INVESTIGATIVE BIOLOGY LABORATORY (BioG 1500) SYLLABUS

This course is designed for biology majors to provide lab experience with an emphasis on the processes of scientific investigation and promote collaboration, communication, and literacy in science. Students gain scientific skills and instrumentation techniques used by biologists to construct new knowledge. Lab topics include genetics, evolution, microbiology, ecology, biochemistry, and molecular biology.

MAIN OBJECTIVES

The course modules follow the “crawl, walk, run” approach to develop a students’ capacity for solving increasingly challenging problems with greater independence. First, the students fill their scientific “tool box” with skills needed to be able to design and carry out experiments. The first module is structured (Antibiotic Resistance), followed by a module that provides more academic freedom (Limiting Nutrient). Lastly, the Human Microsatellite DNA unit emphasizes the importance of accuracy and precision in science.

The main course objectives are:

1. To expose students to realistic scientific questions and encourage critical thinking, teach how to design hypothesis-based experiments, choose appropriate statistical test(s), analyze data, and interpret results.

2. To fill students’ scientific “tool box” by demonstrating mastery of modern lab techniques and scientific methods that can later be applied across varied biological systems and scales.

3. To teach students how to find relevant scientific information using appropriate library tools, and to communicate effectively using both written and oral formats.

4. To teach students how to think through a scientific process with their research group while acquiring conceptual knowledge and understanding the benefits and challenges of collaborative work.

5. To teach how to use discovery science to explore patterns in nature, and understand the importance of accuracy and precision.

6. To provide students with the opportunity to learn and apply fundamental biological information in the context of the course modules.

COURSE STAFF

Course phone: 607-255-2031

Course website: http://InvestigativeBiology.cornell.edu

Dr. Mark A. Sarvary, Director of Laboratories 1140 Comstock Hall mas245@cornell.edu
Dr. Kirsten Deane-Coe, Postdoctoral Teaching Fellow 1132 Comstock Hall kkc32@cornell.edu
Ms. Irena Horvatt, Course Coordinator 1130 Comstock Hall ith7@cornell.edu
Ms. Martha Lyon, Laboratory Coordinator 1105 Comstock Hall
Ms. KC Bennett, Assistant Laboratory Coordinator 1128 Comstock Hall
Lab Instructors (TAs) 1122 Comstock Hall

All rooms are located on the first floor of Comstock Hall. The Administrative office is in 1130, and laboratories are located in 1104, 1108, 1112, 1116 and 1120. Students attend one one-hour lecture and participate in one three-hour laboratory per week.

Weekly Lab: See your roster for the section time and lab room.
FOUR IMPORTANT THINGS YOU WILL NEED IN THIS COURSE

1. *Investigative Biology - a Laboratory Text* (Sarvary, Spring 2016) – available at the Cornell Store


Provides custom-made chapters and pages via electronic access. Purchase the access directly from the publisher: http://tinyurl.com/S16ebook. If you are not sure whether or not you will stay in the course, sign up for the 21-day temporary access before you purchase the book.

3. *Poll Everywhere* classroom response system – free and available online at polleverywhere.com

Poll everywhere produces a tool that allows you to interact with your professor(s) through your own mobile devices. The intended goal is to improve student engagement in the classroom through the use of interactive learning. During each lecture you will use Poll Everywhere to answer multiple-choice and short answer questions based on the assigned readings and your understanding of the lecture. You must log in every time! If you are not logged in, your answers cannot count towards your grade!

How to register:
- Go to: http://tinyurl.com/S16poll
- You will be asked to provide your name and Cornell email address (other email addresses will not be accepted in the course). Create a unique password.
- If you plan on using your cell phone to text the responses, you must enter and certify your cell phone number in your profile (www.polleverywhere.com/profile/edit) to ensure that you receive credit for responding.
- Check if you are connected to BIOG1500 under settings/voter registration. Follow the instructions for “Register as a Participant” to check if your account is connected to the course. It may prompt you to enter Dr. Sarvary’s email address: mas245@cornell.edu.
- If you have any questions, please visit the Poll Everywhere User Guide (www.polleverywhere.com/guide).
- Your information is protected and Poll Everywhere will never share emails or phone number with any third party.

**Answering poll questions:**
- Make sure you are signed in before answering the questions. This will ensure that you receive credit for responding. Signing in is your responsibility. For take home questions, you must be signed in on the web browser that you are using to answer the questions. Without signing in, you will not receive any credit for your answers.

Without completing the steps above, Dr. Sarvary will not be able to see your responses.

4. “R” is a free statistical software that will be needed for data analysis and graphing throughout the semester.

- You can download this software for your PC or Mac from www.r-project.org. Choose one of the US Mirrors. Please also download R-studio from www.rstudio.com/ide/download.
- Create a folder on your computer called “RBioG1500”, where you may wish to store all the datasets used in BioG 1500.
- Download this software to your laptop that you can bring to lab when needed.
HOW TO SUCCEED IN THIS COURSE:

Participate in the lecture dialogues: The content knowledge required for the laboratory sessions will be discussed during the lectures. Questions prior to (and during) the lectures will test whether you completed the assigned readings and test whether you acquired the needed information to complete the laboratory exercises. You should complete the assigned reading (posted scientific papers, the e-book, and the Lab Manual) prior to lecture. During each lecture you will answer multiple choice and short answer questions. Choosing the correct answer will earn you full credit; choosing an incorrect answer will not earn any credit. Approximately 20% of the in-lecture polling scores will be dropped, in case you cannot attend a lecture or your device was not working.

Unless poll questions are assigned as homework, answering them outside of the lecture hall (pretending to be in lecture) is considered academic dishonesty and results in the loss of ALL lecture participation points. No exceptions.

Gain useful lab skills: Your success in the lab course depends on your preparation for each new lab. A thorough reading of the relevant lab chapter, e-book reading, and attending and actively engaging in lecture should adequately prepare you for each lab session. This is a lab course; therefore lab attendance is mandatory. Please arrive on time so you can actively participate in the lab. If you need to miss a lab, you must contact Irena Horvatt in the course administrative office (1130 Comstock Hall) before the day you miss the lab. A valid reason (sickness, religious holidays, or conflicts with other academic activities) will be required. In cases where 2 or more labs have been missed, course withdrawal is suggested.

Take advantage of the course learning tools: Questions to prepare you for each module, and questions to test your knowledge are in the lab manual. Meet your lab instructor during office hour to discuss the answers to these questions. Worksheets and test-your-knowledge questions are designed to help you solve problems related to a lab topic or help you learn a particular skill in science, such as searching for scholarly literature. Some of them will be completed in lab, others outside of lab. Use these questions as smart learning tools! Many of these questions will appear on the practical exams. Instructional videos and Tutorials were developed or sought out by our staff to help you gain certain lab skills.

Be on time and don’t procrastinate: In general, assignments are due in lab, at the beginning of the lab section. The lab instructor cannot change deadlines. If you have a valid reason to receive an extension without penalty, please contact Dr. Sarvary. If you cannot finish your assignment by the deadline, you can submit a late assignment. Late assignments carry a 30% reduction of grade per day: for example if you turn in your assignment within 24 hours after its deadline, you cannot receive more than 70% of the maximum score. If you are 24-48 hours late, your maximum score can be 40%. None of the assignments can be more than 48 hours late. Late submissions will also result in late return of the graded assignments. Some assignments (i.e. peer-review, poll questions, etc.) cannot be turned in late.

Don’t be shy, speak up! We are here for you!: Do not wait until the end of the course to raise problems/issues. Come and talk to us! If you are experiencing undue personal or academic stress at any time during the semester or need to talk with someone about a personal problem or situation, please seek support as soon as possible.

Monitor your assignments and the posted grades on Blackboard. Please look at answer keys as soon as they are posted, and your graded exam as soon as they are returned to you! “Errare humanum est”, but if you notice a grading error on your graded exam, don’t wait! Notify your TA within 48 hours of the receipt of the grade. Due to the fast pace nature of this course, we cannot honor re-grading requests after 48 hours. Please always provide a clear and detailed explanation of why you find an answer incorrect.
The BioG 1500 Staff is available to talk with you about stresses related to your work in this class. Additionally, we can assist you in reaching out to any one of a wide range of campus resources:

- Gannett Health Services at 255-5155, www.gannett.cornell.edu
- Peer Support provided by Empathy Assistance and Referral Service at 255-EARS
- Office of Undergraduate Biology at 255-5233, biology.cornell.edu
- Student Disability Services (SDS) in 420 CCC building; phone number is 254-4545.

**HOW WE WILL ASSESS YOUR KNOWLEDGE AND LABORATORY SKILLS:**

We use a wide variety of assessment techniques to form a realistic picture of your understanding of the course content and the laboratory skills you gained in this course.

**Lab Practical Exams:** This is a biology laboratory course; therefore your scientific skills will be tested in a laboratory setting. Two lab practical exams will be held in lab during regular lab time, in lab 4 and lab 12. They will cover the practical skills of instrumentation, statistics, and methods in science and communication.

**Lab Participation:** Your lab participation grade will be partially based on an evaluation of your lab etiquette, which includes your working habits, responsibility, cooperation, and preparedness. Pre-lab questions will test whether you are prepared for the laboratory. Questions will check whether you completed and understood the readings in the Lab Manual.

**Scientific Literature:** We want to prepare you to tackle the challenges of scientific publishing, so you will go through the same writing process as scientists, who submit their papers to a scientific journal. To help improve your writing skills, your lab instructor will review these drafts. You will receive points if you submit a reviewable assignment. As a final, graded assignment, you will individually write a complete scientific paper on the antibiotic resistance experiment, and present a scientific poster on the limiting nutrient experiment.

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<thead>
<tr>
<th>Component</th>
<th>Percent of Grade</th>
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<tbody>
<tr>
<td><strong>LAB SKILLS AND CONTENT KNOWLEDGE (total 58%)</strong></td>
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<tr>
<td>Practical exam 1</td>
<td>14</td>
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<tr>
<td>Practical exam 2</td>
<td>19</td>
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<tr>
<td>Statistics worksheet</td>
<td>3</td>
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<td>Poll questions</td>
<td>10</td>
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<td>Lab etiquette (attendance, activity, behavior)</td>
<td>6</td>
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<td>Pre-lab questions</td>
<td>6</td>
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<td><strong>SCIENTIFIC LITERATURE (total 42%)</strong></td>
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<td><strong>Publishing your research:</strong></td>
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<td>Dissect a scholarly journal article (worksheet)</td>
<td>2</td>
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<td><em>First submission:</em> Antibiotic Resistance paper for peer-review</td>
<td>4</td>
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<tr>
<td>2 peer reviews and a self-review</td>
<td>6</td>
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<tr>
<td><em>Back to the editor:</em> Antibiotic Resistance paper with peer-reviews addressed</td>
<td>2</td>
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<tr>
<td><em>Ready to be published:</em> Antibiotic Resistance Complete Paper</td>
<td>14</td>
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<td><strong>Going to a conference:</strong></td>
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<tr>
<td>Limiting Nutrient Group Poster, Appendix, Presentation</td>
<td>12</td>
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<tr>
<td>Limiting Nutrient Poster review sheet</td>
<td>2</td>
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<tr>
<td><strong>Total:</strong></td>
<td>100%</td>
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**Final letter grades:** your final performance in the course will not be based on the performance of other students (e.g. no curve). The general guidelines for letter grades: A>90%; B>80%, C>70%, D>60%, below 60% is F. Exact cut-off points will not be known until the day of letter grade assignment. We cannot offer extra/bonus assignments.

*Incompletes:* Cornell policy dictates that an incomplete be arranged only when a student has substantial passing equity in the course (e.g. all requirements for the course have been completed satisfactorily except for a term paper or final exam) and the reason for failure to complete all course requirements is convincing to the instructor and beyond the student's control. If you feel that you deserve an incomplete, you must contact Dr. Sarvary and provide legitimate documentation.

**STAY CONNECTED AND BE INFORMED:**

1. Course website and social media

   You can find valuable course information on our website. Please check back frequently for updated instructional videos on our Youtube channel, science news, blog posts, and event announcements. Use our social media outlets to receive real-time information about the course, staff and your fellow students. Twitter: @Cornellbiolabs; Facebook: facebook.com/BioG1500; Website: investigativebiology.cornell.edu.

2. **Blackboard**~ 9.1

   Instructors and course staff will post course related materials to Blackboard~ 9.1. Some of the assignments may require that you submit them through Blackboard. You will use Blackboard to view course documents, to view slides of course lectures, to receive statistical codes for R, to watch online tutorials for statistics, literature searches and other topics. You can monitor your grades throughout the semester. Access to Blackboard 9.1 requires that you use your net ID, which is the first part of your Cornell email address, and your self-chosen password.

**DISCLAIMERS:**

**Plagiarism:** According to the Cornell University Code of Academic Integrity, a student shall be guilty of violating the code of academic integrity if she/he knowingly represents the work of others as her/his own [or helps another student to do so]. For additional information, refer to http://cuinfo.cornell.edu/Academic/AIC.html. If you are accused of plagiarism, a primary hearing is scheduled at which the evidence is considered and a decision rendered. If you are found guilty, the academic integrity officer of your college is notified.

**Using pedagogical data for publications:** Instructors of this course seek out new, modern pedagogical methods to improve the education of our students. Instructors may use data from exams or from poll questions in aggregate form (without identifiers of any sort) to evaluate our pedagogy. These exam question or poll question evaluations may be published in pedagogical journals. We always maintain our students' confidentiality, but students can request verbally or via email (mas245) to opt out if they have concerns. Please do not hesitate to contact the instructors if you have specific questions.

**Lost and Found:** Items left in the lab room may be turned in to and retrieved from the Course Coordinator Irena Horvatt in 1130 Comstock Hall. Items left in the lecture room may be retrieved from the Call Auditorium staff.
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<thead>
<tr>
<th>Week of</th>
<th>Activity</th>
<th>Readings</th>
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<tbody>
<tr>
<td>Lecture 1</td>
<td>Course Introduction; Pre-course questions</td>
<td>Textbook (BCW), Investigative Bio Lab Manual (IB) AND Assignments Due</td>
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<tr>
<td>Lab 1</td>
<td>Scientific Skills I: Lab safety and etiquette, Microscopy, Simulation modeling, Preliminary study data collection</td>
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<td>Week of Feb. 8</td>
<td>Lecture 2</td>
<td>Scientific Investigations in Biology; Statistics; How can you use the skills taught in this course?</td>
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<td>Lab 2</td>
<td>Scientific Skills II: Importing data in “R”, Spectrophotometry, Full-scale study, Statistical Methods, Pipetting, Serial Dilutions</td>
<td>IB: Ch. 1; BRING LAPTOP; DOWNLOAD “R”; DUE: SERIAL DILUTIONS POLL</td>
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<td>Week of Feb. 15</td>
<td>Lecture 3</td>
<td>Communication in Science; Literature search tools; Scientific skepticism</td>
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<td>Lab 3</td>
<td>Scientific Skills III: Statistics worksheet, Case study: How Scientists Think; Paper discussion, Practical review</td>
<td>IB: Ch. 1; BRING LAPTOP Read paper for discussion</td>
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<td>Week of Feb. 22</td>
<td>Lecture 4</td>
<td>Spontaneous Mutations and Antibiotic Resistance</td>
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<td>Lab 4</td>
<td>Practical exam I; Antibiotic Resistance (AR) I: Treatment simulation game; Paper grading</td>
<td>DUE: STAT WORKSHEET</td>
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<td>Week of March 7</td>
<td>Lecture 5</td>
<td>Darwin and Natural Selection</td>
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<td>Lab 5</td>
<td>AR II: Set-up Class Project; Design group project, AR paper discussion</td>
<td>IB: Ch. 2, Read AR paper for discussion</td>
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<td>Week of March 14</td>
<td>Lecture 6</td>
<td>Responsible Conduct of Research (RCR)</td>
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<td>Lab 6</td>
<td>Mid-semester evaluations; AR III: Frequency calculation, Group experiment design presentation, Group experiment set-up;</td>
<td>IB: Ch. 2 DUE: PAPER DISCUSSION WORKSHEET</td>
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| Week of March 21 | Lecture 7 | Limiting Nutrient (LN) I | BCW: Lec 7  
DUE: SIMBIO SIMULATION POLL |
| Lab 7 | LN I: Design LN Experiment; Climate Change Forum preparation; AR IV: Group Data Collection and Analysis; Appendix writing | IB: Ch. 2, Ch. 3, BRING LAPTOP |
| Week of March 28 | No class all week. Spring break. |
| Week of April 4 | Lecture 8 | Limiting Nutrient II | BCW: Lec 8 |
| Lab 8 | Present AR results; LN II: Present design and Set up LN Experiment; Climate Change Forum preparation | IB: Ch. 3; BRING LAPTOP  
DUE: AR PAPER FOR PEER-REVIEW |
| Week of April 11 | Lecture 9 | Climate Change Forum | BCW: Lec 9 |
| Lab 9 | LN III: LN Paper Discussion; Data Collection and Analysis; Appendix writing | IB: Ch. 3, Read LN paper for discussion, BRING LAPTOP  
DUE: PEER-REVIEW |
| Week of April 18 | Lecture 10 | Human Microsatellite DNA I: Case study | BCW: Lec 10 |
| Lab 10 | Present LN results; DNA I: Student DNA Extraction; Primer design; Poster Preparation | IB: Ch. 4; BRING LAPTOP  
DUE: AR PAPER WITH PEER-REVIEWS ADDRESSED |
| Week of April 25 | Lecture 11 | DNA II: Population Genetics; Hardy-Weinberg Equilibrium; Post-course questions | BCW: Lec 11 |
| Lab 11 | DNA II: Student DNA Results; Gel Electrophoresis; Lab Evaluation; Practical Review | IB: Ch. 4 |
| Week of May 2 | Lecture 12 | Review of the semester: Ignite Talks; Evaluations |
| Lab 12 | Poster session; Practical exam 2 | DUE: LN POSTER (Presentation + Appendix); |
| Week of May 9 | NO LECTURE | DUE on May 10 (9am): AR PAPER FOR GRADING |
| NO LABS | | |
Welcome to BLOG 1500

You are here!
* Lecture in Call Auditorium
* Labs in Comstock Hall
* Purchase e-book and lab manual.

Connect
* Download required software
* Register for Polleverywhere.com
* Connect to course social media (Facebook, Twitter, and the course page investigativebiology.cornell.edu)

Know Your Staff!
* Check the course website for office hours
* READ and RE:spend to e-mails promptly

Lab # 8
* Antibiotic Resistance paper Due

Lab # 6
* Paper Discussion Worksheet Due

Lab # 4
* Practical Exam # 1
* Statistics Worksheet Due

Lab # 9
* Provide Peer Review

Lab # 10
* Paper to Editor w/ review comments addressed

Lab # 12
* Poster Presentation
* Practical Exam # 2

Final Paper
May 10th @ 9am

Useful Course Links:
facebook.com/BioG1500
twitter.com/@CornellBiolabs
investigativebiology.cornell.edu

Investigative Biology

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make information beautiful