**BIOS 4590 B: Research Project Lab**

**Spring 2022**

**Last updated: 3/17/22**

**All course questions will be sent through Piazza.** <https://piazza.com/gatech/spring2022/bios4590b/home>

**COURSE SCHEDULE**

This schedule is subject to change.

|  |  |  |
| --- | --- | --- |
| Week | Day | Deliverable |
| 1 | Jan11 | Shortened lecture to 1230-1pm due to instructor conflict. 1. Introductions, 2, Ant hunting trip with TAs. Bring lab coats, shoes, and clothes for digging dirt outside. |
|  | Jan13 | Presentation by Hu Lab on ant research |
| 2 | Jan18 | Hu discusses fire ant biology |
|  | Jan20 |  |
| 3 | Jan25 | Hungtang presents his work, groups present their Phase 1 ideas |
|  | Jan27 | Groups continue presenting phase 1 |
| 4 | Feb1 | Proposal Phase I Due |
|  | Feb3 |  |
| 5 | Feb8 |  |
|  | Feb10 |  |
| 6 | Feb15 | Proposal Phase II Due |
|  | Feb17 |  |
| 7 | Feb22 | Presentation on results |
|  | Feb24 |  |
| 8 | Mar1 | Presentation on results |
|  | Mar3 |  |
| 9 | Mar8 | experiments |
|  | Mar10 |  |
| 10 | Mar15 | Feedback on proposals |
|  | Mar17 |  |
| 11 | Mar22 | Spring break; No class |
|  | Mar24 | Spring break; No class |
| 12 | Mar29 | Ant photo shoot; Preliminary manuscript due; presentations on figures, movies |
|  | Mar31 | Presentations |
| 13 | Apr5 | Hu absent; attendance optional |
|  | Apr7 | Hu absent; attendance optional |
| 14 | Apr12 | Poster draft due, Feedback on manuscript |
|  | Apr14 | Poster presentation |
| 15 | Apr19 | Final YouTube presentations in class. |
|  | Apr21 | Final manuscript due. Final lab cleanup |
| 16 | Apr26 | No class in afternoon. Poster session 4:30-6:00 PM, Location TBA |

**GRADING**

Proposal phase 1 10%

Proposal phase 2 10%

Final manuscript 40%

Poster 10%

Final Video Summary 10%

Weekly Progress Reports 10%

Attendance 5%

Questions/comments during student presentations 5%

Extra credit: Scientific Photography/social media/Outreach/ helping others/ helping after class up to 10%

**INSTRUCTORS**

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*Laboratory Manager*

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**COURSE SUMMARY**

Students will gain experience in designing, implementing, and communicating a research project. This section of Research Project Lab will have the scientific theme of teamwork. Students will develop projects by working with a champion social insect, the red imported fire ant, *Solenopsis invicta*. Ants are unique among animals in how they work together to succeed in complex environments. They cooperate to rear their young, overwhelm prey, and build remarkable nests. They can link their bodies together to build smart adaptable structures such as ladders, bridges, tents, and rafts. Students will work together to complete projects using ants as model systems to understand behavior, ecology, engineering, and physics of living systems.

**CLASS STRUCTURE**

This is a 3-credit class structured in a 1-6-3 format; that is, the class has both lecture (1 credit) and lab (2 credits) portions. The lecture will usually be done at the first 45 minutes of both Tues and Thursday sections. Afterwards, we will split into groups for the instructor to meet with each group.

**MEETING TIMES**

|  |  |  |  |
| --- | --- | --- | --- |
| **Class** | **Day** | **Time** | **Location** |
| Lab\* | TR | 12:30 pm-3:15 pm | Boggs 1-77 |
| Lecture | R | 3:30 pm-4:20 pm | Boggs 1-77 |

\*Cleanup will occur 20 min before end of class. E.g., at 300pm on Tuesdays and 400pm on Thursdays.

**PREREQUISITES**

The prerequisites for BIOS 4590 are [BIOL 1510 or BIOL 1511 or (BIOS 1107 and BIOS 1107L) or (BIOS 1207 and BIOS 1207L)]. Note also that BIOS 4460 (Communicating Biological Research) is a co-requisite for BIOS 4590, since students will present their research from BIOS 4590 in BIOS 4460. Students enrolled in BIOS 4590 can sign up for any section of BIOS 4460 as long as it occurs during the same semester.

**LEARNING OBJECTIVES**

By the end of this course students will be able to:

1. Articulate a clear research question or problem, and formulate a hypothesis
2. Identify, demonstrate, and use appropriate research methodologies
3. Use library and other tools to search for existing body of research relevant to their topic
4. Know existing body of research relevant to their topic and explain how their project fits
5. Identify and practice research ethics and responsible conduct in research
6. Know and apply problem solving skills to constructively address research setbacks
7. Work collaboratively with other researchers in an effective manner, setting and meeting deadlines
8. Communicate the results of scientific research through written reports, oral presentations, and posters

**LAB SAFETY**

1. A clean and orderly workspace is safer and more conducive to research.
2. Anyone with insect allergies needs to report this to the instructors.
3. Since the fire ants have a venomous sting, protective clothing is recommended. This includes closed toed shoes, long pants, a lab coat, and safety glasses. In addition, latex gloves should be worn when working with ants.
4. Always look out for the safety of each other. If you see a potential problem, tell your lab member or instructor.

**ATTENDANCE AND LAB HOURS**

Since this is a lab-based course, attendance and active participation are required. Each unexcused lab absence lowers the final grade by 10%. Late arrivals by 5 minutes and early departures by 5 minutes are considered tardy. Three unexcused tardies will equal one lab absence. Due to safety reasons, the lab will only be open for experiments only during class time.

**CLASS PARTICPATION**

This course meets in person. Because this is a presentation- and experiment-based course, attendance and active participation are required. Given that we are working collaboratively to evaluate each other's presentations, there is no mechanism to “make-up” a class. While we expect each student to attend every class and to be present for the entire class, we are in a pandemic. If you are sick, in isolation for covid, or in quarantine for possible covid exposure, we ask that you NOT come to class. Instead, email the instructor immediately to communicate that you will not be in class and plan to participate remotely on a bluejeans session for that class, if you are well enough to do so. While far from ideal, this is the safest solution we can implement in the current circumstances.

For non-illness related reasons, if you must miss a class, notify the instructor by email as soon as possible, preferably before the missed hour. There will be no make-ups. Vacation, work commitments, and social events are not acceptable reasons to miss class. Examples of legitimate reasons to miss a lab include serious illness, illness or death in your immediate family, participation in official university activities, and grad school/med school/job interviews arranged ahead of time with the instructor. You will be required to provide documentation for excused absences. Each unexcused absence will lower the final grade by 5%. If a doctor’s note or other official note cannot be provided, a note from the dean of students excusing the absence will be considered.

Studentswill be judged by the extent to which they participate in class discussions (by asking questions, answering questions, offering ideas, opinions, and critiques of student presentations). **Students are expected to ask a question or offer a comment at least once every class if presentations are given.**

Class particpation

**OFFICE HOURS**

By appointment. Please email or consult with instructor or TA during class to set up a meeting.

**ORDERING EQUIPMENT**

The lab has a reasonable budget for the entire semester (approximately $70 per person, but it can be extended for CT-scans and other equipment use). Requested materials may take up to seven days to order and deliver, and this timing needs to be kept in mind in writing the proposal. Equipment orders should be approved by the instructor, and then Alison Onestine.

**RECOMMENDED TEXT**

There is no required textbook for this class. But the following textbooks may be useful to consult. In addition, other readings may be provided during the semester.

Tschinkel WR. 2006. The fire ants Belknap Press, Cambridge, MA.

Bourke AFG, Franks NR. 1995. Social evolution in ants. Princeton University Press, NJ.

Camazine S, Deneubourg JL, Franks NR, Sneyd J, Theraula G, Bonabeau E. 2003. Self-Organization in Biological Systems Princeton University Press, Princeton, NJ.

Hansell M. 2005. Animal Architecture Oxford University Press, Oxford.

Heming BS. 2003. Insect development and evolution Comstock publishing associates, Ithaca.

Hölldobler B, Wilson EO. 1990. The Ants. The Belknap Press of Harvard University Press, Cambridge, Massachusetts.

Hölldobler B, Wilson EO. 2008. The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies W. W. Norton & Company, New York.

Ross KG, Matthews RW. 1991. The social biology of wasps. Comstock Publishing Associates, Ithaca, NY.

Seeley TD. 1995. The wisdom of the hive Harvard University Press, Cambridge, MA.

Turner JS. 2000. The extended organism: The physiology of animal-built structures Harvard University Press, Cambridge, MA.

Vinson SB. 1986. Economic impact and control of social insects. Praeger, New York.

**COURSE PARTICIPATION** will be judged by the extent to which each student participates in class discussions (by asking questions, answering questions, offering ideas, opinions, and critiques of readings) and in lab activities (by being proactive with conducting your own experiments, by being prepared and ready to conduct experiments, by being considerate and helpful of other students in the lab when working alone or in a team). Part of the lab participation grade also includes taking care of your ants and not letting them die off.

**WEEKLY PROGRESS REPORTS**

A weekly report of:

1. progress made
2. problems encountered and expected
3. plans and backup plans
4. any private questions/comments for the intructor

for the next week should by uploaded by midnight each Thursday. Reports are ideally 1/4 to one page, with one paragraph for each section above. Complete sentences should be used. Good weekly reports are often succinct summaries from longer notes. Enough detail should be given that you are prepared to use class time wisely the next week. Well-written progress reports can be recycled for proposals and manuscripts. Read Weitz Lab Paper-writing for writing advice: <https://projects.iq.harvard.edu/files/weitzlab/files/131.5_weitzlab_guide_to_good_paper_writing_10-2012.pdf>

Lab report guidelines here are: <https://www.science.org/content/article/how-keep-lab-notebook>

A scientific notebook is recommended but will not graded.

Weekly report assignments will be made available on canvas. Even after teams have been created, weekly reports should be submitted individually. You can provide link to a google doc is possible, but the new assignment should be kept at the front. Grades will be pass/fail on the weekly reports, with comments given verbally during class time. No extensions are permitted on the weekly uploads. If you upload the wrong file, no credit will be given, and no resubmissions permitted.

In the case of COVID tests being positive for more than one class, and if the student feels healthy, the student will do the following assignment to help keep up with their groups:

**LITERATURE REVIEW** will consist of a review of a scientific topic closely related to the research you were conducting for your research project. The review should begin with a synthesis statement, or new perspective based on the work reviewed. You must work on your own to write this review. Literature reviews should be 4-5 pages long, single-spaced, with 1-inch margins, using 11 pt Arial font. Examples of reviews are given in the Reviews folder in canvas.

**PROPOSAL PHASE 1** will be a numbered list of at least 5 project ideas that the student would want to conduct. Each idea should have a question to be answered and 1-2 sentences about why this is an interesting and feasible project. A proposed team of 2-3 people should be suggested.

After phase 1, students have the option of turning the remainder of the assignments (proposals, manuscripts, final video) in teams. Weekly reports and final reports should clearly state the division of labor for each week.

**PROPOSAL PHASE 2** will be a 1-to-2-page (single spaced, 12-point font) plan of the project to be conducted. The proposal should include background and justification (why would anyone want to do this project and why should anyone want to hear about it), a statement of hypotheses to be tested (these can be in the form of questions or falsifiable statements), how the hypotheses will be tested (i.e., what experiments will be conducted), and how data will be interpreted. It is also a good idea to include preliminary results, and a statement of further expected results, and how the results relate to the goals of the project. The proposal can include a few citations, not included in the page limit. Future tense should be used.

**PRELIMINARY MANUSCRIPT** will be in the style of the *Journal of Experimental Biology* and will be no more than 10 pages (single-spaced, 12-point font), plus figures, tables, and citations. The manuscript must include an abstract, introduction, materials & methods, results, discussion, conclusion, and references cited. Data should be provided in tables and/or figures as appropriate and appropriate legends for tables and figures should be used. There is no limit on the number of citations used; however, students avoid citing papers that they have not read. Elements to focus on for both preliminary and final manuscripts: importance, elegance of methods, explaining to a general audience rather than specialists, and a surprising result. It is helpful to include, for example, an attractive image capturing the point of experiment for a general audience, hypothesis, and conclusion (not just descriptive work), quantitative analysis in the form of physical model, mathematical model, or statistics, etc.

**FINAL MANUSCRIPT** will have the same format as the preliminary manuscript, but it should also include a separate document with a point-by-point response to the comments on the initial manuscript. This point-by-point response can be included at the end of the final manuscript and will not count towards the page limit. Also mark in a separate color any additions or changes to the preliminary manuscript.

**EXTRA CREDIT: SCIENTIFIC PHOTOGRAPHY/SOCIAL MEDIA/OUTREACH**

Using images, video, social media (twitter, Facebook, tiktok), we can increase the visibility of science in general as well as our communities (ant research, Georgia Tech, @GTSciences). During the semester, relevant photos, videos, anecdotes can help document your journey and can be disseminated on social media and your final report video. Just tag your instructor @drdavidhu for any posts.

**FINAL PRESENTATIONS**

Final presentations will be pre-recorded YouTube videos with a maximum duration of three minutes. After the video is shown in class, two additional minutes will be given for demonstrations and answering questions.

Here is a PURA video: <https://www.undergradresearch.gatech.edu/content/pura-video-katie-england>

Examples of final presentations from my fluid mechanics classes.

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| --- | --- | --- | --- |
| 2019 |  Emily Fourney and Gabe Cervantes  | [plant watering](https://www.youtube.com/watch?v=kGMyMX18ty0&t=121s) |  |
| 2020 | Danielle Newman, Dustin Coha, Davis Brown | [water clock](https://www.youtube.com/watch?v=KeIulThIETs&feature=youtu.be) |  |
| 2021 | Alex Castrejon, Claire Young, Koji Shimada | [The Venturi Effect](https://youtu.be/45z8ZUBhHXo) |  |

**ELECTRONIC COMMUNICATION**

Bring your laptop when you work in class, as you will be making electronic notes, looking up papers, and conducting research during class time. Electronic devices should be employed for non-class use sparingly. All class material will be uploaded to the Canvas website, and Canvas will be used to collect and distribute assignments and information.

**STUDENT-FACULTY EXPECTATIONS**

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectations. In the end, respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

**ACADEMIC INTEGRITY**

Academic dishonesty will not be tolerated. This includes cheating, lying about course matters, plagiarism, stealing classroom materials, or helping others commit a violation of the Honor Code. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Code of Conduct, available online at www.honor.gatech.edu. While students will collaborate in performing the experiments and collecting the data, each student is expected to write his or her own notebooks and manuscripts, including creating his or her own tables and figures. Plagiarism includes reprinting the words or ideas of others without citation. As direct quotes are seldom used in scientific writing, you are expected to rephrase the words of others and provide the citation. If this is unclear, please ask your instructor or TAs for help as your write before turning in your assignment.

**FACILITIES**

* CT-scanning in IBB. Costs for high resolution are 15 cents/slice
* Vernier Go Direct CO2 sensor. Similar brand O2, pressure, pH sensor and salinometer
* Analytical balances