Course Syllabus: B. Smith Lab
Research: BIOL-21000, 30200, 40000, 40100, 40200

Goals of Student Research

X to study a scientific problem that does not have a known outcome, to be able to plan the next logical step.

X to gain first-hand understanding of lab and/or field procedures.

X to learn how to integrate different types of knowledge into your research, including course material and library research.

X to learn how to present your results clearly to others, through a written paper, and oral presentation (Biol-30200 and Honors only).

Expectations

1. Research is a course

This is a course. Treat it as seriously as you would any other course; the faculty will. While there are no exams that might normally motivate you in other courses, you are evaluated on your performance, and you will receive a grade at the end of the semester.

Think of it this way: if you are a student who is good at budgeting time, and likes to keep up with your studies and assignments, then you should budget time for research, too. If, however, you are a procrastinator who pulls all-nighters before exams and paper deadlines, then you would have to pull three or four all-nighters for research, too. Unfortunately, you can't. Lab work takes time, and you can't cram it in at the last minute. So you must build time for research into your schedule.

2. Understand the project

The goal of any scientific project is to answer a question or test a hypothesis, however small that question may appear. You should have a thorough understanding of the question or hypothesis, and understand how your experiments will address it. While not all projects result in publishable findings, projects are typically planned so that there is this potential. Clearly, research should not be a repeat of someone else's published work, although it may build on methods and results of others.

3. How Much Time?

Students should expect to spend at least 3 hours per week on research for each credit hour enrolled, so for 3 credit hours of research, you should expect to spend 10-12 hours per week. Though this will be mainly lab time, it will also include meetings with your research advisor, library research, and reading articles. Because of the unusual demands of research (odd hours, procedures performed over several days) it is difficult to apply a time-clock approach to research. The time that you can devote to research may vary from week to week. So, while there are weeks in which you may not be able to spend 10 hours on research, there should also be weeks in which you spend more time on research.

Overall, you will be evaluated both on whether you spent a reasonable time in the lab, *and* how well that time was spent (that is, whether you were actively performing experiments, interpreting results, researching procedures, etc.).

4. Intellectual involvement

Reading. Research involves not only collecting data, but also being able to place those data in context, and being able to relate your findings to those of others. This means that you should have the background necessary to understand how your results fit into the larger body of biological knowledge.

This knowledge can come from a number of sources (for example, courses and discussions with your adviser), but to be a researcher you must be able to find, read and understand primary research articles in your field. In research, your supervisor will guide you, but you are expected to take an active role; do ***not*** expect to do only what you are told. I typically give copies of relevant articles or chapters in books, to get you started, but you need to search out information on your own. While it may be very difficult to find more papers on the specific organism (e.g., water mites) in the context of your research project, you can find additional papers on the ***phenomenon*** you are studying – think of the big picture. Also, this library research and reading should be evident in your written report (i.e., review the literature in your introduction, and make connections between your results and other studies in your discussion section).

Thinking. So: you've read the background materials, designed the experiments, and, after much arduous work, you have results in your hand. Now what? One of the greatest challenges in performing research is to interpret experiments. what do the results mean? Are they what you expected? If not, are you sure the procedures worked as you expected? (Were the proper controls performed?) You will be expected to take an active role in interpreting the results, and in designing the next experiment(s). Your adviser will, of course, help you in this, but think about your results first. What do you think they mean? What other explanations might there be? What experiment might you perform to confirm or extend the results?

5. The Paper

You will write a scientific paper, to be turned in at the end of the semester. The paper must have an Abstract, Introduction, Methods, Results (including applicable figures and/or tables, with appropriate captions), Discussion, and Literature Cited. This format should be familiar from Literature in Biology, and from your own reading of research papers – the book used in Literature in Biology is an excellent resource, plan to use it when writing your paper. As with all papers, your first draft will not be sufficient: you will have to write, edit and edit again (and, you *must* turn in a draft before you get to the final version). Please be aware of plagiarism: if you take a sentence from someone else's work and only change one or a couple of words, it is still plagiarism even if you cite the source. ***Each*** idea has to be referenced (and in the sentence where the idea appears), you ***cannot*** simply cite the reference once at the end of a paragraph containing many ideas from the same source. In such cases, you can avoid referencing each idea yet still indicate your source through careful writing,

e.g.:
"Roberts and Janovy (1985) were the first to study this phenomenon. They found that ..., further, when the ... . Roberts and Janovy go on to state that ... and their conclusion was... ."

Or,
"Roberts and Janovy (1985) were the first to study this phenomenon. In the following paragraph, I will review their work. ....."

6. The Talk (Junior Research, 2nd semester Honors only)

The talk should be less formal than the paper. The talk will cover the same areas as the paper, but because you need to present more background to an audience of non-specialists, expect to spend more time on the Introduction, and less on Methods. You will also need to spend some time thinking about how to (visually) present ideas to the audience – figures are more useful than tables in a talk, but the reverse may be true in a written paper. We have a digital camera available and there is a scanner in the BioCenter, you can easily incorporate lots of graphics into your talk. Pictures are especially valuable when trying to explain experimental setups, and introducing the organisms.

Keep to bulleted points in your powerpoint: if people have to read a lot of words, they stop listening to you or tune-out. Just as you need to edit a paper, so will you have to practice your talk; assume that you'll need several practice runs before the talk is ready to deliver. Reading a talk is unacceptable, and use of cue-cards is very unprofessional. Use the powerpoint as your notes, to jog your memory: if you have practiced your talk adequately, you should remember the details after being cued by the powerpoint.

7. Meetings

There are several purposes behind weekly meetings:

- ensuring regular communication with me
- ensuring that we promptly identify and solve any problems before they become serious
- practising oral presentation of your research
- ensuring steady progress on your research thus minimizing the "crunch" at the end of semester

Don't hesitate to discuss your problems or to ask questions: these meetings ***must*** be open forums, I would never penalize anyone for bringing up difficulties or for posing questions (even if you think you should know the answer).

8. Deadlines

I can forgive ***one*** missed deadline per semester (except those labelled on the schedule as "essential", "critical" or "absolute" - these cannot be missed), but beyond that it will hurt your final grade (unless we discuss it and I agree to extend the deadline). Deadlines near the end of the semester are critical in that I need to budget my time for teaching, etc., so missing a due date may mean that you forfeit advice/suggestions/comments from me, which will hurt your grade even more.

9. Assessment

The Biology Department has identified seven Student Learning Objectives to be mastered by students in our majors. This course focuses on learning to:

- critically analyze biological information, including analysis of the effectiveness of methods, the meaning of observational and experimental data, and the appropriateness of conclusions.
- carry out scientific investigations to answer questions about the natural world.
- effectively communicate scientific works in both oral and written form.

a) Learning Outcomes

1. Understand the question. Understand what has been done in the area, what the major ideas guiding our research are, what we are trying to achieve.

2. Learn techniques applicable to the field. This includes specific techniques that you will use and general lab or field practices. In addition to learning to perform them, you should learn how they work and why they are useful.

3. Learn to interpret data.

4. Learn to work through problems. In particular, be able to analyze unexpected results or bad data and identify and address the cause if possible.

5. Learn to plan research based on previous data. In other words, be able to think about what the next logical step may be.

6. Learn to present results clearly, in both written and oral formats

b) Lab/field Performance

About 50% of your grade. If you put in enough time to do the work, do it conscientiously, and show sufficient evidence of meeting the four goals identified above, you will get a good grade. You will get occasional feedback on your progress towards meeting the goals. This feedback will be in the form of the sheet appended to the syllabus.

- was your work well-documented (i.e., notes and data were organized and complete)?
- were your organisms kept properly?
- was your work area kept reasonably clean and uncluttered?
- did you clean your glass/plastic ware during the semester?
- did you put equipment, supplies, and organisms away at the end of the semester?
- were you spending a reasonable amount of time on your research?

c) Paper and Talk (for Junior & Honors Research)

represents the remaining 50% of your grade. Point-form outlines and rough drafts are included as part of this evaluation. These will be graded based on the goals outlined above – weaknesses in the talk due to nervousness, lack of style etc. will **not** affect your grade.

Written Paper

- how much *effort* went into your research in general, and this report in specific?
- did you search out and integrate related scientific literature?
    - were related papers integrated into a cohesive and comprehensive introduction?
    - did you establish connections between your results and relevant published works?
- did you demonstrate that you had a clear understanding of the topic?
- was the Methods section sufficient that someone else could replicate the study?
- were your tables and figures correctly presented, with appropriate captions?
- how well *organized* was your paper?
- was your paper *proofread* and free of grammatical and spelling errors?

Oral Presentation (Junior Research, second-semester Honors)

- how well done was your oral presentation?
    - was it clear, easily understood, and well organized?
    - had you put a reasonable amount of effort into it?

- The weekly meetings / assignments will impact your grade – they will not be graded individually, they will only be used to assess whether adequate progress was made in meeting the course goals.

    - did you make the deadlines?
    - were the assignments well-done, or rushed because of a deadline?
    - were you putting sufficient time and effort into research throughout the semester?

- Whether or not the experiments worked has **no** bearing on the grade. This is science and good ideas that are executed well often fail to give worthwhile results.

General grading guidelines:

To achieve an "A"

- The student was diligent in the laboratory.
- The student understood the topic well as demonstrated in talk and paper.
- By the end of the semester, the student was able to perform their research procedures reliably, work through problems, interpret their own results and propose hypotheses to account for the results.
- Any living organisms were properly cared for on a regular basis.
- The student presented their results clearly in the paper and talk.
- All necessary information regarding materials, methods and procedures were passed on for reference in future projects (should be adequately covered in the paper, but supplemental material, such as a lab book, may be needed).

Half a letter grade (A to A-, A- to B+, etc…) will be assessed for the following:

- The student's work was solid in most areas, but weak, in one or two of the following: understanding of the topic, ability to perform techniques reliably, ability to interpret results, ability to propose hypotheses to account for results, clarity of the lab notebook, clarity of the paper and talk. Weak performance in more than two of these areas will drop the letter grade another half.

A full letter grade (A to B, B to C, etc…) will be assessed for ***each*** *of the following:*

- The student did not put in enough time and did not finish a sufficient amount of the planned work.
- The student was significantly below acceptable standards in one of the following areas: understanding of the topic, ability to perform research methods reliably, ability to interpret results. In general, I expect a student would only be *significantly* below acceptable standards if they did not put in the effort. If you try hard to meet these goals, you will probably not fall into this category.
- Living organisms and/or equipment for which the student was responsible were not taken care of appropriately.
- The student presented the work poorly – they gave a confusing seminar, submitted a poorly written and confusing paper and/or submitted a markedly incomplete lab notebook. Since I will be available to help as much as possible (reviewing drafts, previewing seminars etc…), this is another area where satisfactory performance can be achieved with reasonable effort.

Academic honesty: Even if you get really odd or disappointing data, it is *essential* to report that as exactly as possible. I have seen one instance that I thought was scientific fraud (fabricating or falsifying data to look better or to replace work that wasn't done), and I hope I never see it again. Confirmed cases are an automatic F for the semester.

10. COURSE POLICIES

Attendance:

The Undergraduate Announcements state the general policy that students are expected to attend classes and that they are responsible for all material even when absent. Conspicuous unexplained absence may result in ***lower grade, or dismissal from class*****.** In the context of research, timing is more

flexible (see above: Expectations - 3. how much time?), but I do take note of total time spent on your research, and attendance of weekly lab meetings is expected.

Acceptable reasons for absence include 1) student illness, requiring the student to be bed-ridden; 2) death or serious illness in the immediate family; 3) appearance in court; 4) religious holidays. Note that you ***MUST*** have written documentation for your reason for absence (e.g., note from doctor, religious leader, etc.). Such notification ***does not guarantee*** my accepting your reason for absence, but failing to notify me guarantees that you will not be excused.

Accommodation for Students with Disabilities:

I will make reasonable accommodations for any students with disabilities. The student must inform me of their need for accommodation, and be registered with the Office of Academic Support Services for Students with Disabilities.

Plagiarism:

As stated above: if you take a sentence from someone else's work and only change one or a couple of words, it is still plagiarism even if you cite the source. You ***must*** rewrite the information or ideas in your own words. This is true regardless of whether it is a published scientific paper, a website, or an unpublished Junior Research paper. Plagiarism is a serious offense of academic misconduct: check the student handbook and the library website for details, but it can lead to judicial proceedings and even expulsion from the college. ***Each*** idea has to be referenced (and in the sentence where the idea appears), you ***cannot*** simply cite the reference once at the end of a paragraph containing many ideas from the same source. In this course, there is potential for plagiarism in the write-ups and the poster presentation.

11. Publication of Results

While the ultimate goal of any research is typically to have publishable results, it is a great challenge to achieve this within one semester. While lack of effort could be the cause, more often it is because of complications or problems beyond our control. Clearly, this is beyond what is expected in the course and doesn't enter into the grading, but a resultant publication is a personal achievement and a valuable addition to your resumé / curriculum vitae. Sometimes, work from several similar research projects can be combined to produce a publishable paper. Constraints on time and the process of submission, acceptance/rejection, and revisions can (and regularly does) take years – especially if several research projects are being incorporated into one paper. Consequently, you need to keep in touch after you leave the lab and Ithaca College! I will always give people due credit for their work, but to be an author on a paper, you need to see and approve the manuscript. Most journals now require you to sign a release that agree with the presentation and that the results are not published or submitted elsewhere. If I can send you a copy (and release, if required) and get your approval, then you will be a coauthor - but if I can't get a response or cannot find you, I can only give you credit in the acknowledgements. Order of authorship reflects the amount of work: if I planned the study and provided the methods, and had to extensively rewrite the paper, then I may take first authorship; if you did most of the work (with appropriate guidance from me), you will be first author.

Website for my Publications: http://www.ithaca.edu/hs/biology/smith_bpubs.htm

Note that we have a Blackboard site specifically for my research lab, which contains various useful resources, including published papers, unpublished documents (theses, junior research papers, etc.)

Evaluation Criteria for research

Student Name: _____ Date: _____

No evidence (0 points)	Approaches goal (1 point)	Meets goal (2 points)	Exceeds goal (3 points)
1. **Understanding the system**: Knows why we are doing each step, the logic behind the research design, and how the measurements work.			
0 1 2 3			
2. **Performance in lab and/or field studies:** Ability to perform research procedures, use related equipment.			
0 1 2 3			
3. **Ability to interpret data**: Can judge the validity of results, decide how well they support or refute the hypothesis, and can propose possible explanations for specific observations/results.			
0 1 2 3			
4. **Ability to solve problems**: When equipment or procedures give no results or clearly incorrect results, can propose logical steps to improve the procedures or rectify the problem.			
0 1 2 3			
5. **Planning**: Can use previous results to suggest a logical follow-up.			
0 1 2 3			
6. **Presentation of results**: Clear presentation, clear paper.			
0 1 2 3			

Scoring Guidelines:

- **No evidence** (0 pts): There is no evidence of achieving this goal. Either the necessary work or information was absent, or if present, of such poor quality that it is not clear that any attempt was made towards achieving this goal.
- **Approaches goal** (1 pt): The necessary information is presented in a manner consistent with the goal, but it is unclear, partially incorrect, or implies or reflects misunderstandings.
- **Meets goal** (2 pts): The information is presented with no errors or misunderstanding implied, but may not show strong evidence of analytical ability. For example, it may be simplistic, literal and descriptive rather than analytical, or lacking in integration, sophistication or rigor.
- **Exceeds goal** (3 pts): Performs the task at the level one would expect of an experienced researcher. The information is presented without errors or misunderstanding, in a comprehensive and integrated fashion, and demonstrates sophisticated and rigorous analysis.

Note that you are expected to *meet* the goals – thus, someone receiving scores of "2" in all categories could get an A if everything else about their work is as expected. An A is even more likely for those who exceed some of the goals, which generally indicates outstanding performance.