

# **Reinventing Life:**

## **Biology for a Rapidly Evolving World**



Biology 103 at Elon University, Fall 2008

### **Professor**

Dr. Jeffrey S. Coker

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### **Course Description**

Can humans responsibly direct evolution? *Reinventing Life* explores how human activities are rapidly changing life and what this means for the future. Basic concepts are linked with the cutting-edge science of environmental change, stem cells, genetic engineering, synthetic biology, and bioethics. A laboratory is included. No credit is given toward a Biology major or minor.

### **Course Goals**

The goals of this course are to...

- Investigate how life is changing in the 21<sup>st</sup> century.
- Evaluate the transformation of ecosystems on a global level.
- Analyze the manipulation of cell growth, division, and differentiation.
- Explore mutation, selection, and biotechnology as drivers of genetic change.
- Design plausible biological systems for the future and plan their implementation.
- Assess the scientific, social and ethical implications of actively managing evolution.
- Design, implement, analyze, and present experiments that explore biological change.

### **Course materials**

- 1) Most readings are articles from the journal *Science* (which can be accessed through the university library or by purchasing a subscription). Other readings written by the instructor will be posted in Blackboard or handed out in class.
- 2) Purchase “*Reinventing Life – Guide for Student-Designed Experimentation*” at the Campus Shop.
- 3) A 3-ring binder is recommended.

## Grading

Grades will be the following:

Tests (3 worth 100 each)	300 points
Lab assignments/reports	200
The 2100 Project	250
Final exam	<u>250</u>
Total	<b>1000</b>

Your final course grade will be assigned based on the following scale:

<b>A</b>	<b>930-1000</b>	<b>B+</b>	<b>865-894</b>	<b>C+</b>	<b>765-794</b>	<b>D+</b>	<b>665-694</b>	
<b>A-</b>	<b>895-929</b>	<b>B</b>	<b>825-864</b>	<b>C</b>	<b>725-764</b>	<b>D</b>	<b>625-664</b>	<b>F &lt;595</b>
		<b>B-</b>	<b>795-824</b>	<b>C-</b>	<b>695-724</b>	<b>D-</b>	<b>595-624</b>	

“A” indicates distinguished performance.

“B” indicates above average performance.

“C” indicates average performance.

“D” indicates a passing performance despite some deficiencies.

“F” indicates failure.

“I” indicates that your work has been interrupted by a severe illness, emergency, or extreme hardship which was not the result of your own negligence.

**Exams:** Each exam (excluding the final exam) will assess your knowledge of material from class, lab, readings, and assignments since the last exam. Most questions will be short answer questions, but short essays, labeling, fill-in-the-blank, multiple-choice, and other question types will also be used.

**Labs:** Lab is a time to DO science. Come prepared to be active! Before you come to lab each week, you should read any lab protocols, bring required materials to lab, and/or do any assigned pre-labs. Labs are performed in collaboration with other students (normally in pairs). Nevertheless, you must do your own work. Note that there is a lab dress code – to protect your health and well-being and to comply with federal and state regulations, you are required to wear shoes and clothing during labs that completely covers. You will not be permitted to attend lab in improper clothing/shoes.

**The 2100 Project:** Project information will be given to you well in advance.

**Final exam:** The final exam will be a cumulative 3-hour exam. If you miss the final exam, you must obtain permission to make it up from the Chair of the Department. Do not schedule travel on the exam day!

**Extra credit:** 1) If you find any errors in your course materials (readings, PowerPoints, etc.), whether big or small, point them out in an email and, if I agree, you’ll get bonus points equivalent to the size of the error. Only one student can get points for an error.

2) Just for fun... If you see your professor outside somewhere on campus, you may approach him and ask for a tree quiz. He will then point at a nearby tree. If you know the full common name, you get 1 point. If you know the full species (Latin) name, you get 3 additional points. It is your responsibility to send your professor an email asking him to record the points. You can get a maximum of 12 extra credit points.

### **Attendance policy:**

- 1) Attendance is essential in a lab course. There are no make-up labs, quizzes, tests, or assignments for unexcused absences or tardies. In other words, being late or absent results in zeros (or point deductions in the case of multi-week labs). This is the reality of the professional world for which you are preparing.
- 2) Excused absences must be approved by Dr. Coker at least 1 class period in advance unless they involve a documented sickness or emergency.
- 3) Students who miss 10 or more classes will receive a final grade of "F." An absence is defined as missing more than 10 minutes of class.

### **Academic Integrity**

You are expected to maintain the highest possible academic and intellectual honesty. Elon University standards of academic integrity prohibit either giving or receiving unauthorized help on graded assignments. Violations of Elon standards will be reported to the Provost's Office. The Academic Honor Pledge must be signed on each exam:

*"On my honor, I have abided by the Elon University Honor Code."*

In addition, as it is stated in the Student Handbook, you are expected to 1) Express opinions with civility and with consideration for the opinions of others; 2) Respect shared intellectual property and resources; and 3) Promote the importance of the honor code in all your interactions for the benefit of the learning community. Information about the Honor Code may be found at <http://www.elon.edu/e-web/students/handbook/akahoncode.xhtml>. If you are unsure what constitutes plagiarism, try the short tutorial at [http://www.indiana.edu/~istd/plagiarism\\_test.html](http://www.indiana.edu/~istd/plagiarism_test.html).

### **Students with Disabilities**

I am committed to teaching every student in this course. If you have a disability that will affect your performance, reasonable accommodations will be made for you. You must provide documentation of disability from disability services (278-6500).

**CLASS TOPICS**

**ASSIGNMENT DUE**

<p>Week 1 Sept 1-5</p> <p>T W T F</p>	<p>W – Welcome to Biology! Introductions Pre-test and survey Biology in the modern world</p> <p>F – Biodiversity big and small Evolution all around us</p>	<p>F – “Humans as the World’s Greatest Evolutionary Force” (Science 293:1786) “Biodiversity Big &amp; Small” (Written by J.S. Coker)</p>
<p><b>Ecological Change</b></p>		
<p>Week 2 Sept 8-12</p> <p>M T W T F</p>	<p>M – Introduction to ecology and ecological change</p> <p>W – Ecological Change Experiments (Part 1) A study of Elon Forest <i>Meet 5 minutes early in front of Chandler Fountain.</i></p> <p>F – Human influence and dependence Video (Journey to Planet Earth – On the Brink)</p>	<p>M – Research your species (assigned in last class) “Food Web Ecology” (Science 309: 68)</p> <p>W – Section I and II of lab guide (Guide to Scientific Experiments; Ecological Change)</p> <p>F – “Long-term Ecosystem Response to the Exxon Valdez Oil Spill” (Science 302: 2082)</p>
<p>Week 3 Sept 15-19</p> <p>M T W T F</p>	<p>M – The decline of biodiversity</p> <p>W – Ecological Change Experiments (Part 2) <i>Meet 5 minutes early in front of Chandler Fountain.</i></p> <p>F – Video: Journey to Planet Earth – What is the state of the planet’s wildlife?</p>	<p>M – “The Scientific Consensus on Climate Change” (Science 306: 1686) “Evolutionary Response to Rapid Climate Change” (Science 312: 1477)</p> <p>W – “Can the bald eagle still soar after it is delisted?” (Science 316: 1689)</p> <p>F – “The Lost World of the Kihansi Toad” (Science 311: 1230)</p>
<p>Week 4 Sept 22-26</p>	<p>M – Sustaining ecosystems and societies</p>	<p>M – Take the Ecological Footprint Quiz at <a href="http://www.myfootprint.org/">www.myfootprint.org/</a>. Bring the questions and results to</p>

M T W T F	<p>W – Ecological Change Experiments (Part 3) <i>Discussion - Meet in McMichael 114.</i></p> <p>F – <b>Exam (100 pts)</b></p>	<p>class. “Building a Green Railway in China” (Science 316: 546)</p> <p>W – <b>Ecological Change Lab Report (50 pts)</b></p> <p>F – Study!</p>
<b>Cellular Change</b>		
<p>Week 5 Sep 29-Oct 3</p> <p>M T W T F</p>	<p>M – Introduction to cells and cellular change</p> <p>W – Cellular Change Experiments (Part 1)</p> <p>F – Manipulating cell growth and division</p>	<p>M – “What is a cell?” (read to ‘Where do viruses fit’) (<a href="http://www.ncbi.nlm.nih.gov/About/primer/genetics_cell.html">http://www.ncbi.nlm.nih.gov/About/primer/genetics_cell.html</a>)</p> <p>W – Section III of lab guide</p> <p>F – “How Does a Single Somatic Cell Become a Whole Plant” (Science 309: 86)</p> <p>“Losing the Links Between Livestock and Land” (Science 310: 1621)</p>
<p>Week 6 Oct 6-10</p> <p>M T W T F</p>	<p>M – Stem cells and cloning</p> <p>W – Cellular Change Experiments (Part 2)</p> <p>F – Managing the Evolution of Diseases (Malaria, AIDS, etc.)</p>	<p>M – “Stem Cell Basics” (<a href="http://stemcells.nih.gov/staticresources/info/basics/StemCellBasics.pdf">http://stemcells.nih.gov/staticresources/info/basics/StemCellBasics.pdf</a>) “The Saola’s Last Stand” (Science 314: 1380)</p> <p>W – TBA</p> <p>F – “Managing the Evolution of Diseases” (J.S. Coker)</p>
<p>Week 7 Oct 13-17</p> <p>M T W T F</p>	<p>M – Meet at the front of the library! Introduction to The 2100 Project</p> <p>W – <b>Exam (100 pts)</b> Mid-term grade reports / mid-term evaluations</p> <p>F – No class. Work on projects.</p>	<p>M – <b>Cellular Change Lab Report (50 pts)</b></p> <p>W – Study!</p> <p>F – Work on projects</p>

	<i>Have a great Break!</i>	
<b>Genetic Change</b>		
<p>Week 8 Oct 20-24</p> <p style="text-align: center;">W T F</p>	<p>W – Genetic Change Experiments (Part 1)</p> <p>F – Introduction to genes and genetic change</p>	<p>W – Section IV of lab guide Examine <a href="http://www.23andme.com">www.23andme.com</a>. <b>1<sup>st</sup> draft of project due (50 pts)</b></p> <p>F – “Introduction to Genes and Genetic Change” (J.S. Coker)</p>
<p>Week 9 Oct 27-31</p> <p style="text-align: center;">M T W T F</p>	<p>M – Genetic mutation</p> <p>W – Natural and artificial selection</p> <p>F – Genetic Change Experiments (Part 2)</p>	<p>M – “First Pass at Cancer Genome Reveals Complex Landscape” (Science 313: 1370) “Mutations and Health” (<a href="http://ghr.nlm.nih.gov/handbook/mutationsanddisorders.pdf">http://ghr.nlm.nih.gov/handbook/mutationsanddisorders.pdf</a>)</p> <p>W – “Unfallen Grains: How Ancient Farmers Turned Weeds into Crops” (Science 312: 1318) “Rapid domestication of marine species” (Science 316: 382)</p> <p>F – “Gene Therapy” (<a href="http://ghr.nlm.nih.gov/handbook/therapy.pdf">http://ghr.nlm.nih.gov/handbook/therapy.pdf</a>)</p>
<p>Week 10 Nov 3-7</p> <p style="text-align: center;">M T W T F</p>	<p>M – Genetic engineering</p> <p>W – Genetic Change Experiments (Part 3)</p> <p>F – <b>Exam (100 pts)</b></p>	<p>M – “A growing threat down on the farm” (Science 316: 1114)</p> <p>W – TBA</p> <p>F – Study!</p>
<b>Reinventing Life</b>		
<p>Week 11 Nov 10-14</p> <p style="text-align: center;">M T W T F</p>	<p>M – Human reproductive options</p>	<p>M – “U.K. Embryos may be Screened for Cancer Risk” (Science 312: 984)</p> <p>“Melting opposition to frozen eggs” (Science 316: 388)</p>

	<p>W – Reinventing Life Experiments</p> <p>F – The organism-machine interface</p>	<p>W – <b>Genetic Testing Lab Report (50 pts)</b></p> <p>F – “Synthetic Biologists Debate Policing Themselves” (Science 312: 1116)</p>
<p>Week 12 Nov 17-21 M T W T F</p>	<p>M – <b>2100 Project Presentations (200 points)</b></p> <p>W – Reinventing Life Experiments</p> <p>F – 2100 Project Presentations (continued)</p>	<p>M – <b>Project</b></p> <p>W – TBA</p> <p>F – Project</p>
<p>Week 13 Nov 24-28 M T</p>	<p>M – 2100 Project Presentations (continued)</p>	<p>M – Project</p>
<p>Week 14 Dec 1-5 M T W T F</p>	<p>M – 2100 Project Presentations (continued)</p> <p>W – Synthesis activity: “From palette to painting” Exam information</p> <p>F – The future of life</p>	<p>M – Project</p> <p>W – Bring all course materials to class.</p> <p>F – “Humans as the World’s Greatest Evolutionary Force” (2<sup>nd</sup> reading)</p>
<p>Week 15 Dec 8-12 M T</p>	<p>M – “Who is at the head of the class?” Semester summary Evaluations</p>	<p>M – Complete synthesis activity and study for exam.</p>
<p><b>Your final exam is 1:00-4:00 PM on Friday, December 12, 2008 (250 pts).</b></p>		