SEMESTER AT SEA COURSE SYLLABUS

Voyage: Fall 2014
Discipline: Biology
BIOL 1559-101: Modern Evolutionary Theory
Division: Lower
Faculty Name: John L. Dahl

Pre-requisites:
A high-school course that has covered basic molecular and cellular biology, botany, and zoology.

COURSE DESCRIPTION

The theory of evolution is a simple but elegant idea that species arose from a common ancestor and that new species continue to arise as a result of natural selection working on the biological diversity of existing populations. Evolutionary Biology is a cornerstone of modern science, and since its introduction by Charles Darwin over 150 years ago it has produced a dramatic paradigm shift in how humans view themselves and all life on this planet. The established truth of evolutionary theory has long been muddled and misinterpreted in American classrooms, which has contributed to an estimated 46% of Americans claiming not to believe in human evolution. This course will explore the history of evolutionary theory, review scientific evidence for evolution-particularly focusing upon the explosion of insights provided by Molecular Biology in the past 20 years, discuss social implications of the theory of evolution, and examine modern challenges like infectious diseases, genetic modification of crops, and climate changes that are particularly interesting from the perspective of evolution. Several sites on the voyage will be significant with regards to the topic of Evolution. Darwin visit to South America played a pivotal role in the formulation of his theory. HIV and drug-resistant tuberculosis are modern examples of evolution in Russia and Africa, Morocco is a treasure trove of Cambrian fossils, and human ancestry traces its origins to Africa.

COURSE OBJECTIVES

1. To help students understand why it is important to understand modern evolutionary theory, what modern implications it has, and how it is one of the most simplest and powerful ideas in the history of human thought.
2. To have students understand how science operates ('scientific method') and the types of problems science can and cannot successfully address.
3. To show students the wide breadth of evidence that supports the fact of evolution by natural selection; evidence that draws from the areas of comparative anatomy, biogeography, paleontology, and molecular biology.
4. To introduce students to the lives, life-styles, and discoveries of several historical figures that played major roles in the formulation of the evolutionary theory including Charles Darwin, Alfred Wallace, and numerous others.

5. To explore with students the impact that evolutionary theory has had on 19th -21st century world society, including the economic policy of the former USSR and fundamentalist Christian movements in the USA.
6. To expose students to modern evolutionary writing aimed at the general public (selected works by Wilson, Gould, and Dawkins).
7. To provide students with a global perspective of evolutionary theory and an appreciation of the planet's biological diversity that has been made possible by evolution by natural selection.

REQUIRED TEXTBOOKS
AUTHOR: Jerry A. Coyne
TITLE: Why Evolution is True
PUBLISHER: Viking (Penguin)
ISBN #: 978-0-670-02053-9
DATE/EDITION: 2009/1st

TOPICAL OUTLINE OF COURSE

Depart Southampton- August 23:

A1- August 25: : Introduction to the course and to its field program. Why understanding evolution matters and an overview of evidence for evolution

Questions to be Addressed:
- What is the evolution of the theory of evolution?
- What is evolution and why do you need to know about it?
- Is evolution a fact or a theory?
- What evidence exists for evolution?

Reading Assignment:
Why Evolution is True (*WEIT*) Preface and Introduction

Assignment Due Today:
Watch the PBS film *Evolution: Darwin's Dangerous Ide*a before next period

A2-August 27: Russia: Early theories of life, Lamarckian evolution, MDR-TB

Questions to be Addressed:
- How did political-social forces in the Soviet Union lead to disastrous decisions based upon faulty ideas of evolution?
- Where did *M. tuberculosis* come from?
- What factors have driven the rise of multiple drug-resistant tuberculosis (MDR-TB)?
- How bad is drug-resistant tuberculosis?

Reading Assignment:
Why Evolution is True (*WEIT*) Chpt. 1
Chpt. 7 from the book *Time Bomb* (pdf)

Assignment Due Today:
Watch the PBS film *Evolution: Evolutionary Arms Race* before arriving in Russia

St. Petersburg: August 29- September 2

A3- September 3: Charles Darwin and the Origin of Species

Questions to be Addressed:
- Who was Charles Darwin?
- What led him to formulate his theory of evolution?
- Why did it take him so long to present his case to the public?
- Was Darwin right?

Reading Assignment:
Read Chpt. 4 of *Origin of Species* (pdf) and a graphic novel version of this chapter (pdf)

Assignment Due Today:
Watch the movie *Creation* (109 min) before next class

A4- September 5: Biological definition of "race," Social Darwinism, Evolution as a tool of political propaganda in Nazi Germany

Questions to be Addressed:
- Does the term "race" have any biological significance?
- What is the origin of the idea of a master (Aryan) race?
- What is eugenics philosophy?

Reading Assignment:
WEIT Chpt. 8, p. 212-216

Assignment Due Today:
Watch the movie *The Genius of Darwin*, pt 2 (first 30 min) and the movie *GATTACA* (107 min) before arriving in Hamburg

Hamburg: September 7-11

A5- September 12: Evolution of Social Behavior, parallels with the Great War (WW I)

Questions to be Addressed:
- Does evolution drive the formation of altruistic social systems?
- What is inclusive fitness and kin selection?
- What is a social cheater?

Reading Assignment:
Read the Scientific American article on punishing cheaters (http://blogs.scientificamerican.com/primate-diaries/2012/08/16/punishing-cheaters/?print=true)
Altruism and Aggression from the book *In Search of Nature* (pdf)

Assignment Due Today:
Watch the movie *Paths of Glory* (88 min) before arriving in Belgium

Quiz #1

Antwerp: September 14-16
Le Havre: September 17-19

A6-September 20: The Engine of Evolution: Natural Selection and Genetic Drift

Questions to be Addressed:

- What is the Hardy-Weinberg equation and how is it used?
- What are some of life's most amazing adaptations?
- Is evolution a random event?
- How can something as complex as the vertebrate eye arise by evolution?
- What was Malthus' contribution to the theory of evolution?

Reading Assignment:
WEIT Chpt. 5

Assignment Due Today:
Watch the movie *When Ireland Starved* before arriving in Dublin

A7- September 22: Current societal issues involving evolution

Questions to be Addressed:

- Are genetically-modified organisms (GMOs) health for consumption?
- Are use of GMOs ethical?
- How has forensic science called into question the death penalty?

Reading Assignment:
Chpt. 6 from the book *The Secret of Life* (pdf)

Assignment Due Today:
Watch the film *Food, Inc.* before next period

Dublin: September 24-27

A8- September 28: Origin of Life, Cambrian Explosion

Questions to be Addressed:

- What are different theories for the origin of life?
- How has life altered the planet?
- How did multicellular life begin?
- Could life exist on other planets (panspermia)?

Reading Assignment:
Introduction from the book *Vital Dust* (pdf) and Chpt. 2 from the book *Wonderful Life (*pdf)

Assignment Due Today:
Watch the movie *First Life-Arrival* before the next class period

A9- September 30: Age of Earth and the fossil record; Moroccan trilobites

Questions to be Addressed:

- What is a "missing link" and is it necessary to support the theory of evolution?
- How are fossils made and do they show gradual change?
- What are some of the most amazing fossil finds and what do they tell us?

Reading Assignment:
WEIT Chpt. 2

Assignment Due Today:
Watch the movies *The History of Earth* (91 min) and *Titanoboa* (53 min) before next class period
Quiz #2

Lisbon: October 1-2
In transit: October 3
Cadiz: October 4-5

A10- October 7: Speciation

Questions to be Addressed:

- What drives variation in species?
- Of what value is biological diversity to humans?
- Can we see evolution of new species happening today?

Reading Assignment:
WEIT Chpt. 7

Assignment Due Today:
Watch the three part BBC series *Sea Monsters* and the movie *Evolution-What Darwin Never Knew* before arriving in Morocco

Casablanca: October 8-11

A11-October 13: Biogeography: the study of the distribution of species on Earth

Questions to be Addressed:

- What was so special about the Galapagos Islands?
- What is convergent evolution?
- How do island ecologies support the theory of evolution?

Reading Assignment:
WEIT Chpt. 4

Assignment Due Today:

A12- October 15: A12- October 19: Human Evolution

Questions to be Addressed:

- Did humans evolve from chimpanzees?
- What evidence exists for human evolution and human migration?
- Who was "Mitochondrial Eve"?

Reading Assignment:

WEIT Chpt. 8
Chpt. 2 from the book *The Secret of Life* (pdf)

Assignment Due Today:
Watch the movie *Journey of Man* (113 min) before arriving in Senegal

Dakar: October 16-19

A13- October 21: HIV: the origin and evolution of a virus

Questions to be Addressed:
- Where did HIV come from?
- Why is it so hard to stop HIV?
- Why does the virus evolve so quickly?

Reading Assignment:
Chpt. 1 from *Evolutionary Analysis* 4th edition (pdf copy)

Assignment Due Today:
Watch the movie *Origin of AIDS* before the next class period

A14- October 23: HIV: evolution of resistance to the virus

Questions to be Addressed:
- Why are some people naturally immune to HIV disease (AIDS)?

Reading Assignment:
Chpt. 1 from *Evolutionary Analysis* 4th edition (pdf copy)

Assignment Due Today:
Watch the movie *Surviving AIDS* before the next class period
Quiz #3

Takoradi: October 25-26
Tema: October 27-28

A15- October 29: Evolution of whales; Evolution of "zombie" parasites

Questions to be Addressed:
- What are vestigial organs and what do they tell us about evolution?
- Why would mammals return to the sea?
- Can parasites alter behavior of an infected host to help spread the parasite?

Reading Assignment:
Selected chapter from *World War Z* (pdf)
WEIT Chpt. 2

Assignment Due Today:
Watch the movie *Evolution: Extinctions* before next period

A16- October 31: Extinction

Questions to be Addressed:
- How many massive extinctions have occurred in Earth's history and why?

- Are humans driving the next great extinction?
- Why do individuals die?

Reading Assignment:
Is Humanity Suicidal from the book *In Search of Nature* (pdf)

Assignment Due Today:
Watch the movies *End of the Line* and *Evolution: Extinctions* before next class period

Study Day: November 2

A17-November 3: Evolution of the Brain

Questions to be Addressed:
- Do evolutionary forces drive the formation of culture and language?

Reading Assignment:
WEIT Chpt. 8

Assignment Due Today:
Watch the PBS movie *Evolution: The Mind's Big Bang* before arriving in Tema

A18- November 5: Evolution and Sex: evolutionary reasons for sex and sexual selection

Questions to be Addressed:
- What evolutionary advantage can exist for the peacock's tail?
- What advantages and disadvantages does sexual reproduction provide?
- Do bacteria have sex?

Reading Assignment:
WEIT Chpt. 6

Assignment Due Today:
Watch the movie *Evolution: Why Sex?* before next period

Rio de Janeiro: November 7-9
In-transit: November 10-11
Salvador: November 12-14

A19- November 15: Evolution in culture, art, film, and literature

Questions to be Addressed:
- How has human evolution been portrayed by Hollywood?
- What did paleoartists like Charles Knight contribute to public perception of evolution?
- What evolutionary themes appeared in the dystopian novels of H.G. Wells?

Reading Assignment:
A select chapter from *Galapago*s by Kurt Vonnegut

Assignment Due Today:
Watch the movie *Island of Lost Souls* before next period

Show photograph of the bower each man has built (women choose)

A20- November 17: Molecular evidence of evolution

Questions to be Addressed:

- Does genome size matter?
- What is a "molecular clock"?
- Does non-coding DNA have evolutionary significance?

Reading Assignment:
None

Assignment Due Today:
Watch the movie *Evolution-What Darwin Never Knew* before next class period

Study Day: November 19

A21-November 20: Evo-Devo: the evolution of development

Questions to be Addressed:

- What is a genetic tool kit?
- How could the great diversity of animals evolve from a common ancestor?
- What do you have in common with a fruit fly and what are hox genes?

Reading Assignment:
WEIT Chpt. 3

Assignment Due Today:
Watch the movie *Titanoboa* (53 min) before arriving in Barbados
Quiz #4

Bridgetown: November 22-24

A22-November 25: The debate over "Scientific Creationism" and Intelligent Design

Questions to be Addressed:

- What are creationist arguments look like?
- Does accepting the theory of evolution require one to become an atheist?
- Why is the theory of evolution such an emotionally charged issue for so many?

Reading Assignment:
WEIT Preface and Introduction

Assignment Due Today:
Watch the films *Judgment Day: Intelligent Design on Trial* and *American Experience: The Monkey Trial* before the next period

A23- November 27: Evolution and Ethics

Questions to be Addressed:

- "Why should the fifth ape love thy neighbor?"
- Can evolution produce altruistic behavior?
- What is "the selfish gene" and can it be responsible for kindness? (Why do

people donate blood?)

Reading Assignment:
WEIT Chpt. 9
Chpt. 9 from the book *Timeless Healing* (pdf)

Assignment Due Today:
Watch the movies *Evolution: What About God?* and *Cuba: the Accidental Eden* before arriving in Havana and Nature:

Havana: November 29- December 2:

Study Day- December 3

Assignment Due Today:
Completed Field Journal and Completed Class Journal

A24-December 4 (A Day Finals): Quiz #5

FIELD WORK

Field lab attendance is mandatory for all students enrolled in this course. Please do not book individual travel plans or a Semester at Sea sponsored trip on the day of our field lab.

FIELD LAB (*At least 20 percent of the contact hours for each course, to be led by the instructor.*)

Idea #1: Visit a zoo and a botanical garden in **Belgium.** The day of the field lab would begin at the **Antwerp Zoo**, which is one of the oldest zoos in the world (founded in 1843) and within walking distance of the ship. A visit to the zoo would include a focused study of two areas (the monkey and reptile houses). Following this visit the students will take a 36 km (30 min bus ride) from the zoo to the **National Botanic Garden of Belgium** on the northern side of Brussels. The group will be led on a 2 hour tour of "The Evolution House" (one of several greenhouses in the giant Plant Palace) that spans 500 million years of plant evolution from the Jurassic period to the present. **http://www.br.fgov.be/PUBLIC/GENERAL/universities.php**

Within 5 days of the visit, a 1000-word report will be due on the topic "How a visit to a zoological and botanical garden enhanced my understanding of the evolutionary process". Participation in the zoo visit and the quality of this report will constitute 20% of the student's course grade.

Idea #2: Visit a Neanderthal cave (Gorham's Cave) in Gibraltar near **Cadiz, Spain**. I have had some contact with the possibility of Dr. Clive Finlayson who is the director of the Gibraltar Museum and is considered a leading expert on Neanderthals, about the possibility of him hosting a group of students for a day. This field lab would involve a 1.5 hour bus ride to Gibraltar from Cadiz with the primary objective of visiting Gorham's Cave in the southeastern corner of Gibraltar, which has been nominated as a UNESCO World Heritage Site and contains evidence of being one the last places inhabited by Neanderthal man. It may be also possible to visit Forbes' Quarry on the northern edge of Gibraltar, which contains a WWII pillbox and is the sight of the second Neanderthal skull ever discovered. Gibraltar is truly an amazing place to visit and the day's lab could include climbing to the Rock of Gibraltar to observe wild Barbary apes which are the only other free-living primates in Europe besides man.

http://news.bbc.co.uk/2/hi/5343266.stm

Within 5 days of the visit, a 1000-word report will be due on the topic "How a visit to Gibraltar has altered your perception of life for early human subspecies". Participation in the zoo visit and the quality of this report will constitute 20% of the student's course grade.

FIELD ASSIGNMENTS

- Students will keep a field journal of their experiences throughout the voyage with the intent of recording in drawings and descriptions flora and fauna they witness throughout the voyage. The purposes of this will be to simulate the experience Darwin had in his historic voyage, to train students in the skills of naturalistic observations, and to allow students to develop their skills in scientific illustration.
- Towards the conclusion of the course (following immediately after the fifth quiz on Dec. 8th), students will orally present short power point presentations in which they show 2-4 slides containing photos of images they took during the entire length of the trip that illustrates some evolutionary principle/observation. During these short presentations,

students will also point out some problem they observed during the trip that has some kind of evolutionary significance.

METHODS OF EVALUATION / GRADING RUBRIC

Teaching Methods:

Lectures and discussions will be the primary formats for delivering content in class and will be interspersed with application-related experiences and small group work. Student work will include small group projects and attendance and participation is expected for each lecture period.
Readiness concept: The responsibility to learn is fundamentally that of the student. In order to succeed in a new subject, students must be actively engaged in the process of learning. Preparation for each class is essential and requires that each student read the assigned readings, have deeply processed issues, and be able to express a point of view.

Course requirements and Evaluation:

Final course grade will be based upon the following percentages:

5 quizzes (10% each). Each quiz will consist of multiple choice, true/false, and short essays
Completed Field Journal (15%)
Student paper based upon field lab (20%)
Completed Class Journal (15%)

Grade will be determined based upon the following final percentages of possible points:

A+	100 - 97.6%
A	97.5 - 92.6%
A-	92.5 - 90.0%
B+	89.9 - 87.6%
B	87.5 - 82.6%
B-	82.5 - 80.0%
C+	79.5 - 77.6%
C	72.6 - 77.5%
C-	72.5 - 70.0%
D+	69.9 - 67.6%
D	67.5 - 62.6%
D-	62.5 - 60.0%
F	59.9% and below.

RESERVE LIBRARY LIST

AUTHOR: Charles Darwin
TITLE: Origin of the Species by Means of Natural Selection
PUBLISHER:
ISBN #:
DATE/EDITION: (currently in SAS stacks)

AUTHOR: Richard Dawkins
TITLE: The Selfish Gene

PUBLISHER:
ISBN #:
DATE/EDITION: (currently in SAS stacks)

AUTHOR: Candice Millard
TITLE: River of Doubt: Theodore Roosevelt's Darkest Journey
PUBLISHER: Broadway Books
ISBN #: 0767913736
DATE/EDITION: 2005/1st paperback edition (currently in SAS stacks)

AUTHOR: Richard Milner
TITLE: Darwin's Universe; Evolution from A to Z
PUBLISHER: University of California Press
ISBN #: 0520243765
DATE/EDITION: 2009/1st ($47 from Amazon)

ELECTRONIC COURSE MATERIALS

AUTHOR: Scott Freeman and Jon Herron
CHAPTER TITLE: Chapter 1: A Case for Evolutionary Thinking: Understanding HIV
BOOK TITLE: Evolutionary Analysis (4th edition)/ Pearson Prentice Hall publisher
ISBN #: 0132275848
PAGES: 3-36

ADDITIONAL RESOURCES
Students will have access to the following DVD movies via onboard CCTV. Watching these movies will be a required part of course activities:
Evolution: Darwin's Dangerous Idea
Evolution: Evolutionary Arms Race
Evolution: Great Transformations
Evolution: Why Sex?
Evolution: What About God?
Evolution: Extinctions
Evolution: The Mind's Big Bang
Food, Inc.
The Genius of Darwin, pt 1 & 2
GATTACA
Creation
American Experience: Influenza
American Experience: The Monkey Trial
Judgment Day: Intelligent Design on Trial
End of the Line
Journey of Man
When Ireland Starved

HONOR CODE

Semester at Sea students enroll in an academic program administered by the University of Virginia, and thus bind themselves to the University's honor code. The code prohibits all acts of lying, cheating, and stealing. Please consult the Voyager's Handbook for further explanation of what constitutes an honor offense.

Each written assignment for this course must be pledged by the student as follows: "On my honor as a student, I pledge that I have neither given nor received aid on this assignment." The pledge must be signed, or, in the case of an electronic file, signed "[signed]."