BIOL 2355: Honors Genetics Laboratory – Syllabus – Fall 2016

Sections: Section A Thursday 12:05-2:55 or Section B Thursday 3:05-5:55
Classroom: CE 123 (located on the ground floor of Cherry Emerson in the SW corner)
Co-requisite: BIOL 2354 & BIOL 2355 are co-requisites. You must take both courses simultaneously.

Course Description:
This course is designed for exceptional students interested in learning important concepts and practical techniques in the field of genetics. Honors Genetics Lab is project-based, where students will design and conduct a laboratory experiment aimed at exploring aspects of transmission genetics, population genetics, and molecular genetics using the Georgia Tech Urban Honey Bee Project and neighboring hives. As with all research, we will begin with a question and then follow the scientific method to generate a hypothesis, design and conduct an experiment, and analyze the data to draw a conclusion. Because we'll be exploring new questions to Atlanta's urban honey bee populations, we'll probably also bump into the primary frustrations of scientific research—assays that require troubleshooting, delays when protocols don't work perfectly at first pass, and results that don't match our thinking about the system. We'll do this because asking real questions in a relevant study system is what scientists do, and learning how to navigate the process and solve the ensuing problems is the best training you can have for your senior research experience and to pursue careers in scientific research, medicine & human health, or other fields that require problem solving and logic.

By the end of this course, you will be able to:

1) Generate genetics hypotheses using the European Honey Bee.
2) Design experiments and interpret results using basic statistical analysis.
3) Create and troubleshoot genetics lab protocols.
4) Cite relevant genetics primary literature.
5) Write effective and accurate notebook entries, and lab reports in the style accepted by genetics scientific journals.
6) Use appropriate lab safety standards and precautions.

While this laboratory is the co-required companion to BIOL 2354, your grade in each course is independently earned. This course is 1.0 credit hour. You are expected to work for 3 full hours in lab each week, and for the additional time required to complete your lab prep and assignments.

Instructor:
Dr. Chrissy Spencer
Email: chrissy.spencer@biology.gatech.edu
Office location: CULC 474C
Office Hours: Wed 2pm-4pm
Phone: 404 385 0539

Teaching Assistants:
Audrey Calvird
Email: acalvird6@gatech.edu
Office location: IBB main lobby
Office Hours: Mon 2pm-4pm

Chance Meers
Email: Chance.Meers@gatech.edu
Office location: EBB 5th floor lobby
Office Hours: Wed 10am-12pm

Schedule: Honors Genetics Lab meets every Thursday from 8/25 through 12/1 except *11/24 (Thanksgiving Holiday)*. A final lab report or presentation will be due on Thursday 12/1, during the last full week of classes. Because of the project-based nature of this course, we will set the schedule for the following week based on the progress made in the week before. Expect a small writing or reading assignment each week. Consult bio2345.biology.gatech.edu/bee-project-f16-schedule/ each Monday for up-to-date weekly schedule and assignment due dates. Major assignment due dates are listed below after the assignment description.

Required Textbooks and materials:

Text:	same as for lecture; textbook is a useful reference
Lab Manual:	There is no lab manual for purchase for this course. Instead handouts will be provided in lab.
Notebook:	You will need paper and pencil to take notes during lab. After lab, you'll use your notes to create an electronic lab notebook entry on the course website bio2345.biology.gatech.edu.
Safety:	Lab coat (see 'Lab Safety' below for details)
Other:	Close-toed shoes and long pants are **required** for every lab held in CE123 (wet labs); calculators and laptops (one per group) are useful.

Lab Safety: Georgia Tech has a strict and strictly enforced policy regarding appropriate clothing in laboratories where chemicals and organisms are used or manipulated. **Students not conforming with the following requirements will be asked to leave the lab** and may not return without appropriate clothing:

1. **Long pants** must be worn in the laboratory.
2. **Close-toed shoes** that cover the sides and top of the foot must be worn in the laboratory.
3. **Lab coats** must be worn when working at the bench. Students are responsible for keeping their lab coats in good condition and reasonably clean so as not to create a hazard. Lab coats must be 100% cotton and cover the wearer to the knees.
4. **Safety glasses** must be worn when working at the bench. Safety glasses must have side shields for splash protection and conform to the wearer's face. Glasses must be worn over prescription glasses and contact lenses. Safety glasses will be made available for your use in the lab.

The laboratory safety policies (see last page of the syllabus) will be discussed in detail on the first day of lab.

Evaluation:

Grades will be calculated on the following scale:

A: ≥ 90.0%	
B: ≥ 80.0% and < 90.0%	
C: ≥ 70.0% and < 80.0%	
D: ≥ 60.0% and < 70.0%	
F: < 60.0%	

Points will be based on the following:

Participation	10%
Pre-Lab Assessments (~5)	10%
Lab Notebooks	20%
Lab Write-ups	45%
Grant Proposal	15%

Attendance: 100% attendance is expected for each lab, and for the entire lab period. Given that you are working with others to perform experiments and collect data on an on-going project, there is no mechanism to "make-up" a lab. If you must miss a laboratory, notify the instructor by email (or phone) as soon as possible, preferably before the missed lab. There will be no make-up laboratories. Vacation, work commitments, and social events are not acceptable reasons to miss lab. Examples of legitimate reasons to miss a lab include serious illness, illness or death in your immediate family, and participation in official university activities. You will be required to provide documentation for excused absences. Unexcused

absences will result in a 10% reduction in your final course grade; you will not be permitted to make up work missed in lab. Persistent tardiness may result in loss of points from your participation grade.
Participation: Genetics Lab requires cooperative use of materials, awareness of lab safety protocols, preparedness before class, and effective interaction in class. Each class period, we will assess your participation in class. Student use of a cell phone for non-lab business during lab may result in 0 participation points for that lab period. If you are in a situation where you must leave your phone on, please alert the instructor ahead of time and step outside to take the call. You are encouraged to check in with the course instructors at any time during the semester to gauge your participation score to date.

Pre-lab assessments will be available on t2/Pre-labs on the Tuesday before each lab. Pre-labs concentrate on the upcoming lab material and are due by 11:55 pm on the Wednesday before each lab. Late submissions will not be accepted. If you miss a pre-lab due to an unexcused absence from lab, you will receive a zero for that pre-lab. You should plan to complete the assigned reading before attempting the pre-lab. Pre-labs are open-book but individual, non-collaborative assignments.

Lab Notebook: Your lab notebook will be maintained electronically. For each *experiment* that we address, your notebook should include an introduction to the experiment, explanations of the methods used (detailed enough that you could repeat a year from now), reasons for conducting particular methods, results of experiments you complete, explanation of analyses, and summaries of conclusions. Your notebook should describe the beginning, middle, and end of each experiment—its rare to set-up and analyze an experiment in the same day, so experiments are likely to span multiple weeks if not the entire semester. Lab notebooks should be updated **within 24 hours of lab** (25% of notebook grade) and will be monitored and commented on regularly, and graded periodically. Your final notebook will be graded on content, accuracy, and completeness according to the rubric in the lab manual (75% of notebook grade). A thorough lab notebook will be fundamental to write accurate lab write-ups. In your notebook, **you are to write in your own words**, even if you are working with a team on the experiment. The only exceptions to this are:

- team-devised protocols,
- data, which should be proofread carefully, and
- tables and figures. These may be shared within your team but should be critically examined for accuracy.

If a teammate made a mistake that you preserve in your notebook and work, you become responsible for that error as well. Therefore, data entry and analysis are best done collaboratively, with proofreading, rather than by one member of the team. Anything you write in your lab notebook may be used word-for-word in your lab report, though the notebook is better used as draft language to be revised for the lab report. The lab notebook rubric is at the end of this syllabus. **Due: Nov 21st by 11:59 pm**

Lab Write-ups: During the semester, you will generate a full laboratory report in the style of a scientific journal. This report will be written in stages; each stage will receive with peer and/or instructor feedback. All lab reports are individual assignments. While lab work is done collaboratively, every component of the lab report, except shared tables and figures (see notebooks), should be generated by the report's author. There will be many writing assignments due during the semester to encourage you to test your ideas in writing. Each will be submitted electronically to t2/Assignments *and in hard copy in lab*; each assignment will be announced the week prior and will be due by the beginning of lab. A late assignment will be reduced one letter grade (10%) for each 24-hour period that it is late. **Final Lab Report Due: Nov 17th at the start of lab**

For notebooks and reports, you may want or need to set up an appointment for interactive writing assistance from tutors in the Communication Center (communicationcenter.gatech.edu) in the CULC.

Grant Proposal: At the end of the semester, we'll reflect on the work we've done and determine what questions the data leads us to ask. From one of those questions, you will individually generate a 2 page mini-grant proposal. **Due: Dec 1st by 11:59 pm**

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 notebook entries and lab write-ups. **Plagiarism** includes reprinting the words of others without both the use of quotation marks and 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 instructors for help as you work on an assignment.

Learning Accommodations: If needed, we will make classroom accommodations for students with disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services (disabilityservices.gatech.edu).

Due Dates

- Final lab Notebook – Nov 22nd by 11:59 pm
- Final Lab Report –Nov 22nd by 11:59 pm (email in advance to petition for extension)
- Group Poster – Dec 1st by end of lab

Guidelines and Rubrics

- Genetics Lab Notebook Guidelines and Rubric (on the last page!)
- Genetics Lab Report Guidelines (revised-oct-2016) and Rubric
- Poster Guidelines Rubric

Weekly Schedule – Subject to Change

8/25 – WEEK 1 – Bee Overview (meet in CULC 481)

- What do you want to learn in this course
- Basic bee biology & tour the bees
- Syllabus overview and plan for the semester
- Dissecting a scientific paper
- In-lab Reading: Youngsteadt et al 2015 abstract

9/2 – WEEK 2 – Project Planning (meet in CE 123)

- Lab safety, lab tour, and basic bench skills
- Discussion of Youngsteadt et al 2015
- Project planning (02 2355 F16 – Week 2 – Slides and 02 Research Questions from Section B)

9/9 – WEEK 3 – PCR Pilot

- PCR pilot of human DNA using two human genes
- Discussion of Sguazza et al 2013 detection of bee viruses by multiplex pcr
- Finalize a project question and plan our experimental design.
- How to create a protocol

9/15 – WEEK 4 – PCR pilot gels, Protocols

- Gel loading practice and run gel of PCR products
- Hypothesis Score Card
- How to create a protocol

9/22 – WEEK 5 – RNA isolation/cDNA synthesis pilot

- Experimental Design: Colony and Sample Assignments (note this is not the version with your names on it!)
- Handout: Overview of Reverse Transcription
- Protocol from lab: RNA-isolation-cDNA-synthesis-protocol
- Original kit instructions for the protocol used in lab:
    - GeneJet RNA purification kit (see pages 6-7)
    - TaqMan Gold RT-PCR kit (see pages2-11 and 2-17)

9/29 – WEEK 6 – PCR on cDNA pilot

- Overview and discussion of Experimental Design and colony assignments
- PCR on the cDNA you and your partner synthesized last week. Note that our PCR using primers from Sguazza et al 2013 and control primers (for the pilot only) from Scharlaken et al 2008.
- Peer review of Methods

10/6 – WEEK 7 – Gel Electrophoresis on PCR pilot

- Run PCR samples in 2% agarose at 100 V for 45-60 minutes.
- Size the bands on your gel and record the results.
    - 07-how-to-calculate-length-of-dna-fragments
    - 07-semi-log-paper
- Writing workshop: Introductions
    - 07-intro-writing-workshop

10/13 – WEEK 8 – RNA isolation/cDNA synthesis

- Experimental Design posted in the lab and here: experimental-design. Identify your 4 additional samples and make a plan to process those 4 samples.
- Protocol from lab: rna-isolation-cdna-synthesis-protocol-week-8
- Original kit instructions for the protocol used in lab:
    - GeneJet RNA purification kit (see pages 6-7)
    - TaqMan Gold RT-PCR kit (see pages2-11 and 2-17)

10/20 – WEEK 9 – PCR on cDNA

- PCR on all five cDNA samples with five RNA virus loci
    - PCR protocol:
    - Note that our PCR using primers from Sguazza et al 2013
- Peer review of Introduction

10/27 – WEEK 10 – Gels and data pooling

- For each sample, combine your five loci into 2 wells, carefully recording what is in each well. Keep the negative control in its own well. Electrophorese your PCR products on a 2.0% agarose gel at 100 V for 45-60 minutes, or until good size separation for PCR products ranging from 150–775 bp. Record the gel number and gel lanes that contain your samples. Visualize using UV, calculate band sizes using the gel doc software, print your gel (invert the image—bands dark, gel background light) for your lab notebook and lab report, and record your results.
- Add your sample results for presence/absence of each RNA virus to the class dataset gsheet shared by t2 email.
- Urban/Rural workshop – while your gels are running.

11/3 – Week 11 – Data Assembly

- Return Intros and give some general comments
- Data Assembly Workshop:

1. On your teams, discuss options for Urban/Rural categorization for each hive (15 minutes)
2. Assemble data in class gsheet, initial, and proofread. *Once finalized, no more editing, only downloading for your own use.*
3. Brainstorming session: How would you graphically present data points? Should we average or pool the 5 different samples from each colony?
4. Brainstorming session: What statistical approach or test would you use for each of the graphical presentations ideas.

After lab, please update lab notebook by Friday midnight:

- Align your urban/rural classification of each hive site with the class data, and upload an excel file or gsheet link containing your working dataset.
- Record your intended graphical presentation (sketch or description) and the statistical comparison you propose to use. If you don't have a name for the statistical text, then provide a specific description or a sketch figure of what you want to compare.
- **What's due:** Figures and Tables in draft form in lab next week and uploaded to t2.

11/10 – Week 12 – Data Analysis

- Download the following files to your desktop:
    - week-12-data-analysis-in-r-code (revised)
    - aovdata
    - regdata
    - tdata
- Discuss due dates.

11/17 – WEEK 13 – Results & Discussion Working Session

- Thank you cards with a report by virus and hive for each beekeeper.
    - Everyone signs every card
    - Reports divided up among teams. Make a group template for report format.
- Instructor overview of what should be in the results/discussion.
- Peer Review Results, Figures/Tables, Discussion
- Working session on your analysis and writing. Ask for peer or instructor guidance.
- REMINDER: Error bars should be standard error of the mean:
    - SEM = (Standard Deviation) / √(N – 1)
    - In excel, the formula is = (STDEV(range))/(SQRT((range)-1)))
- **11/24 – WEEK 14 – Happy Thanksgiving!**
- *No class meeting*

12/1 – WEEK 15 – Group Posters (Meet in CULC 481)

- Poster Guidelines Rubric
- Poster template and sample
    - bee-poster-f14-sample
    - bee-poster-template1
- POSTER DUE at the END OF THE LAB PERIOD to t2/Assignments/Group Poster.

12/6 – WEEK 16 – BEE PARTY

- Please stop by the Bee Party on Tuesday 12/6 from 11 am – 1 pm in CULC 205Q to see the amalgam poster, have some bee-shaped festive snacks, and maybe win a door prize! (This is just for fun, not required for the course.)