BIOLOGY 1510 **BIOLOGICAL PRINCIPLES** **SPRING 2016**

Instructors:

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Schedule and Classroom:

Section A	Location	Time
Lecture	CULC 144	9:05–9:55 am MWF
Recitation	CULC 144	6:05–6:55 pm R (if no test)
Midterm exams	CULC 144	6:05–6:55 pm R
Final Exam Day/Time	CULC 144	F 4/29 11:30am–2:20 pm

Prerequisites:
Good background in high school biology and chemistry.

Description:
This is an **active-learning** class that introduces students to basic principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, evolution, and ecological relationships. This course will help you develop critical scientific skills including hypothesis testing, experimental design, data analysis and interpretation, and scientific communication. Class time will consist of a variety of **team-based activities** designed to discuss, clarify, and apply new ideas by answering questions, drawing diagrams, analyzing primary literature, and explaining medical or ecological phenomena in the context of biological principles. We will spend class time on building your comprehension on the material you find the most difficult, based on pre-class assessments. You will play a prominent role in determining what is the focus of each day's effort.

Course Readings:
BIOL 1510 is taught on the flipped classroom model, meaning that you will need to complete your assigned readings before each lecture. BIOL 1510 will be taught without a textbook this semester. All course readings and videos are on the course website bio1510.biology.gatech.edu. We have used this model in the past for optional readings, and your peers have told us they like the website as the "go to" for all course readings and videos. The day-by-day schedule below contains links to each required reading. Some students prefer to have access to additional readings to support learning around certain topics, so we have also provided links to Biology by OpenStax College, an online textbook available for free. For the lab, please purchase the Biology 1510 Lab Manual/Notebook (ISBN 978-0-7380-7700-0), available only at the Georgia Tech Bookstore.

Learning Catalytics for Participation and Homework:
To complete your pre-class incoming knowledge evaluation (IKEs), team in class activities (TICAs), and your weekly homework assignments, students are required to have a Learning Catalytics account. Points earned in learning catalytics will contribute to the "participation" portion of your course grade. Learning Catalytics can be purchased directly at https://learningcatalytics.com/users/sign_up or from the Georgia Tech Bookstore in Tech Square. To participate in class, you will need to bring an internet-ready smartphone, tablet, or laptop to class to earn participation points. Phone and computer use is restricted to class-related material, and off-task use may result in loss of participation points for that day. Your entire Learning Catalytics contribution of IKEs, TICAs, and Homeworks tallies to 10% of the course grade.

Incoming Knowledge Evaluation (IKEs):
Before each class, we'll expect you to complete the pre-class readings on the website. Once you've reviewed the material, log in to learning catalytics to complete that day's Incoming Knowledge Evaluation (IKE). IKE sessions close at the start of class and will not be reopened for credit, but you can review closed sessions for study purposes. We'll use your responses to guide what we do in class. IKE questions are not often at the same level as you can expect to see on an exam; instead, they ensure that you come to class with effective baseline knowledge to work up to exam level questions in class. We will drop the 5 lowest IKEs from your participation grade.

Lectures and Team In-class Activities (TICAs):
Attendance in lecture correlates strongly with performance in Biology 1510. We will make our lecture materials available and urge you to download and print them for use in active note-taking during class. Much of the material and application of ideas needed for success in this course will be presented only in lecture and assessed via Learning Catalytics. Questions presented in class are usually at the same level as exam questions. TICA sessions in Learning Catalytics close at the end of class, with a few exceptions, and will not be reopened for credit, but you can review closed sessions for study purposes. We will drop the 5 lowest TICAs from your participation grade.

Homework:
Homework assignments will be made available each week in Learning Catalytics and are always due on Sundays at midnight. Homeworks close on Sunday at midnight, with few exceptions, and will not be reopened for credit, but you can review closed sessions for study purposes. In the week of each Midterm Exam, all homeworks for that module will be reopened for practice, not for credit. We will drop the lowest Homework from your participation grade.

Exams and Quizzes:
This course has four midterm exams and the cumulative final exam. The midterm exams will be held in the evening, are "closed-book," and will be made up of multiple-choice questions based on topics, materials, and discussions presented in class, assigned readings, TICAs, and Homeworks. Quizzes may be administered in lecture, lab, and online.

Missed Exams:
If you miss an exam for any reason, you will receive a grade of 0 (zero) on that exam unless you **petition us for a makeup exam within 24 h of the start of the missed exam**, and we approve your petition. Your petition must be submitted in writing (by e-mail) and must include documentation of a legitimate reason for missing the exam. You may, of course, submit your petition before the exam if you know of your scheduling conflict in advance. We will consider each petition individually. Examples of legitimate reasons to miss an exam include illness, illness or death in your immediate family, and participation in official university activities. If we approve your petition, we will remove the missed exam from your grade calculation by using the weighted average of your other exam scores as your grade for the missed exam, making it completely neutral in your final point total.

Group Projects:
Groups of 4-5 students each will create a short video to explain a fundamental concept related to the course. Each student will be assigned to a group and a topic, and each group will complete only one group project during the semester. **Group assignments, details, and deadlines will be provided once drop/add ends.** Video grades have a group and an individual component. The Group Component will be based on instructors' grades and peer evaluations. The same group project grade will be assigned to all members of a group; each group member is fully responsible for all submitted project work. The group video projects consist of 3 deliverables: a story board, a transcript, and a video posted to youtube and shared on the bio1510.biology.gatech.edu website. The Individual Component includes peer-evaluation of all members of your team and peer-review of a subset of videos from other groups.

Recitations:
Lecture recitations occur on the two Thursdays prior to each exam from 6:05–6:55 pm and are led by the lecture Teaching Assistants. Attendance is optional but strongly encouraged, as it is designed to improve your understanding of the lecture material. Bring your wifi enabled device to access Learning Catalytics during recitation to receive participation credit for your recitation attendance, which can add points to the Participation portion of your grade. Recitation attendance adds bonus points to your participation grade with a weight equivalent to an IKE (see Grading below).

Labs:
Labs will begin the week of January 11. You'll need the combined lab manual/notebook (ISBN 978-0-7380-7700-0), a 100% cotton lab coat, and you must wear closed-toe shoes that cover your entire foot as well as long pants. Note that while no **labs meet during the second week of classes,** you will have a **Pre-lab assignment due before you meet for lab: part 1 is due on January 21st, part 2 is due before your lab section meets (see lab T-square announcement for details)***. Labs are held in Clough Commons and taught by Teaching Assistants (TAs); your TA contact information is available on the BIOL 1510 lab T-square site. All communications regarding lab should be directed to your lab TAs. Most FAQ about labs are answered on the lab T-square site and lab syllabus. ***Laboratory attendance is mandatory and each unexcused absence will lower your final course grade (not just your lab grade) by 5%.** *Details of the absence policy are in the BIOL 1510 lab syllabus.

Tutoring:
Georgia Tech offers a variety of free learning and communications support options. Learn about free tutoring resources at www.success.gatech.edu or at the Center for Academic Success's tutoring desk in Clough Commons 273. For assistance with revising lab reports or building and polishing a group project presentation, consult the Communications Center (Clough Commons 447 or commlab.gatech.edu).

Honor Code:
All students are expected to abide by the Academic Honor Code, which can be viewed online at www.honor.gatech.edu. Plagiarism is the unattributed use of the words of ideas of others; plagiarism on any assignment, including laboratory reports and the group project, will be referred to the Office of Student Integrity for adjudication. If you have any questions regarding your assignments and plagiarism, we encourage you to come consult with any of us before you submit the 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).

Grading:
Your final grade will depend on the following combination of grades:

In-class exams (~ 10% each, see #1 below)	40%
Final exam (Module 5 and cumulative)	20%
Group project (1)	10%
Participation*	10%
Laboratory	25%

*comprised of 5% homeworks, 3% TICAs, and 2% IKEs.

Note that these components total 105%. The maximum overall score we will allow in this course is 100%, so this scheme includes 5% of extra credit. We will use the following procedure in calculating your final grade:

1. We will weight your 4 midterms 6%, 10%, 10%, and 14%, where your lowest midterm score will count 6% and your highest midterm score will count 14% of your final grade.
2. We will combine your exam, lab, group project, and other scores into a raw composite score (0 – 100%) using the weights shown above.
3. We will assign final letter grades using the following scale:

A: $\geq$ 90.0%
B: $\geq$ 80.0% and < 90.0%
C: $\geq$ 70.0% and < 80.0%
D: $\geq$ 60.0% and < 70.0%
F: < 60.0

Module	Major theme	Teaching Goals
Intro	• Course intro	• Scientific method
1	• Molecules, Membranes, and Metabolism	• Overview of biomolecules • Introduction to bioenergetics: respiration and photosynthesis. • Chemiosmosis in respiration and photosynthesis • Diversity of metabolic pathways
2	• Genetics	• Mendelian genetics • DNA and genomics • Gene regulation in prokaryotes and eukaryotes
3	• Evolution	• Earth history • History of life on Earth • Mechanism of evolution
4	• Ecology	• Behavior and evolution • Simple population models • Community structure • Mass and energy flow through ecosystems
5	• Honey Bees	• Honey Bee Evolution • Pesticide Metabolism • Immune Defenses • Bee Ecology

The schedule below is subject to change.

Sp 2016	Lecture	Who	Lecture Topics	Website Reading (required)	OpenStax Biology (optional)
11-Jan		JL	Course overview Intro to Instructors		
13-Jan		JL	Scientific Thinking: What is science? What is the scientific method? What is data?	Strong Inference	1-1-2 Science of Biology
	M 1		**Start Module 1: Molecules, Membranes, Metabolism**	Chemistry Review	1-2 The Chemical Foundation of Life
15-Jan	1.1	JL	Biomolecules Small molecules Major classes of macromolecule	Biomolecules	1-3 Biological Macromolecules
				Protein structure and function	
18-Jan			*MLK DAY*		
20-Jan	1.2	JL	Cellular Structure Lipid bilayer membranes Archaeal membranes Serial endosymbiosis and eukaryote evolution	Membranes	2-1 Cell Structure 2-2 Structure and Function of Plasma Membranes
22-Jan	1.3	JL	Membrane function and transport systems Membrane composition and adaptation Membrane proteins Transport: passive diffusion, osmosis, facilitated diffusion, active transport	Membrane transport	2-2 Structure and Function of Plasma Membranes
				Cells	
25-Jan	1.4	JL	Energetics and enzymes Thermodynamics and free energy Catalysis and kinetics, and enzymes feedback regulation Redox reactions Membrane potential	Energy and Enzymes	2-3 Metabolism
27-Jan	1.5	JL	Cellular respiration Oxidation of food and reduction of an e- acceptor Electron transport chain Chemiosmotic generation of ATP Aerobic vs anaerobic respiration	Respiration	2-4-2 Energy in Living Systems 2-4-5 Oxidative Phosphorylation
29-Jan	1.7	JL	oxidative pathways glycolysis, substrate-level phosphorylation pyruvate oxidation citric acid cycle regeneration of NADH, fermentation	Oxidative pathways	2-4-3 Glycolysis 2-4-4 Oxidation of Pyruvate and the Citric Acid Cycle 2-4-6 Metabolism without Oxygen
1-Feb	1.8	JL	Evolution of mitochondria and eukaryotes Amino acid and lipid breakdown Consequences of defects in metabolism	Fermentation	Smith and Baco 2003 2-4-7 Connections of Carbohydrate, Protein and Lipid Metabolic Pathways
3-Feb	1.9	JL	Photosynthesis Overview: reduce CO2 to organic C Pigments and light absorption Origin of photosynthesis: single PS, cyclic photophosphorylation	Photosynthesis	2-5-2 Overview of Photosynthesis 2-5-3 Light-Dependent Reactions
5-Feb	1.10	JL	Carbon fixation	Carbon fixation	2-4-4 Using Light Energy to Make Organic Molecules

8-Feb	1.11	JL	Photosynthetic strategies C3 and C4 photosynthesis Recap: compare and contrast respiration & photosynthesis, mitochondria & chloroplasts.	C4 plants	OpenStax: Photosynthetic Pathways
10-Feb	1.12	JL	Project Inroduction and Workday		
	M 2		**Start Module 2: Genetics**		
12-Feb	2.1	JL	Chromosomes and Cell Division Mitosis Meiosis	Mitosis and Meiosis	2-7-2 Cell Division 2-7-3 The Cell Cycle 3-1-2 The Process of Meiosis
15-Feb	2.2	JL	Mendelian genetics	Mendelian genetics	3-2 Mendel's Experiments and Heredity
17-Feb	2.3	JL	Mendel's model genetic system Monohybrid and dihybrid crosses	Chromosome theory of inheritance	
18-Feb			**Module 1 Exam (6 pm) covers Module 1 content only.**		
19-Feb	2.4	JL	Sex-linkage and pedigree analysis Probabilities of genetic outcomes Genetics of human disease	Patterns of Inheritance	3-3 Modern Understanding of Inheritance
22-Feb	2.5	JL	DNA as the basis of inheritance Experimental evidence for role of DNA DNA structure Semi-conservative replication of DNA	DNA	3-4 DNA Structure and Function
24-Feb	2.6	JL	Gene expression: DNA to protein Basics of transcription and translation	Gene expression	3-5 Genes and Proteins
26-Feb	2.7	JL	Prokaryotic and eukaryotic genomics Genome size and organization Mammalian genomes Genome evolution	Genomes	3-7-3 Mapping Genomes 3-7-4 Whole-Genome Sequencing 3-7-5 Applying Genomics
29-Feb	2.8	JL	Gene Regulation	Gene regulation	3-6 Gene Expression
2-Mar	2.9	JL	Project Workday		
	M 3		**Start Module 3: Evolution**		
4-Mar	3.1	CS	What is life? What is evolution? An evolutionary framework for biology	What is life? What is evolution?	1-1-3 Themes and Concepts of Biology
7-Mar	3.2	CS	Evolution of evolutionary thought Evidence for evolution Evolution by natural selection Common misconceptions	Evolution by Natural Selection	4-1-2 Understanding Evolution
9-Mar	3.3	CS	Mechanisms of evolution	Mechanisms of evolution	4-2-2 Population Evolution
10-Mar			**Module 2 Exam (6 pm) covers Module 2 content only.**		
11-Mar	3.4	CS	Genetic variation Hardy-Weinberg equilibrium Mutation, drift, selection	Mechanisms of evolution	4-2-3 Population Genetics
14-Mar	3.5	CS	Species and speciation What is a species Mechanisms of speciation Reinforcement & hybridization Allopatric & Sympatric speciation	Speciation	4-1-3 Formation of New Species
16-Mar	3.6	CS	Earth history Fossil record & radiometric dating Key events in the history of life	Earth History	OpenStax: Radioactive Decay Radiometric dating section

18-Mar	3.7	CS	Origin of life RNA world Miller-Urey experiment	Origin of Life	No relevant material in OpenStax
3/21-3/25			*Spring Break*		
28-Mar	3.8	CS	History of life on Earth Life in the remote past Patterns of biological diversity over time Life and changes in the physical environment Biological classification		No good, relevant material in OpenStax
	M 4		**Start Module 4: Ecology**		
30-Mar	4.1	CS	Intro to Ecology Physical Environment	Intro to Ecology	8-1-2 Scope of Ecology 8-1-3 Biogeography
31-Mar			**Module 3 Exam (6 pm) covers Module 3 content only.**		
1-Apr	4.2	CS	Behavioral ecology Foraging and defense against predation Mate choice and sexual selection Kin selection and altruism	Behavioral Ecology	8-2-8 Behavioral Biology
4-Apr	4.3	CS	Population ecology	Population ecology	8-2-2 Population Demography
6-Apr	4.4	CS	Structure, dynamics, & regulation of populations Life histories Human populations through history Population management		8-2-3 Life Histories 8-2-4 Environmental Limits to Population Growth 8-2-5 Population Dynamics and Regulation 8-2-6 Human Population Growth
7-Apr			VIDEO PROJECTS uploaded by midnight		
8-Apr	4.5	CS	Community ecology	Community ecology	8-2-7 Community Ecology
11-Apr	4.6	CS	Competition, Predation, parasitism, mutualism Keystone species Island Biogeography		
13-Apr	4.7	CS	Ecosystems	Ecosystems	8-3 Ecosystem
15-Apr	4.8	CS	Energy and material flow through ecosystems Biogeochemical cycles Human impact on ecosystems		
	M 5		**Start Module 5: Integrative Biology**		
18-Apr	5.1	CS	Honey Bee Evolution	Honey Bee Evolution	
20-Apr	5.2	CS	Pesticide Metabolism	Pesticide Metabolism	
21-Apr			**Module 4 Exam (6 pm) covers Module 4 content only.**		
22-Apr	5.3	CS	Immune Defenses	Immune Defenses	7-10 The Immune System
25-Apr	5.4	CS	Bee Ecology	Bee Ecology	
29-Apr	**Final Exam**		**Friday 11:30am-2:20pm. Final Exam is cumulative, with an emphasis on Module 5 content.**		