

**What is Life?**  
New York University  
Laura Franklin-Hall  
Fall 2009

Class Time: Friday 11:00-1:30 (2<sup>nd</sup> floor seminar room, 5 Washington Place)  
Office Hours: Thursday 11:00 – 12:30 (407, 5 Washington Place)

Course Sketch

It seems that living things—such as people, penguins, algae, and bacteria—differ from rocks, metal and other inanimate matter in some fundamental way. But in what exactly does this difference consist? Are living things animated by souls that non-living things lack? Or do living things possess some life-bestowing metabolic property? In this course we will probe both contemporary and historical answers to the question “what is life?” through an examination of the work of philosophers, biologists, and writers of fiction. After considering the views of historical thinkers such as Aristotle, Descartes, and Coleridge, our investigation will be driven by examinations of the boundary between the living and the non-living. We will consider how life first evolved on earth from inanimate matter, and learn about the search for life on other planets. What assumptions about the nature of life guide such searches? How different from terrestrial life might alien life be? Next, we will discuss scientific attempts to manufacture artificial life, both in the past and in our own time by synthetic biologists, engineers, and computer scientists. Finally, while reading Mary Shelley’s *Frankenstein*, among other works, we will enjoy reflecting on how life—and artificial life in particular—has been portrayed in literature.

Reading Schedule

Introduction and Historical Foundations

Class 1, 9.11.09.

Pt 1: What is *life*? Introduction to topics.

Pt. 2: How did Aristotle distinguish the living from the non-living?

*De Anima* (4th century b.c.e.), Book 2, chapters 2-4

Historical Controversies

Class 2, 9.18.09. Debate 1: Is life “organized dust” or something more?

Pt. 1: Mechanism

Rene Descartes: life as the operation of a complex machine  
from the *Treatise on Man [De homine]* (1662)

Pt. 2: Vitalism

Samuel Coleridge: all matter as living; life as ‘unity in multiplicity’  
*Hints Towards the Formation of a More Comprehensive Theory of Life* (c. 1810)

Class 3, 9.25.09. Debate 2: The puzzle of generation

Pt. 1: Epigenesis

Aristotle, from *The Generation of Animals* (4<sup>th</sup> century b.c.e.)

Pt. 2: Preformationism and a synthesis

Charles Bonnet, from *The Contemplation of Nature* (1766)

J. F. Blumenbach, *On Generation* (1792)

Contemporary Foundations

Class 4, 10.2.09. What is the theory of evolution by natural selection?

Pt. 1: Background to Darwin’s views

Erasmus Darwin, from *Zoonomia* (1803)

Jean-Baptiste Lamarck, from *Zoological Philosophy* (1809)

Pt. 2: Darwinian Evolution

Charles Darwin, from *On the origin of species* (1859) chapters 3, 4, and 14

### Contemporary Controversies

Class 5, 10.9.09. The targets of selection

Pt. 1: Genic Selection

Richard Dawkin, *The Selfish Gene* (1976) chapters 1-4

Pt. 2: Individual Selection

Stephen J. Gould, "Selfish Genes and Nice Groups" (1980)

Pt. 3: Multi-Level Selection

Samir Okasha, "The Units and Levels of Selection" (2008)

10.10.09 – *Visit to the American Museum of Natural History*

Class 6, 10.16.09. How did life originate?

*Seven clues to the origins of life* (1985) Cairns-Smith, A. G. Cambridge: Cambridge University Press. [entire]

Class 7, 10.30.09. Is life in the universe common or rare?

Cohen and Steward, *What Would a Martian Look Like?* (2002) chapters 4, 5, 6, and 10

Peter Ward, *Rare Earth*, (2005) chapter 3

OPTIONAL: William Herschel on life on the moon (1771/1776)

### The Quest to Define Life

Class 8, 11.6.09. Other Kinds of Living Things?

Sousa "Biological Individuality" (2005) - individual organisms

James Lovelock, *The Ages of Gaia* (1988) chapters 1 and 2 - the earth as an organism

Herbert Spencer "The Social Organism" (1860) - society as an organism

Class 9, 11.13.09. Defining Life

Ganti, *The Principles of Life* (2003 [1971]) chapters 1 - 3

Dupre & O'Malley "What are living things?" (2008)

Bedau "What is Life?" (2008)

### The Quest to Manufacture Life

Class 10, 11.14.09. Historical Reactions to Artificial Life

Frankenstein, Mary Shelley (1816) (available in the bookstore)

Schummer "The Creation of Life in Cultural Context: From Spontaneous Generation to Synthetic Biology" (2007)

Class 11, 11.20.09. Manufacturing Life: "Wet" AL and "Soft" AL

visit from Rockefeller scientist Alfred Libchaber, 12:15 - 1:30

Szostak, Bartel & Luisi "Synthesizing Life," (2001)

Bedau "Artificial Life" (2003)

11.27.09. No class: Thanksgiving Break

Class 12, 12.11.09. Artificial Life and Artificial Mind

John Searle, "Minds, Brains and Programs" (1980)

David Chalmers, "The Puzzle of Conscious Experience" (1995)

Take-Home Final Exam Due 12.13.09

### General Information

1. This course is multi-disciplinary – it is a biology course, a philosophy course, and

a history course, rolled into one. These different aspects will require different skills. We will talk about expectations during class.

2. This course includes a required field-trip – we will visit the American Museum of Natural History outside of class hours, most likely on a Thursday afternoon in October. Everything will be paid for by the college except your subway fare. We will travel together from the NYU campus.

#### Requirements

1. *Attendance* in seminar is required. Although absences can be excused in *special* circumstances, no more than 2 absences can be excused in total. For each unexcused absence, your final grade will be penalized by 5%. Excuses will only be granted in special circumstances (religious commitment, serious illness, etc.)
2. *Class participation*: This is a small seminar, and we aim to have interesting discussions. It is crucial that you be prepared for each class by completing the reading. I don't expect that this will be necessary, but if evidence indicates that the reading is not being accomplished, *I reserve the right to administer pop-quizzes*.
3. *Written Assignments*
  - 5 response papers (6% each): 30% (6 weeks, skip one)
  - Participation: 10%
  - Final Essay: 30%
  - Final Take-Home Exam: 30%