EEEB W2001.001
ENVIRONMENTAL BIOLOGY I
TIME Tuesday and Thursday 01:10-02:25
ROOM Pupin Laboratory 420
TEXT Raven, P. H., G. B. Johnson, J. B. Losos, S. R. Singer (2010) *Biology* (9th edition).

The textbook can be purchased online (e.g., Amazon.com). It is also available as an e-book on tablets. For the iPad, the text is available through the Inkling App in the iTunes Store.

PERSONELL

INSTRUCTOR	RECITATION	OFFICE HOURS	CONTACT INFO
Dustin Rubenstein LECTURER		Thursday 2:45-3:45 1112 Scherm. Ext. *(or by appointment)*	dr2497@columbia.edu 1-212-854-4881
Elise Bone LECTURER		Wednesday 11:00-1:00 1111 Scherm. Ext.	eb2801@columbia.edu
Vivian Valencia TA	Thursday 9:00-10:00	Thursday 11:00-12:00 E3B meeting area*	vv2188@columbia.edu
Mary Heskel HEAD TA	Wednesday 4:00-5:00	Wednesday 3:00-4:00 E3B meeting area*	mah2207@columbia.edu
Evan McCartney-Melstad RA		Tuesday 5:30-6:30 E3B meeting area*	emm2242@columbia.edu

**11th Floor Schermerhorn Extension across from elevator.*

MECHANICS

Readings Each lecture has assigned readings. Please do the readings ***before*** class – even if just quickly. After class, read the chapter again, this time carefully while making notes. If you have questions, bring them to recitation. **You are responsible for material in the reading even if it is not covered in lecture.**

Grading is based entirely on 4 exams (quizzes) given during class. Make-up exams are not offered. The four quizzes are worth 25 points each. Grading will be based on a one-way sliding curve that will ensure that at least 10% get As. For example, 90 or above = A, 75-89 = B, 60–74 = C, 50-59=D, and 50 or below = F, but if this scheme yields less than 10% A's, we will alter the curve to reach the desired 10%. Because it is sliding one way, however, it means that the entire class could theoretically get an A. There are no homework assignments or term papers, but there are practice problems to help you prepare for the some of the quizzes. Quizzes are multiple choice, fill in the blank, short-answer, type, though short essays may be used.

Recitation, which starts in the second week of class, is technically not required, but those who attend recitation invariably do better in class. Recitation serves to reinforce the material you will learn, covers material not covered in lecture but appears in your reading, and is a place to answer any questions you or your fellow students might have. Your quizzes will be returned in recitation and it is there that the answers to the questions will be discussed. Recitation also serves as a place for review prior to a quiz.

There are two recitation sections. The TAs will share running them. Enrollment will be capped at 30 per section to make sure no one section is too crowded. Please sign up as soon as you can for your preferred section by contacting the TA of the recitation section you prefer to be in (e-mail above) or be sure to go to the first section in the SECOND WEEK OF CLASS.

CourseWorks All handouts and some lectures will be posted on the course website using CourseWorks.

DESCRIPTION

Environmental Biology

The world consists of subatomic particles organized into atoms which form elements, which form compounds, which vary in their abundance and form (gases, liquids, and solids) according to fixed rules. Therefore, the distribution and abundance of matter on the surface of any planet and the environmental conditions of its surface are predictable. The distribution and abundance of matter and the environment of Earth, however, cannot be predicted from physics and chemistry alone. An extraterrestrial observer would find Earth's temperature much cooler than it should be, too rich in oxygen, and it would display a mysterious greening up in the north every summer as its icy cap retreated. The key to the mystery is biology.

Through a matrix of interconnected biological processes, comprising some one thousand billion tons of biomass made up of some thirty million species scattered over the planet's five hundred million square kilometers, Earth's environment is kept from ever reaching the hot, suffocating, sterile and inhospitable planet it should be according to what we would predict from physics and chemistry alone. Charles Darwin, in *The Origin of the Species*, more than a century and a half ago, captured what makes biology so amazing in his famous closing passage,

"There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."

Astronomers and geologists may disagree – a planet simply following the fixed laws of physics and chemistry can be very interesting independent of biology – but to those of us who find the living world wondrous and the challenge of solving the mystery of Earth's environment irresistible, mastering the biological sciences (e.g., ecology, evolution, physiology, morphology, molecular biology, and behavior) becomes a passion.

W2001 is designed to teach and train its students the fundamentals of biology so that they can join the ever-growing number of biologists who strive to better understand the living world and our place in it. Because our environment is changing rapidly due to factors such as elevated levels of greenhouse gasses, increased rates of biological extinction, the alteration of patterns in the distribution and abundance of species (e.g., changing forests to pastures, grasslands to farms, or consuming most of the ocean's large predatory fish), there is a tendency to conflate environmental biology with environmentalism. While they are related, environmentalism is not science. Environmentalism is a philosophical, political, and personal perspective while environmental biology is a branch of the biological sciences. Environmental biology can form the foundation for environmental management (e.g., including farming, aquaculture, waste-water treatment, or forestry), recycling, pollution mitigation, restoration ecology, understanding climate change, public health, epidemiology (the study of diseases and their spread, such as West Nile Virus, Lyme disease, SARS, malaria, and others), conservation biology, and much more. This course, however, is not about those complex topics *per se*, though we will refer to them from time to time. Rather, this course is about the fundamental biological principles behind all those topics.

Molecules to the Biosphere

Biological processes, just like abiotic processes, occur at different scales. In this first semester of the two-semester course on environmental biology, the faculty and TAs will cover the foundations of biology – individuals and evolution. In the second semester, the faculty and TAs will cover the larger scales – populations, communities, ecosystems, the biosphere, and the environmental sciences that build upon these, including conservation biology.

In this first sequence (W2001) , we will cover,

1. the balance of nature
2. self versus non-self
3. cells
4. multicellularity
5. multi-organ systems
6. development
7. genetics
8. inheritance
9. population genetics
10. gene function
11. genomics
12. evolutionary mechanisms (I)

In the second sequence (W2002) we will cover,

1. the hierarchy of life
2. paleobiology
3. behavioral ecology
4. population biology
5. community ecology
6. conservation biology
7. bio-thermodynamics
8. evolutionary mechanisms (II)
9. photosynthesis and respiration
10. nutrients
11. ecosystems
12. the biosphere

Mastering Biology

We are biased, to be sure, but we cannot imagine anything more exciting or important in understanding the natural world, its history, its change, and our place in it than biology. All the faculty are practicing researchers in their fields, thus their approach is to explore biology as a way of knowing and understanding nature. We love what we do – but that doesn't mean it isn't hard work.

All fields have their vocabulary and rules, and to master any field requires knowing both. Simply mastering the vocabulary and rules, however, does not mean one has any proficiency in the field. For example, when learning another language one has to master thousands of words, each with their definitions, and hundreds of rules of grammar and pronunciation, often each having many exceptions, but the goal isn't simply mastering the vocabulary and grammar, but knowing how to read, write, and speak the language. Similarly, in biology, there are terms and rules that must be memorized, but the goal isn't to memorize them, but to use them to explore nature, test new theories, and participate in the exchange of ideas among people about the biology of the natural world. For example, there are nearly 1500 terms in your textbook's glossary alone and there several hundred complex rules – rules about inheritance, how genes are transcribed, how the vertebrate immune system works, how life evolves, and much more. Proficiency in

biology, however, isn't mastering these 1500 terms and hundreds of ideas, but being able to use this information to explore and understand the natural world, test ideas in biology, or perhaps even generate some theory of your own.

Fortunately, the task is not as daunting as it seems if one focuses on and grasps core concepts. For example, when it comes to form and function, the key is to understand how complex systems are assembled from units - proteins are made up of amino acids, nucleic acids of nucleotides, membranes of phospholipids, and microtubules of tubulins. Likewise when it comes to biological diversity, the key is to understand how evolution and ecology generate and maintain diversity.

Our quizzes will always provide opportunities for students to show their mastery of the terms and rules, but they will also test for understanding concepts and applying what is learned to novel problems in biology.

Biology's Biology and E3B's Environmental Biology

While there is some topical overlap between the E3B biology sequence (W2001-W2001) and the Biology department's sequence (C2005-C2006), they differ considerably in emphasis and focus. Biology's introductory biology course is designed to serve students for whom the molecular and cellular biology of animals is important in their lives and careers. This focus is especially useful for students taking advanced courses offered by Biology and for those considering careers in biotechnology, engineering, and biological research at the cellular level. In contrast, E3B's course is designed to serve students for whom the biology of the living world in important. Our coverage includes viruses, plants, fungi, as well as animals, and covers the full scale of biological form and function, from the cell to individual, to population, to community, to ecosystem, to the biosphere. W2001 also looks at the diversity of life in all places on Earth (from deserts to rainforests) over all of Earth's history (from trilobites and dinosaurs to genetically engineered organisms). This training is especially useful for careers in environmental biology, including civil engineering, epidemiology, biological research at the organismal, population, community, ecosystem, and biospheric levels in academic, private, and governmental institutions, and for those considering applied issues and environmental professions such as conservation biology, restoration ecology, and natural resource management.

Because W2001 covers molecular and cellular biology, it may appear to be equivalent to Biology's C2005. Not surprisingly, however, in order to cover the large array of biological topics in W2001, our depth of coverage in physiology and cell and molecular biology is much less than that of Biology's. Of course, the converse is true – the depth of their coverage of the diversity of life, ecosystems, and the environment is much less than that of E3B's.

In the long run, both courses provide invaluable exposure to the core principles of biology and both will prepare one for standardized tests and entry into professions or professional schools. More importantly, both will make its students good citizen scientists.

COURSE SCHEDULE

W	MON	DAY	TOPIC	LECT	READING*
1	Sept	6	Definitions and requirements of life; composition of Earth and the 'happy accident'	EB	1-3, 26.1
		8	Self-replicating molecules and the development of self; cellular structure	EB	28-1, 4, 5, 9.1-9.4
2		13	A ***brief*** survey of unicellular life	EB	28, 29
		15	A ***brief*** survey of viruses and Multicellularity	EB	19.1-19.3, 27
3		20	Multicellularity and A ***brief*** survey of animal life	EB	19.3-19.6, 25, 32, 33
		22	A ***brief*** survey of plant and fungal life and Bodily regulation (a.k.a. "blood and guts")	EB	30, 31, 43, 50.1-50.3
4		27	Blood and Guts: Osmoregula-, secr-, circula, and respiratory systems	EB	50.4-50.7, 49
		29	**QUIZ 1**		
5	Oct	4	Blood and Guts: Musculoskeletal systems	EB	47
		6	Blood and Guts: Cephalization and the end of paradise (sensory apparati)	EB	44, 45
6		11	Blood and Guts: Gut feelings (endocrine and digestive systems)	EB	46, 48
		13	Blood and Guts: Homeland defense (immune systems)	EB	51
7		18	Contemporary research	EB	TBA
		20	**QUIZ 1**		
8		25	With and without sex (mitosis and meiosis)	DR	10, 11
		27	Life's greatest mystery (inheritance)	DR	12
9	Nov	1	Life's greatest mystery explained (chromosomes)	DR	13
		3	Life's roadmap (DNA)	DR	14
10		8	ELECTION DAY		
		10	How life's roadmap works (genes and gene expression)	DR	15,16
11		15	How life's roadmap works 2.0 (genomics)	DR	17, 18
		17	**QUIZ 3**		
12		22	Life's variation (population genetics)	DR	20
		24	THANKSGIVING		
13		29	Darwin's discovery (evolution and natural selection)	DR	21, 22
	Dec	1	Darwin's other discoveries (sexual and kin selection)	DR	55
14		6	Contemporary research	DR	TBA
		8	**QUIZ 4**		

** Note that additional primary readings may be posted to CourseWorks and that some minor changes to chapter readings may be made.*