BIOL 1511L: Honors Biological Principles Laboratory Fall 2014
Laboratory Syllabus

Biology 1511 labs are held in room CULC 475. **Labs begin the first week of classes (August 18, 2014).**

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BIOL 1511 Laboratory Policies

Note: This syllabus is subject to change.

1. **Lab structure & learning objectives.**

The scientific method, as a way of acquiring knowledge has been one of the most significant factors in the improvement of the humans' quality of life. Biological research has given us major advancements in health and understanding of our environment. In this course you will learn and practice the scientific method by doing original biological research. This course is designed as a research service-learning lab, which means you will be immersed in a research experience from day one. Service-learning is a way of integrating relevant community service with academic coursework in order to enhance learning, teach civic responsibility, and strengthen communities. The lab class is partnering with the Atlanta Botanical Gardens to conduct research that will benefit our learning in biology and the greater Atlanta community. You will work in teams with the support of the entire class to brainstorm and critique ideas to design a semester-long research project to explore a question related to invasive species within Mason Mill Park. The Atlanta Botanical Gardens will use our data for long-term ecological monitoring and other initiatives. You will participate in all steps of the scientific process performing research on invasive plant species and their effects with our service learning partner, the Atlanta Botanical Gardens. You will do background research, learning to read and evaluate primary literature to identify areas of potential research. You will design an original hypothesis and a series of experiments to test the hypothesis. You will learn scientific techniques as well as basic statistical analysis of data. You will communicate your findings in both written and spoken presentations. Please bear in mind that the 1511L schedule may change as the semester progresses to accommodate for your projects. After participating in Biology 1511 Lab, we expect that you students will be able to do the following:

A. Interpret and summarize primary biological literature.

B. Work with a Community Partner to create testable scientific hypotheses regarding real world scientific issues.

C. Work in groups to design experiments and gather data to test their hypothesis.

D. Apply qualitative and quantitative methods including basic statistics and visualizations to their data to evaluate their hypotheses.

E. Communicate their research findings in both written and short presentation formats.

F. Acquire basic biological laboratory and ecological sampling techniques.

2. **Lab materials.** There is no lab manual for this course. You will need a spiral bound carbonless lab notebook and a 100% cotton lab coat.

3. **Safety.** Safety policies are mandated by federal, state, and institutional rules to keep everyone safe. During lab (in the lab & in the field) it is important to be aware of your surroundings. Depending on the types of protocols involved in your project, you may be required to wear gloves and/or your safety goggles (both provided), and we'll inform you of potential hazards as needed. **Report all injuries or accidents immediately**. The following are non-negotiable policies:
   - You must wear shoes that cover your feet entirely (i.e., no flip flops, ballet slippers, or sandals).
   - No food or drinks, including water bottles, in the lab. You may bring water and a snack for the field.
   - No cell phone use, including texting (phones must be silenced and off the lab bench).
   - Clean up your lab station at the end of lab.
   - During wet labs, required attire includes: long pants to the ankle, lab coat & goggles and hair tied back.
   - Properly dispose of trash, glassware, and biohazard waste.

4. **Absences & Tardiness.** It is essential that you attend lab and are on time; your group is counting on you. There are no make-up labs for unexcused absences as this is a project-based lab. An unexcused lab will cost you 5% reduction of your grade and your participation points for that lab. There is no penalty for an excused absence. In the event that you miss a lab, or know in advance that you will need to be excused from a lab, contact Dr. Bardill and your group members since they are counting on your contributions. Documented excused absences may include: an illness of your own or within your family (physician's note required), schedule conflict with an obligation to an official organization (letter from Dean of Students or head of organization is required), car accident (copy of police report required), etc. [FYI: Full-time students can be exempt from/rescheduled for jury duty with proof of full-time enrollment.] **Note**: **if you miss a lab you are still responsible for completing assignments and getting data from your group members.**

5. **Plagiarism will not be tolerated**. On the first day of class, we will discuss what plagiarism is, particularly in the context of group work. Most of the work you do in lab will be with your group. Though your project is designed as a group, your notes in your notebook must be in your own words, not copied from a group member's notes. However, you'll be turning in several written assignments and presentations that will be created as a group. Since your name is on this work, you're responsible for being completely certain that the *entire work* meets the standards of the honor code. Anything written that is not an original idea of yours must be referenced. Direct copying from other students' work will result in a grade of "0" for that assignment. Your conduct is expected to conform to the Georgia Tech Honor Code (http://www.honor.gatech.edu). Please familiarize yourself with its expectations and responsibilities.

6. **Grades.** Your lab grade is comprised of the components described below:

   - Group project components are worth 40% of your lab grade:
     - Annotated bibliographies (two, each worth 5%) are worth 10%.
     - Collecting, analyzing, and annotating your group's samples (data file) is worth 5%
     - Written proposal is worth 15%.
     - Final presentation is worth 10%

   - Class participation components are worth 60% of your lab grade:
     - Group evaluations (two, each worth 2.5%) are worth 5%.
     - Reflection statements (two, each worth 5%) are worth 10%.
     - Lab notebook (two unannounced checks, each worth 5%) is worth 10%.
     - Lab Report drafts (4, each worth 1.25% graded only on completeness) are worth 5%
     - Final Lab Reports are worth 25%
     - Lab participation is worth 5%. Tardiness to lab without excuse will result in a deduction of 1% for each 10 minutes. Tardiness to labs requiring site visits may cause unexcused absences, as we will

not hold the van more than 10 minutes and you will then be responsible for your own travel to the site.

7. **Class discussions about journal articles and experimental design.**

Reading, understanding, discussing and critiquing research papers and thinking through experimental design is crucial to doing science. Since we're working together to learn about new ideas together, I expect that you will contribute to our class discussions about experimental design and journal articles. This means sharing at least one specific question or comment to each discussion.

Advice from former 1511 and 1521 students to aid in your success:

Literature searches:

- Don't underestimate the value of the annotated bibliographies. Although they may seem like a waste of time, the ability to understand and utilize others' writing is so useful in research.
- Do tons of research on your topic. Don't be afraid to investigate something different.
- Be creative and read many research papers for ideas on project topics.
- Find as much literature on your topic as you can. It will save you a lot of time in the end.
- Endnote is your BFF.

Organization and group work:

- Pick group members who have similar interests in research topics. Don't just work with people you like.
- More than anything else, develop a good relationship with your groupmates. It will help you to communicate more effectively with them and also to get work done better. Also, it will be a more enjoyable experience because you will be spending a lot of time in lab with them and outside too.
- Keep communication open and honest with group members. Be sure to plan meetings ahead of schedule and clearly distribute work.
- Make sure you and your group fully think through your procedure step by step to make sure you know what you're doing.
- Create a regular timeline listing goals and coursework over time, and update them if plans change. It can get overwhelming when you realize you have a lot due the next week and not much time to do it.
- Write your methods section as you go, and then revise it at the end.

General advice:

- Don't be frustrated when you aren't given instructions. Be confident in trying things and be ready to problem solve to fix mistakes.
- Understand that all the hard work you will put in will teach you about science and it all has a point.

Most of all…Have fun & have a terrific semester!

Tentative Lab Schedule (subject to change)

Date	Week	Activity	Assignments due*
8/18	**1**	*At lab*: in-class reflection about prior experiences doing science; overview of class and project; syllabus discussion; how to keep a lab notebook; plagiarism activity; how to read journal articles first papers assigned: form groups; accessing primary literature and Endnote workshop, discuss sampling procedures	*Bring laptop*
8/25	**2**	*At site*: discuss journal articles	Reflection statement #1
9/1	**3**	*No Lab Labor Day*	Proposals Due
9/8	**4**	*At lab*: Discuss proposals, make changes as necessary; research sampling procedure, genomic DNA isolation	*Bring laptop* Annotated bibliography 1
9/15	**5**	*At site*: sampling	
9/22	**6**	*In lab isolation*	Group Evaluation 1
9/29	**7**	*In lab genomic DNA* Pass out 2nd annotated bibliography papers	Intro Draft Due
10/6	**8**	*In lab intro to PCR*	2nd Annotated Bibliography
10/13	**9**	*No lab Fall Break*	
10/20	**10**	In *Lab*	Methods Draft Due
10/27	**11**	*In Lab*	Group Evaluation 2
11/4	**12**	In *Lab*	Results/Discussion Due
11/11	**13**	In Lab Presentation practice	Presentation Drafts/data file
11/18	**14**	*Presentation at service learning partner*	Reflection Statement 2
11/25	**15**	Work on final report	Abstract draft Due
12/1	**16**	*No Lab Last Week of classes*	Final Lab Report Due Wed 12/3 at noon

Please bear in mind that the 1521L schedule may change as the semester progresses to accommodate specific project needs.
*Unless otherwise specified, all assignments are due at 8:00am the Monday before lab, through T-square. This due date/time applies to both lab sections. You will get only up to 50% credit for a late assignment (turned in within 2 days).

Annotated Bibliography

As you develop and execute your research project, your group will collaboratively create two annotated bibliographies (each worth **5%**). Essentially, creating an annotated bibliography accomplishes two objectives: (1) writing a summary of the paper helps you to understand what you read and (2) your summaries will be useful for the rest of the class, as we identify which references are most useful to cite in our paper and where our project fits in the grander scheme of research.

How do you go about writing an annotation? First, read the abstract and then the methods, to determine if the study has a relevant research design and methodologies that will inform our experimental design. An annotation is generally 5-8 sentences per reference. This includes a paragraph summary in your own words of the purpose of the study, methods, and then, an explanation of how you will use this reference, i.e., from reading the annotation, another classmate should be able to determine why this study is of interest for our project, and glean an understanding of the methods and major findings in the paper. We will practice writing an annotation for a reference in class so that you will have an example.

For each annotated bibliography you will review 4 articles. 3 articles will be given to you by your instructor and your group will choose one article to review. Your annotated bibliography will be completed as a group and is worth 20 points, which will be graded according to whether the following criteria are included:

- (4 pt) 1pt each for including 44 peer-reviewed journal article references
- (4 pt) Formatted according to Bioscience style (the journal) (Since you can format your bibliography automatically in Endnote, you either get full credit or no credit.)
- (12 pt) Each reference should be annotated. You can expect to receive full credit if every reference is well-annotated; 8pt if >4 refs are well-annotated; 5pt if <2 are well-annotated.

Written Proposal

As a group, you will present your proposed project, within the confines set out by the instructors in a one page written proposal. This will allow you to receive constructive criticism about your hypothesis and allow us to develop the proper methods for your experiment. In your report, you will outline our research questions and hypotheses, explain the relevant background information that informs our project and discuss the biological significance of our goals. In total, this assignment is worth 25 pts and is **15%** of your grade. Each group will be responsible for preparing a one page paper on the following.

- Relevant background from literature review
  - 5 pt: Research questions & hypotheses (your hypothesis must be explicitly stated, do not state the null hypothesis).
  - 5 pt: Explaining background and findings from 4-5 sources (1 pt for citing).
  - 5 pt: Connecting this information to our study of invasive species in general (explaining how it informs our study, what we might expect).

- Formatting
  - 1 pt Times New Roman 12 point font
  - 1 pt length
  - 3 pts Well written, no grammatical mistakes.

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Reflection Statements

Reflecting on your experiences throughout the semester ties your experience in this research service-learning project to academic learning. Reflection involves observation, asking questions, and putting facts, ideas, and experiences together to derive new meaning and new knowledge. You will write 2 reflection statements. Reflection statements should be thoughtfully composed and written individually. They should be typed, 1-3 pages in length (long enough for thoughtful responses) and are due at the start of a given lab section. Reflection is an integral part of this course, and we will have follow-up discussions based on what we've all written (myself & the TAs included). I will compile parts of your reflections (only the "doing science" and "service learning" parts, not the "group work" part) (with names removed) for these discussions and to share with the class. If you do not wish to share some part of your reflection, please indicate this on your statement—that is fine.

Reflection statement 1 should include your responses to the following prompts:

- *Doing science:* Why are you taking this course? What does doing science mean to you? What is your past experience with biology? What did you enjoy most? What did you find most challenging in biology (either in the past, this semester thus far, or both)? What do you hope to learn as a result of participating in this lab?
- *Service learning:* What does this phrase bring to mind for you? Have you participated in service learning before? How do you view service in your life, i.e., (how) is it relevant or important to you? What do you think service learning will mean in the context of this course for you?
- *Group work:* Describe your experience working in groups in the past. What have you enjoyed and why? What problems did you encounter, and why? What challenges do you anticipate?

Reflection statement 2 should include your responses to the following prompts:

- *Life experience:* What have you learned in lab that you're using (or plan to use) in another class or in life?
- *Doing science*: What have you most enjoyed about doing science? What was most challenging? What advice would you share to help future 1511 students undertake this process?
- *Group Work:* Consider your experience this semester: what were the high and low points of working with your group? Reflect on the challenges associated with collaborative projects and formulate potential recommendations for future improvements (i.e. if you were to undertake a similarly structured project in the future and to share with future 1511 classes).

Each statement is worth 30 points (10 points possible/each component) (doing science, service learning, and group work).

Great answer (10 pt)=all questions were answered with thoughtful statements that demonstrate deep consideration of the ideas; logical flow of ideas in all paragraphs; correct grammar/spelling throughout.
Fair answer (7 pt)=all questions were answered but responses show only cursory consideration of the idea; some but not all paragraphs have logical flow of ideas; correct grammar/spelling in many but not all places.
Poor answer (4 pt)= not all questions were answered; responses show little to no consideration of the idea; lack of logical flow of ideas in many places; frequent grammar/spelling mistakes.

Lab Paper

Criteria ***Scientific approach***	**Specific objectives**	**Level of achievement**		
		Excellent (2)	Needs work (1)	Absent (0)
(1) *Abstract:* The abstract helps the reader to understand the larger document by acting as a summary or "pre-reading" of the key points. Abstract is concise yet complete: a 100-150 word paragraph summary. 1-2 well-developed sentences articulate each objective listed.	(a) Purpose or motivation for experiment is linked to concepts and "big picture," in light of Piedmont Park & the greater Atlanta region. (b) Particular question and hypothesis addressed in experiment are stated. (c) Experimental approach taken to address the question is described. (d) Major findings and interpretations are described. (e) Judgment about the hypothesis is linked to findings. (f) Conclusions are stated: why this matters and significant implications, again in relation to Piedmont Park and the larger community.			
(2) *Introduction:* What question is your experiment designed to address? What do you expect to find and what evidence would be needed to support this claim? How are these hypotheses grounded in scientific concepts? What is the relevant background information and previous research that sets up your question?	(a) The question or objective is well-defined. (b) Alternate hypothesis(es) is stated. Null hypothesis is not stated. (c) Reasoning for hypothesis(es), based on scientific concepts and logic, is explained. (d) Evidence needed to support/reject hypotheses is described. (e) Relevant background and previous research findings are cited			
(3) *Methods:* How will you address your question? What data will you collect and how? How will you analyze and interpret this data?	(a) Pertinent details are described (e.g., controls) (b) Specific data collection is described in enough detail so the experiment could be replicated. (c) Analysis and interpretation procedures are described in enough detail so the experiment could be replicated.			
(4) *Results:* What did you find?	(a) Begins with 1-2 sentences describing the overall findings of the lab. (b) Findings from the data analysis are reported only, without making explanations or conclusions about the data.			
(5) *Discussion:* What do your findings mean? Interpret your results with regard to your hypothesis.	(a) Begins with a statement relating the overall results to the hypothesis. (b) Specific data is used as evidence to decide whether the hypothesis is supported, in conjunction with the appropriate scientific concepts. (c) Findings are compared to other published research and differences between study findings are discussed. (d) Other issues are addressed as appropriate, e.g., problems that occurred; sources of uncertainty in the lab procedure or findings; improvements or extensions of the experiment.			
Presentation (6) *Writing:* Grammar; spelling; clarity and conciseness of sentences; flow of ideas; use of technical terminology.	(a) There are no grammatical or spelling errors and italics are used as needed. (b) Sentences are clear and to the point. (c) Flow of ideas is cohesive and logical. (d) Use of technical terminology is appropriate. (e) Writing is understandable to non-scientist professionals.			
(7) *Figures & tables:* Graphs; drawings, diagrams, tables.	(a) Correct format is used (titles, captions, graph components) and visuals are well-suited to the data. (b) Visuals are discussed and clearly referred to in text and arranged in an order that effectively conveys the data's "story."			
(8) *Formatting*	(a) Word document: 12 pt Times New Roman, 1 inch margins, single-spaced with a space between paragraphs (b) Title of paper is relevant and interesting; conveys findings (c) 10 peer-reviewed references are included and formatted according to *Ecology*.			

Grade= (Scientific approach points *x* 2) + (Presentation points)= 100 points possible to earn for final lab paper
Your raw datafiles must be clearly labeled spreadsheets, compatible with Excel and included in your final report (electronic version) or you will lose 10 points automatically.

Presentation Rubric

Presentation Element	Accomplished	Average	Developing	Score
Introduction	• Effectively conveys background and reason for experiment. • Reason is connected to a clearly stated hypothesis. Null Hypothesis is not stated.	• Missing small points of background. • Reasoning does not clearly link to hypothesis. Null hypothesis is not stated.	• Missing large points of background information or is not conveyed • Reasoning in not linked to hypothesis at all. Null hypothesis stated	
Methods	• Methods are explained in enough detail that experiment could be replicated. • Statistical test used is described and appropriate for the experiment.	• Methods are lacking small details that impede replication. • Statistical test used is described and appropriate for the experiment.	• Methods are lacking large details making replication impossible. • Statistical test used is either not described or not appropriate for the experiment.	
Results	• Overall findings are related in relevant detail (including *p*-value from stats test). • Figures are included and can be interpreted on sight without help of presenter but figures are also adequately explained.	• Overall findings are related but lacking detail (lacking *p*-value from stats test). • Figures are included and adequately explained but require explanation from presenters.	• Overall findings are not related. • Figures are not included, adequately explained or are not appropriate for gathered data.	
Discussion	• Findings are interpreted and analyzed. Data are used to determine if hypothesis is supported. • Other issues are addressed as appropriate, including problems with the experiment and sources of error in the experiment. • Future research questions based on findings are proposed.	• Findings are interpreted and analyzed data is incorrectly used to determine if hypothesis is supported. • Sources of error or problems are unrealistic. • Future research questions are proposed but not based on findings of lab.	• Findings are interpreted and analyzed data is not used to determine if hypothesis is supported. • Other issues such as problems with the experiment and sources of error in the experiment are not addressed.. • Future research questions based on findings are not proposed.	
Style	• Slides are clear, concise and visually appealing. • All presenters speak using slides as a prompt, rather than reading. • Time is appropriate	• Slides are slightly unclear. • All presenters speak and spend considerable time reading from slides • Presentation is slightly over or under time (1 minute)	• Slides are muddled and difficult to understand • Not all presenters speak • Presentation is over or under time (>1 minute)	

- Accomplished =3 pts
- Average = 2pts
- Developing = 1pt
- All points doubled except style.

Group Evaluations

Your name: _____

Please fill in the chart to rate each of your group members, using the following scale:

Always (3) Often (2) Sometimes (1) Never (0)

Your evaluation score is 5 points for completing your peers' evaluations + the average score your group members award you. A total of 20 points may be earned.

Please rate the following items.	**Group member:**	**Group member:**	**Group member:**
Contribution: He/she actively, equally, and productively contributed to all group efforts, including group discussions, work, written assignments, and presentations, both within and outside of lab?			
Creativity: He/she exhibited creativity when designing experiments and solving problems.			
Logical thinking: He/she showed logical thinking during the design of the experiment and in solving problems.			
Group dynamics: He/she demonstrated aspects of teamwork (e.g., listening, sharing knowledge, asking useful questions, working together, encouraging others, flexibility) that helped the group succeed, and contributed to resolving issues arising between group members.			
Feedback: He/she used constructive criticism positively to further improve the quality of group products.			

For each group member, in at least 1 sentence but no more than 3 sentences, please address the following questions:

1. What is the single most valuable contribution this person makes to your group?

2. What is the single most important thing this person could do to more effectively help your group?

Lab Notebook Guidelines

Scientists keep lab notebooks so that they have a record of thoughts and ideas related to their research. Lab notebooks are a record of observations, methods, protocols, results, conclusions, and plans for future work. As a working scientist, looking through your lab notebook can help you to figure out what's worked and what hasn't when you are troubleshooting a protocol. It is more reliable your memory when you're trying to describe something that you found to a collaborator. Lab notebooks usually become the property of the lab when you leave, so that if someone else continues to work on the project or a related project, there is a written record. Since you will be designing and carrying out a research project with your group, you will keep a lab notebook. There is no one right way to keep a lab notebook, but there are general guidelines that you can adapt so that the notebook is useful for your purposes. There will be two unannounced lab notebook checks during the semester, each worth 10pt (5% each check, 10% total). Points will be allocated in the following way: 2pt legibility; 2pt organization; 3pt sufficient content; 3pt up to date (to the prior lab class).

1. **Keep it up to date:** Keeping your notebook up to date also ensures you have a record of what's going on with your research at each step, rather than trying to remember what you did at the end of the semester. It's very likely you will not remember!

2. **What should be included:** The more detailed your lab notebook the easier it will be to write your proposal and final report. Including the following may be helpful, but you may find that some items are not applicable for each lab. Your lab notebook should help you to keep track of what you have done and the progress you have made toward answering your questions.

   Title/ date/ name

   Observations and background information: Be clear and concise. You may need to refer to your observations in order to design the appropriate experiment(s). What are your questions? What are you basing these questions on? This section will become part of your background information in your lab report.

   Questions and goals: What are the main questions you are investigating in your experiment? What is your focus for lab that day? There can be more than one. Be clear about which question(s) you choose to answer and explore. These questions will directly drive your hypotheses and therefore your experimental design.

   Hypotheses: Your hypotheses are based on your original observations. What are your null and alternative hypotheses? Clearly state the objectives of your proposed study. Outline your *a priori* expected outcomes.

   Experimental Design: Include variables, what exactly did you measure, and how did you measure it? How does measuring this allow you to address your hypotheses? How many replicates did you do? Where might error creep into your design? Did you change any methodologies during your experiments? Why? Be detailed so that others can replicate or repeat your experiments. This should be a good resource for you to refer from week to week. Do you need to re-evaluate your research plans or methods?

   Results & Data Analysis: This will include your raw data and data collection notes as well as statistical analyses and logical, informative graphs. This may also include diagrams and drawings (especially important when identifying organisms). When using statistics, explain what those statistics are, why you're using them, and what they are telling you.

   Plans for the following week: your to-do list.