at the end of each laboratory, and submission of your properly completed laboratory notebook at the end of the semester. The above assignments are designed to assist your experience and knowledge for future endeavors in your careers in plant and soil sciences, as well as reducing the pain and suffering required for the accurate completion of the final laboratory report. All tasks are career oriented and will materialize again in the future!!

**Final Report and PowerPoint Presentation:**

When developing management (nutrient, building, etc.) recommendations for any land use it is important to carefully and thoroughly characterize the properties of the soils at the site. This process will provide information on the current status of the soil, relative to the characteristics needed for the intended use of the soil, and will serve as a guide for any corrective measures that must be taken prior to initiating the activities planned for the site. Standardized methods to characterize soils for most important chemical, physical, and biological properties have been developed and published by the Soil Science Society of America and other national organizations. Management recommendations based on the results of soil analyses are more commonly developed at state or regional levels and reflect differences not only in soil type, but in other parameters important to soil management such as climate, topography, hydrology, and types of plant communities present.

The objective of your laboratory report is to prepare a soil management recommendation for the intended use of the soil you worked with throughout the semester, based on your soil analyses and any other information that is available (e.g. soil survey manuals, crop/plant management information found in the Delaware Nutrient Management Handbook, textbooks, journal articles). You should include all of the data that you have obtained over the course of the semester, i.e. Your Soil’s Required Laboratory Data Sheet, which can be found on pages 3-7. The report should be concise and to the point - no less than 3 pages of text (double spaced, Times New Roman, 12pt font) accompanied by tables and/or figures properly illustrating your collected data and any tables, figures, or graphs that contain data you feel justify the recommendation you are making (tables and figures do NOT contribute to the minimum page count). For a passing grade on the report, it is essential that you follow all of the provided directions and that you fully justify and discuss your results from each laboratory experiment. You must make the correct connections and explain them in detail. The report must be typed using the following format:
1. A **cover page**, with an appropriate title, your names, date, course title, and course section number.

2. A clear and concise **introduction** that describes the purpose of the report. Where did you collect the soil and why did you choose this site? What is the current use of the soil? What would you like to use this soil for? Will the soil be used for personal or commercial farming? How large of an area will your soil encompass? Feel free to be very creative in this section. If you do not have a specific purpose for the soil you collected— you will not be establishing an actual garden or crop— create a story or situation in which you might one day grow the crop of your choice.

3. A neatly prepared **data summary**. This should be in tabular and graphical form. Any data that you feel are not necessary for your recommendation should be placed in tables in the Appendix of the report. You must include all your data somewhere in your report; discuss all chemical and physical characteristics of your soil, which can be found on pages 5-8. Footnote any pertinent information regarding the methods used to obtain the data. **All graphs or charts must be prepared using a computer graphing program.** Hand-drawn graphs and tables will not be accepted.

4. A detailed **discussion section**. This section should clearly discuss any soil and crop properties that were particularly important to you in developing your soil management recommendation. You should discuss the essential techniques important to the proper management of your crop. Include a discussion of how the properties of your soil impact management of the crop and what must/should be done to the soil to enhance its productivity for the intended crop. Any potential environmental considerations should also be covered. This section should be written in detail. Use all of your soil knowledge to show that you understand the linkages between soil properties, plant productivity, and environmental quality. This section will be heavily graded. It is important that you demonstrate the soil knowledge that you have gained over the semester and that you thoroughly understand the subject matter.

5. A **conclusion** section. This should briefly but clearly summarize the steps you think should be taken with respect to soil management (e.g., add organic material, add fertilizer, control soil erosion, etc.) for your intended crop.

6. An **appendix**. The appendix is for any data or information that you obtained over the course of the semester that you did not use in your report or recommendation.

Upon completion of your report, please prepare a 10-minute PowerPoint Presentation summarizing the main points of your written report. This is to encourage discussion with and a broader perspective for your classmates. Include the information outlined above, fully explaining your results and your suggested nutrient management recommendation. This should entail no less than 6 slides; discuss all the chemical and physical properties listed on pages 5-8. PowerPoint can be entertaining; have fun with it!!! The point of this lesson is to share your findings with the class and to demonstrate the knowledge that you have accumulated throughout the semester.
**Overall Laboratory Grade:**

There will be eight quizzes (with lowest score dropped), a required lab notebook, and a final presentation/paper. Attendance will affect your grade!

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Quizzes (7 @ ~7.1%)</td>
<td>50%</td>
</tr>
<tr>
<td>Lab Notebook: Study Questions and Exercises</td>
<td>30% (15% each)</td>
</tr>
<tr>
<td>Presentation and Report</td>
<td>20% (10% each)</td>
</tr>
<tr>
<td>*Attendance</td>
<td>-5% for each unexcused absence</td>
</tr>
</tbody>
</table>
Laboratory #1: Syllabus and Orientation (no quiz)
Laboratory #2: The Soils Around Us (no quiz)
Laboratory #3: Soil Formation and Classification (quiz)
Laboratory #4: Physical Properties of Soils, Part 1 (quiz)
Laboratory #5: Physical Properties of Soils, Part 2 (Field Component) (quiz)
Laboratory #6: Soil Water (quiz)
Laboratory #7: Soil Descriptions (Field Trip) (no quiz)
Laboratory #8: Soil Colloids (quiz)
Laboratory #9: Soil Chemical Properties (quiz)
Laboratory #10: Soil Survey Reports and Crop Management (quiz)
Laboratory #11: Soil Organisms (quiz)
Laboratory #12: Careers, Nutrient Management (no quiz)
Laboratory #13: Presentations, Turn in Notebooks (no quiz)