CC106: Biodiversity / Causes & Consequences

I. COURSE DESCRIPTION (http://www.bu.edu/core/cc106/CC106_2010_Description.html)

A. Why this course should interest you. “Man versus the environment”...“Civilization versus nature.” While such proclamations are widespread, they simply don’t make any sense. (It would be similarly ludicrous to say: “Fish versus their aquarium.”) The truth is humanity depends upon biodiversity. Humans are but one branch among millions on an ancient tree of life, and humanity remains inextricably linked to other organisms in a complex contemporary web of life. Our civilizations are ecosystems comprising thousands upon thousands of interacting species (when you include microbes). This network of biodiversity is the source of our health and wealth. This fact is not widely appreciated, and perhaps as a result, human actions are now threatening the ecosystems that sustain us.

B. Scientific explanations for biodiversity. This course provides the conceptual framework for a lifelong understanding of the causes and consequences of biodiversity. The course will center on an inclusive biodiversity equation that encapsulates both the creative forces that generate biological novelty and the destructive forces that eliminate it. These forces span the entire biological hierarchy from molecules to cells, organisms, societies, and ecosystems. Major topics will include the origin of life, the history of organismal complexity, the evolution of sexual reproduction, the relationship of the biosphere to the geosphere, and the various forms of intimate interaction that exist between species, both beneficial and exploitative (e.g., mating, parasitism, agriculture).

C. A different perspective on human history. Human activity impacts biodiversity, and biodiversity impacts human history. The concluding section of the course will evaluate aspects of human evolution and human history in light of biodiversity principles. We will focus on the peculiarities of human mating systems and social structure and the profound impact that pathogens and agriculture exert on humanity.

II. COURSE INSTRUCTORS (http://www.bu.edu/core/cc106/CC106_2010_Instructors.html)

If you can’t attend office hours, contact the instructor by e-mail to arrange an appointment.

<table>
<thead>
<tr>
<th>Name</th>
<th>Office</th>
<th>E-mail</th>
<th>Dept. Web Link</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alex Coverdill</td>
<td>CAS 119</td>
<td><a href="mailto:alexjc@bu.edu">alexjc@bu.edu</a></td>
<td>Core</td>
<td>Mon / 9:30-11:30</td>
</tr>
<tr>
<td>(lab coordinator)</td>
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<tr>
<td>John Finnerty</td>
<td>BRB 425</td>
<td><a href="mailto:jrf3@bu.edu">jrf3@bu.edu</a></td>
<td>Biology Dept</td>
<td>Tue / 10:00-12:00</td>
</tr>
<tr>
<td>Rob Hausman</td>
<td>BSC 523</td>
<td><a href="mailto:hausman@bu.edu">hausman@bu.edu</a></td>
<td>Bio Dept</td>
<td>by appointment</td>
</tr>
<tr>
<td>Daniel Hudon</td>
<td>CAS 119</td>
<td><a href="mailto:hudon@bu.edu">hudon@bu.edu</a></td>
<td>Core</td>
<td>by appointment</td>
</tr>
<tr>
<td>Scott Mohr</td>
<td>BMERC 302G</td>
<td><a href="mailto:mohr@bu.edu">mohr@bu.edu</a></td>
<td>Chemistry</td>
<td>by appointment</td>
</tr>
<tr>
<td>Nathan Phillips</td>
<td>STO 441</td>
<td><a href="mailto:nathan@bu.edu">nathan@bu.edu</a></td>
<td>CEES</td>
<td>Tue / 11:00-12:30; Wed / 12:30-2:00</td>
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<tr>
<td>(course coordinator)</td>
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</tr>
<tr>
<td>Karen Warkentin</td>
<td>BRB 500</td>
<td><a href="mailto:kwarken@bu.edu">kwarken@bu.edu</a></td>
<td>Bio Dept</td>
<td>Tue / 3:30-4:30; Fri / 11:00-12:00</td>
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<tr>
<th>Component of Grade</th>
<th>Description</th>
<th>Fraction of Grade</th>
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<tr>
<td>Mid-term Exam I</td>
<td>This exam will cover material from lectures 1-8, discussions A-D, lab 1, and integrating forum I. Questions will be in multiple choice format. The material contained in the lecture, lab, and discussion handouts will be heavily emphasized. You will be expected to understand the required readings, particularly as they pertain to the material covered in lecture, discussion, lab, or the forum. You will not be asked to remember details from the readings that were not covered in class.</td>
<td>20%</td>
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<tr>
<td>Mid-term Exam II</td>
<td>This exam will cover material from lectures 9-15, discussions E-H, lab 2-3, and integrating forum II.</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>This exam will cover material from lectures 16-22, discussions I-M, labs 4-5, and integrating forum III.</td>
<td>20%</td>
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<tr>
<td>Discussion</td>
<td>Short quizzes (or exercises) will be given during each discussion. Quizzes will focus on issues that were covered in lecture and the readings that are assigned for each discussion. Additionally, one half of your discussion grade (or 10% of your total course grade) will be based on the writing assignment.</td>
<td>20%</td>
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<tr>
<td>Lab</td>
<td>The labs will require you to perform exercises and answer questions. You will work in teams of two, and you will each receive the same grade for the material you submit to your lab instructor.</td>
<td>20%</td>
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* Biodiversity (2002; custom edition for Boston University) Campbell & Reece.
  This text is a recommended (but not required) reference book for the course. Several copies are available for 24-hour loan in the Core office.

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  Several chapters are required reading for the course. *Purchase is recommended.*

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  Two chapters are required reading for the course. *Pdf files for these chapters are posted on the course website.*

* The Omnivore's Dilemma (2006) Michael Pollan

Version 02/22/10
V. COURSE WEB SITE: (http://www.bu.edu/core/cc106)

The course website contains all the information present in this syllabus plus additional resources including downloadable course notes, laboratory manuals, required and supplemental readings, animations, announcements, and biodiversity news. You should consult the course website often. When important updates are made to the course website, you will be notified by e-mail.

VI. LECTURE & EXAM SCHEDULE
(http://www.bu.edu/core/cc106/CC106_2010_LectureSchedule.html)

Location: SMG 105; Time: Tuesdays and Thursdays from 2:00-3:30.

Students are expected to attend all lectures. The material covered during lecture will be weighted heavily on the two midterm term examinations and the final exam.

WHY IS THERE DIVERSITY AND WHY SHOULD YOU CARE?

January 14 1. Why does biodiversity matter to humanity?
Lecturer: Finnerty
Readings: none

Lecturer: Finnerty
Readings: Ridley, pp. 1-27 "Keeping Living Things Simple"

LIFE’S EARLY HISTORY

January 21 3. From a chemical perspective, what’s special about life? The nature of biological macromolecules; What are organisms made of, and how does their chemical composition differ from inorganic matter? What can we say about the first life forms?
Lecturer: Mohr

January 26 4. How do we read the fossil record? How do we determine the geological age of things? How do we know that the continents moved? How can we reconstruct our climatic history? What kinds of fossil evidence do we have?
Lecturer: Hudon
Readings: Campbell & Reece, pp. 510-533

January 27 LAST DAY TO REGISTER FOR A CLASS

January 28 5. How has biodiversity changed over the ages? What were the most cataclysmically important events in Earth’s biological history? The origin of life; photosynthesis & the oxygen revolution; the emergence of multicellular life; signs of sex?; flowers!
Lecturer: Hudon
Readings: Campbell & Reece, pp. 510-533
DIVERSITY AT THE MOLECULAR LEVEL

February 2 6. What is a gene and how are genes organized in genomes? How does the architecture of the genome influence heredity and the course of evolution? Why did Darwin need Mendel?
Lecturer: Finnerty
Readings: Rose & Mueller, pp. 3-23, especially "Darwin Needed Mendel;" pp. 125-143, "Natural Selection"

February 4 7. How does diversity arise at the DNA Level?
Lecturer: Mohr
Readings: Rose & Mueller, pp. 165-186, "Molecular Evolution"

February 9 8. How does DNA diversity impact the functional diversity of proteins?
Lecturer: Mohr
Readings: Campbell & Reece, pp. 303-326, "From Gene to Protein;" pp. 71-80, "Proteins—Many Structures, Many Functions"

February 11 INTEGRATING FORUM I: Genetic Engineering of Food Crops.
How are we directly engineering the diversity of our food using molecular genetic tools? What are the benefits? What are the dangers? How is it affecting us?
Moderator: Hausman.
Readings: To be announced.

February 15 UNIVERSITY HOLIDAY

February 16 SUBSTITUTE MONDAY SCHEDULE

February 18 EXAM 1; Covers lectures 1-8, discussions A-D, lab 1, and forum 1.

February 18 LAST DAY TO DROP A COURSE WITHOUT EARNING A ‘W’

ORGANISMS & THE IMPORTANCE OF SEX FOR DIVERSITY

February 23 9. What is a cell?
Lecturer: Coverdill
Readings: Campbell & Reece, pp. 106-135 "A Tour of the Cell"

February 25 10. How does development contribute to complexity and diversity?
Lecturer: Coverdill
Readings: Arking, pp. 109-123, "Evolutionary and Comparative Aspects of Longevity and Aging;" Campbell & Reece, pp. 197-200, "Overview of Cell Signaling;"

March 2 11. Why Sex? What is sex? How did it evolve? Which organisms use it and which organisms don’t? What are the costs and benefits of sex?
Lecturer: Warkentin
March 4  

12. What are the consequences of sex? Sexes, sex differences, and sexual selection.

Lecturer: Warkentin
Readings: Diamond—*Why is Sex Fun?*: pp. 1-14, "The Animal With the Weirdest Sex Life;" pp. 15-40, "The Battle of the Sexes;"

March 6-14  

SPRING BREAK

March 16  

13. The Diversity of Sex. How is sex determined? How are mating systems organized, and why are they so diverse?

Lecturer: Warkentin
Readings: Rose & Mueller, pp. 557-574, “Mating Strategies;”

March 18  

INTEGRATING FORUM II / Gameshow I: The Mating Game

Moderator: Snyder
Readings: Diamond—*Why is Sex Fun?*: pp. 41-62, "Why Don’t Men Breastfeed;"

THE ENVIRONMENT

March 23  

14. What is the “Environment?”

Lecturer: Phillips
Readings: Rose & Mueller, pp. 351-379, “Competition”

March 25  

15. How do organisms affect the “abiotic” environment?

Lecturer: Phillips

March 30  

EXAM II. Covering lectures 9-15, discussions E-H, labs 2-3 & forum II.

April 1  

16. How does the environment impact the organism? Natural Selection and Phenotypic Plasticity

Lecturer: Warkentin

April 5  

Last Day to DROP Classes and Earn a ‘W’

April 6  

17. How do relationships among organisms evolve? The case of the PARASITES!

Lecturer: Finnerty
HUMANITY & BIODIVERSITY

April 8  18. What makes us human? Human evolution, part I. Big brains and bipedalism
Lecturer: Finnerty

Lecturer: Warkentin
Readings: to be determined.

April 15  20. How did we evolve food production? How did it change our existence?
Lecturer: Warkentin

April 19  UNIVERSITY HOLIDAY

April 20  21. How did biodiversity shape the outcome of the clash of civilizations?
Lecturer: Finnerty
Readings: Diamond, —Guns, Germs, & Steel, pp. 53-66, "A Natural Experiment of History"

April 22  SUBSTITUTE MONDAY SCHEDULE

April 27  22. How is intensive agriculture and factory farming changing the planet?
Lecturer: Phillips
Readings: To be announced

April 29  INTEGRATING FORUM III. What to eat and why it matters?
Moderator: Phillips
Readings: To be announced.

May 6 (9-11 am)  FINAL EXAM. Covering lectures 16-22, discussion I-M, forum III, & labs 4-5.
### VII. LAB SCHEDULE [All labs are held in SCI 307](http://www.bu.edu/core/cc106/CC106_2010_LabSchedule.html)

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<tr>
<th>LAB</th>
<th>SECTION</th>
<th>DATES</th>
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<tr>
<td><strong>I. Evolutionary Pattern &amp; Process</strong>&lt;br&gt;&lt;br&gt;Part A. This lab explores the widespread pattern of nested similarity in organisms. It was this pattern that led the earliest evolutionary theorists (e.g., Erasmus Darwin, Jean Baptiste Lamarck, Alfred Wallace, Charles Darwin) to develop the hypothesis of &quot;descent with modification.&quot; By examining the traits of real arthropods and simulated beetles you will learn that nested similarity is consistent with &quot;descent with modification&quot; but inconsistent with &quot;special creation.&quot;&lt;br&gt;&lt;br&gt;Part B. Darwin and Wallace first recognized the role of natural selection. For natural selection to operate, there must be variation in a population, the variation must be heritable (i.e., caused by genetic mutation), and this heritable variation must cause differences in the survival and reproduction of individuals. By assuming the role of a &quot;faux chicken,&quot; you will test the importance of variability, heritability, and mutation.</td>
<td>GROUP 1 [L1, L3, L5]</td>
<td>Lab meets: Jan. 25&lt;br&gt;Report due: Feb. 8</td>
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<td>GROUP 2 [M3, M5, M7]</td>
<td>Lab meets: Jan. 27&lt;br&gt;Report due: Feb. 10</td>
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<td><strong>II. Molecular Phylogeny of the Apes</strong>&lt;br&gt;&lt;br&gt;Part A / You will use protein sequences to deduce the evolutionary relationships of the great apes. (gibbon, orangutan, gorilla, chimpanzee, and human). Part B / You will design a pair of &quot;primers&quot; that could be used to isolate the same gene from each of the apes using the method of PCR (Polymerase Chain Reaction). Part C / A few volunteers from each lab section will provide a tissue sample from which we will obtain the DNA sequence of a mitochondrial gene. These data will be used in Lab III, Human Genetic Diversity.</td>
<td>GROUP 1 [L1, L3, L5]</td>
<td>Lab meets: Feb. 8&lt;br&gt;Report due: Feb. 22</td>
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<td>GROUP 3 [L4, L6]</td>
<td>Lab meets: Feb. 16&lt;br&gt;Report due: March 1</td>
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<td><strong>III. Human Genetic Diversity</strong>&lt;br&gt;&lt;br&gt;In this lab, you will construct a molecular phylogeny of human populations using published mitochondrial DNA sequences from various populations all over the world supplemented by DNA sequences derived from your own classmates (whose identity will remain anonymous).</td>
<td>GROUP 1 [L1, L3, L5]</td>
<td>Lab meets: March 22&lt;br&gt;Report due: March 24</td>
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<td>GROUP 2 [M3, M5, M7]</td>
<td>Lab meets: March 1&lt;br&gt;Report due: March 29</td>
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<td></td>
<td>GROUP 3 [L4, L6]</td>
<td>Lab meets: March 3&lt;br&gt;Report due: March 31</td>
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<td><strong>IV. Biosphere 3, part A</strong>&lt;br&gt;&lt;br&gt;In this lab, you will create your own self-contained biosphere by adding primary producers (algae), primary consumers (brine shrimp), and secondary consumers (sea anemones) to a small aquatic environment. Your experiment will test hypotheses about the composition of biological communities.</td>
<td>GROUP 1 [L1, L3, L5]</td>
<td>Lab meets: March 22&lt;br&gt;Report due: April 5</td>
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<td>GROUP 2 [M3, M5, M7]</td>
<td>Lab meets: March 24&lt;br&gt;Report due: April 7</td>
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<td>GROUP 3 [L4, L6]</td>
<td>Lab meets: March 29&lt;br&gt;Report due: April 12</td>
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<td>GROUP 4 [M4, M6]</td>
<td>Lab meets: March 31&lt;br&gt;Report due: April 14</td>
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<td><strong>V. Biosphere 3, part B</strong>&lt;br&gt;&lt;br&gt;In this lab, you will record data from your biosphere experiments set up during the last lab. You will also begin &quot;THE GREAT BIOSPHERE COMPETITION.&quot; Each team of two persons will get one attempt to construct what they hope is &quot;the world's most stable micro-ecosystem.&quot; The winner is the team that can keep an indicator species alive for the longest period of time (days, weeks, months, years...who can say?). Teams will report to the course coordinator by e-mail when their ecosystem goes caput, kicks-the-bucket, goes belly-up, etc. The winning team will achieve lasting fame on the CC106 website.</td>
<td>GROUP 1 [L1, L3, L5]</td>
<td>Lab meets: April 5&lt;br&gt;Report due: April 20*</td>
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<td>GROUP 2 [M3, M5, M7]</td>
<td>Lab meets: April 7&lt;br&gt;Report due: April 22*</td>
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<td>GROUP 3 [L4, L6]</td>
<td>Lab meets: April 12&lt;br&gt;Report due: April 27*</td>
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<td>GROUP 4 [M4, M6]</td>
<td>Lab meets: April 14&lt;br&gt;Report due: April 29*</td>
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The report for lab 5 is due at lecture* or in the core office^ on the specified date.
VIII. DISCUSSION SCHEDULE

Attendance at discussion is mandatory. We will not directly review lecture material in discussion (as is done in CC105). Rather, the material covered in discussion will reinforce the lecture material by focusing on the same major topics, but from a different perspective. You will be responsible for the material covered in discussion on the midterm exams and the final exam. The handouts that are distributed during discussion will not be made available elsewhere.

Jan. 20, 25  A. Introduction to the course. Description of writing assignment.
Jan. 27, Feb. 1  B. Misconceptions about evolution.
Feb. 3, 8  C. Evaluating alternate hypotheses for origin of biodiversity—(1) evolution, (2) special creation, (3) “intelligent design.”
Feb. 10, 16  D. Understanding the genetic code.

End of material covered on the first midterm exam. (Exam date: February 18)


Mar. 1, 3  F. Self-organization. How simple “rules” can produce complex coordinated behavior.

March 15, 17  G. The evolution of sex differences. Why don’t male mammals lactate?

March 22, 24  H. The peculiarities of human sexual reproduction—the evolution of concealed ovulation.

End of material covered on the second midterm exam. (Exam date: March 30)

Mar. 29, 31  I. The biogeochemistry of modern Americans
April 5, 7  J. Did cooking make us human?
April 12, 14  K. The evolution of agriculture and human history.
April 21, 22  L. Disease in human history.
April 26, 28  M. Eat locally?

End of material covered on the final exam. (Exam date: May 6)

IX. ACADEMIC CONDUCT

It is each student's responsibility to know and understand the provisions of the Academic Conduct Code in the College of Arts and Sciences. The Code is available online at http://www.cs.bu.edu/ugradprogram/conduct.html.

Cases of suspected misconduct will be referred to the Dean of the College. If the Dean's office comes to the conclusion that cheating or plagiarism have occurred, a grade of zero will be awarded for the assignment in question.