Principles of Biology (BIOL-UA 123)
Syllabus and Course Policies

Course People and Logistics

Instructor of Record

Eric D. Brenner (eb50@nyu.edu)

Professor Brenner also serves as Lab Director. He and the biology staff make sure the labs are set up and that the laboratory instructors are prepared to help you learn.

Your laboratory instructor will supervise your lab section; your instructor may be a full-time professor or a teaching adjunct (TA). Contact your individual TA if you have inquiries about their lab including homework, quiz and exam questions and writing assignments. Your TAs will give you their office hours and specific contact information when they meet you.

Laboratory Locations: 603, 604, 606 Silver. Biology Office 605 Silver

Course Concept

Welcome to Principles of Biology Lab! The goal of this course is to give you direct hands-on experience with biology. This is a stand-alone course that is associated with the Principles of Biology lecture (BIOL-UA11/12). Principles of Biology Lab supports the lecture course, but functions as a separate course.

Biology is based on knowledge and inquiry. This lab gives knowledge (built upon the foundations of the POB lecture), and a chance at scientific inquiry. Biological discoveries are occurring at an astronomically increasing rate—giving us answers to age-old questions and causing well-established paradigms to shift. As new discoveries are made, new technologies emerge that dramatically impact our lives. From food to medicine the impact is keenly felt. This is a wonderfully exciting and stimulating time to study biology.

During the semester you will sample from a panorama of biological topics, address hypothetical scientific questions, and develop your scientific writing skills. You will also have a chance to sample an aspect from the research of several faculty members in the NYU Biology Department. Principles of Biology Laboratory is a brand new course with the goal of providing the NYU student with a direct view into the most current topics in Biology, while providing you with the ground work to use this experience as a launching pad to higher level lab courses at NYU, which in turn will inevitably prepare you for your future career.

Important announcements will be posted on NYU Classes frequently. You should therefore check the site at least every day. We encourage you to contact your
Laboratory Instructor during the lab, at office hours and via email. Please take advantage of all the resources that are available in this course. Good luck!

**Course materials**

- The laboratory manual will be posted on-line. All instructions for lab exercises will be posted on the NYU Classes site by the Friday before the week of the lab.
- The text for the Principles of Biology lecture course provides excellent reference material for this lab course and can be found at the NYU bookstore:
  
  *Campbell Biology 9th edition*, by Reece et al. (required for lecture course Biol-UA11/12)

- **Lab materials** (manual homework, study questions, and lectures) will be posted on the course's NYU Classes web site. Grades will also be posted on NYU Classes. To access the site, log in through NYUHome. Your TA will also establish a separate NYU Classes site specific to your lab section.

**Grading**

Grades are based on performance in the laboratory. The following components of the lab are listed as fraction of the grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Homework (On-line, night before)</td>
<td>10</td>
<td>(4 sets home-work questions at 2.5% each)</td>
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<tr>
<td>Post Labs</td>
<td>30</td>
<td>(10 post-lab assignments 3% each)</td>
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<tr>
<td>Quizzes</td>
<td>20</td>
<td>(5 quizzes at 5% each – 5 questions/quiz)</td>
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<tr>
<td>One Writing Assignment</td>
<td>20</td>
<td>(2 sections: Why &amp; What -10 % each)</td>
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<tr>
<td>Final Lab Practical Final Exam</td>
<td>15</td>
<td>(Stay on top of lab. Final is cumulative!)</td>
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<tr>
<td>Lab Participation</td>
<td>5</td>
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<tr>
<td>Week</td>
<td>Title</td>
<td>Activity</td>
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<tr>
<td>Lab 1</td>
<td><strong>Module 1: MOLECULAR BIOLOGY</strong>&lt;br&gt;<strong>Micropipetting</strong></td>
<td><strong>Expertise in Biology:</strong> Micropipetting</td>
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<tr>
<td>Lab 2</td>
<td><strong>Molecular origins</strong></td>
<td>Molec. Inheritance of (PTC) perception</td>
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<td>(Quiz 1)</td>
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<td>Lab 3</td>
<td><strong>Genotyping traits</strong>&lt;br&gt;(HW1) (AMNH visit assigned)</td>
<td>PTC-PCR, Plasmid Transformation with GFP&lt;br&gt;Presidents Day Weekend – No Classes</td>
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<tr>
<td>Lab 4</td>
<td><strong>Microbiology</strong></td>
<td>PTC gel and pGLO Observation</td>
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<tr>
<td>(Quiz 2)</td>
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<tr>
<td><strong>Module 2: GENETICS AND EXPRESSION</strong>&lt;br&gt;Lab 5</td>
<td><strong>Gene expression I</strong>&lt;br&gt;(HW2)</td>
<td>RNAi/Mutation studies in C. elegans – pick worms</td>
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<td>Lab 6</td>
<td><strong>Gene expression II</strong></td>
<td>RNAi/Mutation studies in C. elegans – phenotypes</td>
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<td>(Quiz 3)</td>
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<td>Spring Break – No Classes</td>
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<tr>
<td><strong>Module 3: EVOLUTION AND DEVELOPMENT</strong>&lt;br&gt;Lab 7</td>
<td><strong>Phylogeny I</strong>&lt;br&gt;(HW 3 &amp; 4 AMNH due) (Begin Writing Assignment: &quot;Why&quot;?)</td>
<td>Animal DNA isolation &amp; PCR</td>
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<td>Lab 8</td>
<td><strong>Phylogeny II</strong>&lt;br&gt;(&quot;Why&quot; – due)</td>
<td>Phylogenetic Tree Modeling; Sequencing</td>
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<td>Lab 9</td>
<td><strong>Phylogeny III</strong>&lt;br&gt;(Quiz 4) (&quot;Why&quot; – returned) (Begin Writing Assignment: &quot;What&quot;?)</td>
<td>Phylogenetic Molecular Tree building</td>
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<tr>
<td>Lab 10</td>
<td><strong>Mol. Embryology</strong>&lt;br&gt;(&quot;What&quot; – due)</td>
<td>Zebra fish and vertebrate development</td>
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<td><strong>Module 4: ENVIRONMENTAL BIOLOGY AND PLANT BIOLOGY</strong>&lt;br&gt;Lab 11</td>
<td><strong>Plants</strong>&lt;br&gt;(Quiz 5) (&quot;What&quot; returned)</td>
<td>From Algae to Flowers, Plant Signaling</td>
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<td>Lab 12</td>
<td><strong>Ecology</strong>&lt;br&gt;(Complete writing assignment due)</td>
<td>DBH vs. Biomass</td>
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<td>Lab 13</td>
<td><strong>Lab Practical Exam</strong></td>
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Project 1 – MOLECULAR GENOTYPES AND PHENOTYPES: From microbes to humans (Labs 1-4)

You will note the universality of DNA controlled life. You will isolate DNA from humans (yourself) for a PCR/CAPS reaction. For a later, related lab you will use plasmid DNA to transform bacteria. You will explore how genes underlie phenotypes and learn to associate genotypes with phenotypes while developing technical experience with molecular biology.

Your will learn how a specific CAPs marker polymorphism in your PTC locus correlates directly with your own taste perception. To do this, your will conduct a PCR reaction on their own DNA to amplify a fragment from the PTC gene, followed by a restriction digest. The restriction digest on the PTC gene fragment reveals a polymorphism that is known to correlate with taste sensitivity to PTC paper. You will then test your own sensitivity to PTC paper. Thus, you will complete a full cycle correlating your own taste perception phenotype to the CAPS marker phenotype.

In the next lab of this project, using bacteria, your will learn how plasmids are used as vectors to transfer genetic traits into microorganisms. You will perform a transformation of the GFP gene into E. coli with the ampicillin gene functioning as a transformation positive marker. You will then visualize GFP expression while noting transformation efficiency. This lab enables you to understand not only how a gene can confer a specific phenotype, but also to gain expertise in molecular technique.

LAB STRUCTURE

Project 1 – MOLECULAR BIOLOGY: Human Genetics and Expression Systems

Lab 1: Prelab – Learning to use a micropipette
Experiment: You develop your expertise using a micropipetter

Lab 2: Molecular, Inheritance of phenylthiocarbazide (PTC) perception
Experiment: You will isolate your own DNA (epithelial cheek cells using mouth wash) with a simple, crude, solubilization and purification protocol. DNA is used in the next lab.

Lab 3: Genotyping traits: Plasmid Transformation of Bacteria with GFP, PTC-PCR
Experiment: Using your DNA from the prior lab, you will perform a PCR reaction to determine their PTC genotype (which affects taste sensitivity to phenylthiocarbazide, a classic assay) and test the hypothesis that your own genotype matches your phenotype, i.e., polymorphic CAPS profile.

Lab 4: Microbiology PTC gel and pGLO Observation
Experiment: You will transform E. coli with a plasmid expressing GFP
Project 2 – GENE FUNCTION: RNAi and mutant studies in C. elegans (Labs 4 & 5)

Building on the prior project (genotype to phenotype), you will explore how scientists study gene function. In this project you will form a hypothesis regarding the role of one of three genes in C. elegans (HBL-1, BLI-1 AND DPY-1). You will observe known point mutants of these three distinct genes in C. elegans to study the affect of gene loss on phenotype. You will then form a hypothesis based on observations exploring the modulated reduction of gene activity utilizing RNAi. You will feed C. elegans bacteria expressing dsRNA and try to correlate the affects of reduced gene expression with cognate point mutants in the same genes. This lab tests observational skills that are required during genetic studies to define gene function. The identities of the RNAi lines are unknown. You will develop a hypothesis as to which RNAi line matches a known gene mutant by observing, measuring and cataloging gene likely characters. High resolution video data is used in this endeavor and incorporated as links in written assignment.

Lab Structure

Lab 5: Gene expression I - RNAi/Mutation studies in C. elegans – pick worms
You will pick individual wildtype C. elegans and place them on E. coli cells expressing double stranded RNA for unknown genes that match correlate genes whose mutations confer phenotypes of interest.

Lab 6: Gene expression II – Observe RNAi and point mutants
You will attempt to identify the causative gene of an RNAi phenotype by matching its phenotype to the different point mutant lines. You will then gather both RNAi vs mutant line data to test their hypothesis regarding gene function.

PROJECT 3 – EVOLUTION AND DEVELOPMENT (Labs 6-8)

The goal of this lab is for you to develop a hypothesis regarding the relationship among evolutionarily informative taxa among the Animalae, different group. Using parsimony, You will try to recover the original phylogeny.


You will use COX sequence to produce molecular characters. Following PCR, sequence generation and analysis, you will build a best-fit phylogeny in an attempt to reconstruct evolutionary relationships.

Next you will gain an understanding of the phylogenetic hypothesis via a thought lab prepared by Dave Fitch, where you test multiple hypotheses to reconstruct a phylogeny using synthetic characters. Phylogenies are initially constructed on paper and then applied using a computerized character matrix.
For the final lab of this project you will view actual taxa in their phylogenetic reconstruction. You will observe morphological characters using both in-house sources and observations during a visit to the AMNH. Morphological characters are then overlain on the molecular tree that you have built.

Lab Structure

Lab 7: Phylogeny I - DNA Prep and PCR
Experiment: You will isolate animal DNA and use PCR to amplify molecular characters among a selection of animals that bear key traits representing key states in animal evolution.

Lab 8: Phylogeny II - Phylogenetics Tree Building/Solving, Animal Phylogeny
Experiment: You will prepare samples for sequencing. You will draw out a synthetic phylogeny to understand phylogenetic reconstruction.

Lab 9: Phylogeny III Animal Molecular Phylogeny Building
Experiment: Using your sequence data, you will conduct a bioinformatic (Blast and Pubmed search) on a gene important in the animal’s evolution. Then you will construct a phylogenetic tree revealing the basic evolutionary criteria that led to the rise of the vertebrates, land animals, and ultimately apes (including humans).

Lab 10: Embryology: Zebra Fish Early Development
Experiment: You are introduced to embryo development by studying the unity and diversity of patterns in sea star, chickens and fish (live). You will note neurulation and variations in development of the dorsal central nervous system. You will examine living fish to observe embryology in real time.
PROJECT 5 – PLANT BIOLOGY AND ENVIRONMENTAL BIOLOGY (Lab 11-12)

In the first component of this project students first gain an overview of plant diversity by examining living materials representing various states of land-plant evolution. Emphasis is on understanding the key environmental influences that led to the ascendance of angiosperms.

Students next examine plant-signaling systems. Students conduct their own study of plant growth via an hypothesis based approach. One of the great limitations to the understanding plant systems is the fact that plants move (relatively) slow. Students thus conduct a time-lapse experimental system using their iphone/ipads/ Samsung device etc... and in-class movie making tools to examine genes/hormones involved in the phototropic and gravitropic responses. Students test their hypothesis regarding conditions necessary to initiate/block developmental processes.

The second component of this project allows students to explore an ecological method to measure carbon acquisition levels of different tree species found on the NYU campus. Students collect data in the field at an on-campus site and then quantify this data.

Lab Structure

Lab 11: Plants - From Algae to Flowers
Experiment: Lab is two-fold: Students view the panorama of plant diversity in vivo, while students develop, and test, a hypothesis regarding plant signaling systems. Students study specimens of plants revealing key states of plant evolution. Students also develop a hypothesis that is then tested regarding the identity of photoreceptors involved in sensing plant light or gravitropic systems involved in signaling changes in gravity.

Lab 12: Ecology – Carbon sequestration (Katie Schneider/Mary Killilea)
Experiment: Make field measurements to estimate plant productivity to understand tools used to study ecological resource acquisition, particularly carbon usage. On our campus, students sample trees for DBH (diameter at breast height) and convert this figure to biomass, which is then used to calculate NPP (net primary productivity).

Quiz, exams and post-labs

If you miss a quiz or the final exam, you need to provide your recitation instructor with a legitimate excuse accompanied by a signed and dated note from a licensed professional (e.g., a doctor, the NYU Student Health Center); otherwise, you will not receive any points for that quiz or the exam. You may then take a modified version of the exam within three business days of the test at the discretion of your instructor.

If you miss an exam or quiz for a valid reason and have not taken a make-up exam before the semester is over, you will receive a grade of "Incomplete" for the course. You will have to complete the course by taking a make-up exam as soon as possible (and certainly before the end of the next semester). You must arrange the make-up
exam (through e-mail) with your laboratory instructor. Students may not remove an “Incomplete” by taking summer session *Principles of Biology Laboratory* exams.

If you do not appropriately make-up a missed quiz or exam, you will receive a "0" for that exam. Students who miss more than one exam should probably consult with the Dean of Students.

Please notify your laboratory instructor immediately if you are not in the proper state to take an exam due to life events or illness. Do NOT take a quiz or an exam and then ask for special consideration after. Once you take an exam, it counts as part of your grade. Instead, take care of yourself and get your condition documented by a medical professional.

**Homework.** Homework will be assigned as scheduled and complete through NYU classes.

### Other Matters

**Special needs.** Please inform Prof. Brenner of any accommodations you require. Requests for special accommodations during exams (including taking the exam at the Moses Center for Students with Disabilities) must be submitted at least 10 days before the exam.

**Withdrawing from the course.** If life events are significantly hurting your performance in the class, you should consider taking care of yourself first and withdrawing from the course. Please consult with the Dean of Students.

**Academic honesty.** We do not tolerate plagiarism or cheating, which includes providing information about exams and quizzes to students who have not yet taken them. When academic dishonesty is suspected, it will be dealt with seriously in adherence to the official guidelines of New York University. The College of Arts & Science guidelines, which all students should read, are available online at [http://cas.nyu.edu/page/ug.academicintegrity](http://cas.nyu.edu/page/ug.academicintegrity). We will report incidents to the department and to the office of the Dean; these incidents may become part of your record.

**Letters of recommendation and comment forms.** It is helpful to develop a constructive relationship with your laboratory instructor. Asking good questions and paying attention go a long way in earning the appreciation of your instructor.

**How to do well in this class**

Check the NYU Classes site regularly. Submit all homework. Complete Post-labs.

Always read the lab manual section very well BEFORE you come to lab. Examine the diagrams and figures. There may also be assigned specific readings that correspond with the lab, please complete them before coming to class.

Be focused during the lab and participate in discussions. Take notes during the instructor’s presentation and take very careful notes of your experimental methods and observations. Be a good citizen; that is, make sure to work well with your lab group. Share, discuss, help and be engaged. Your understanding of the lab material will improve the more you are involved. To do this, it helps to talk about biology with others. Study in groups and teach each other; ask each other to explain difficult concepts.
Some of the folks you meet in this class may become your close friends during the next few years at NYU, and perhaps for the rest of your life.