Syllabus

Course Description

Astrobiology addresses three basic questions that have been asked in various ways for generations:

1. how does life begin and evolve
2. does life exist elsewhere in the universe
3. what is the future of life on Earth and beyond?

This large multidisciplinary introductory class delves into the origin of life in the universe and the quest for space exploration. The class will approach these topics through the lens of astronomy, biology, physics, geology, chemistry, philosophy and art. The class is intended to reach a general audience of various backgrounds. By exploring the planetary and physical conditions required for life to exist, students will learn about

1. *core science concepts such as the scientific method, length and time scales, evolution,* and
2. *how these ideas alter our perception of everyday life, popular culture and the art*

A fundamental aspect of this class is to explore the disciplinary perspective attached to the concept of extraterrestrial life and the evolution of this concept through time and space. This topic is a perfect medium to teach core concepts in science such as: scientific methodology, systems, evolution and scale and to link these concepts to philosophical, historical and sociological considerations.

Course Objectives

- We would like you to come away from this class understanding the fundamental theories of the origins of life.
- We would like you to appreciate the scale of the universe and our position in it. This includes both astronomical and biological length and time scales.
- We expect you to understand the physical and chemical controls on life on and outside of the Earth System

- We expect that you will be able to discuss cultural representations of extraterrestrial life and reflect on how those representations are used to navigate a variety of cultural fears and desires.
- Learn about the physical and technical challenges to explore our universe and interstellar travel.

Class Organization

To foster the transdisciplinary nature of the course and the topic, the course is organized around weekly "Guiding Questions." Each of these questions will be explored in depth through the dual lens of science and the humanities. As such, different instructors will be leading the various lectures, with sometimes several instructors leading the same class at the same time. Along with traditional lectures, the class is also formatted for regular flipped classrooms, debates and guest lectures. Attendance will be assessed using iClickers

Assessment

There will not be traditional midterms in this class. Instead, you will receive weekly assignments related to the weekly topic. These assignments will vary in their format: some will be online quizzes; others will be blog discussions, summaries of reading, etc. In place of a final exam, students will complete a final project in the form of a poster conference (in groups of 5). Details on the assignment are given below. Overall the final grade will reflect an equal distribution between humanities and sciences related assessments. Assignments will always be given on Friday and will have to be completed within a week

Grading

Your final grade will be based on the following criteria:

- Weekly assessment (x14) 60%
  - Assigned every Friday and due the following Friday by beginning of class
  - No late assignments will be accepted – lowest score assignment will be dropped
- iClicker participation 15%
  - Students may have up to 6 unexcused absences without affecting their grade
- Final Project 25%
- Academic dishonesty will NOT be tolerated
  - Students with multiple iClickers in class will be reported to Center for Student Conduct
  - Plagiarism of weekly assignments and/or final project will also be reported

Grading Scale

Grading scale: (The same percentages apply to individual item grades)

- A = (100% - 93%)
- A- = (93% - 90%)
- B+ = (88% - 90%)
- B = (82% - 88%)
- B- = (80% - 82%)
- C+ = (78% - 80%)
- C = (72% - 78%)
- C- = (70% - 72%)
- D+ = (68% - 70%)
- D = (62% - 68%)
- D- = (60% - 62%)
- F = (Below 60 %)

Course Schedule

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Week 1 (Jan 13-17) – What is life?

Monday (All instructors)

Introduction to the course and team

The syllabus, course policies, grading, etc.

Wednesday (Nico, Juan)

A scientific perspective: What is Life?

Readings: The Pillars of Life

Friday (Sarah, Mike)

A philosophical/cultural perspective: What is Life?

Philosophical and conceptual problems for defining life : Defining Life, Steven A. Benner, ASTROBIOLOGY, Volume 10, Number 10, 2010

Terry Bisson, "They're Made Out of Meat"

Week 2 (Jan 20-24) – How did life originate?

Monday - MLK Day Holiday

Wednesday (Nico)

The Origins of Life: Scientific Theories.

Students come to class and find their groups which have been assigned the Friday before.

LAYOUT OF ROOM WITH AREAS FOR GROUPS WILL BE PROJECTED

Readings:

Youtube: What Was The Miller-Urey Experiment?
https://www.youtube.com/watch?v=NNijmxsKGbc

Steele et al. Short, 2018 - Cause of Cambrian explosion - Terrestrial or Cosmic?

Noble, 2018 - Editorial to Steele

Wolchover, 2017 - First Support for a Physics Theory of Life, Quanta Magazine

Friday (Mike)

Reductionism and creationism

Readings: Creationism is not a science,

Michael Ruse (From Philosophy of Science: The Central Issues, 2nd Ed, Curd, Cover, and Pincock, WW. Norton & Co., 2013)

Reductionism in Biology, Standford Encyclopedia of Philosophy, Sections 1 & 2 only

Week 3 (Jan 27 - 31) – What is Consciousness?

Monday (Mike)

Mind-body dualism, materialism, supervenience:

Reading: The Flight From Dualism

(From *Philosophy of Mind and Cognition: An Introduction,* Brandon-Mitchell, Jackson; Blackwell Publishing, 2007)

Wednesday (Sarah, Mike)

Sentience and consciousness

Reading: Ursula K. Le Guin, "Vaster Than Empires and More Slow"

and What is it like to be a Bat? Thomas Nagel (from *The Norton Introduction to Philosophy,* Rosen, Byrne, Cohen, Shiffrin, WW Norton and Co. 2015)

Friday (Mike, Juan)

Artificial intelligence, machine learning

The Turing Test, Standford Encyclopedia of Philosophy, Introduction and Section I, and Section 6, The Chinese Room

Week 4 (Feb 3-7) – What is the Universe?

Monday (Nico, Juan)

A brief history of the Universe - Energy, stars and the building of planets

Readings:

Universe expansion and Superstring theory: Compiled Universe, Hubble, String and Quantum Gravity Overview.pdf

Wednesday (Nico)

Our galaxy and the solar system - Origin of the solar system and the Drake equation

Readings:

Theories of the Solar system formation

the nebular hypothesis: Origin of the solar system

audio file: Challenging the conventional wisdom

Friday (Mike)

Realism and antirealism

Reading: Realism and Antirealism in the Philosophy of Science

Week 5 (Feb 10-14) – Chemical constraints for life as we know it

Monday (Juan)

The biochemical ingredients of life, why is water so important for life?

Readings:

Physical Biology of the Cell - Ch. 2-3

Unusual properties of water

Wednesday (Juan)

Life under extreme conditions on earth

Readings:

Hydrothermal Vents and the Origin of Life

Looking for LUCA, the Last Universal Common Ancestor

Friday (Juan)

Length and timescales in biology, length and timescales of the universe

Week 6 (Feb 17-21) – What is required for Life? Physical constraints

Monday - President's Day Holiday

Wednesday (Nico)

Planetary constraints for life development, part I

Readings:

Plate tectonics https://www.quantamagazine.org/plate-tectonics-may-be-essential-for-life-20180607/

Friday (Nico)

Planetary constraints for life development, part II

Readings:

How to Create a Scientifically Plausible Alien Life Form

PDF

The impact of gravity on life

, Morey-Holton 2003

Week 7 (Feb 24-28) – What are Exoplanets?

Monday (Nico)

The case of MARS

Wednesday (Nico, Sarah)

Is Earth an anomaly?

Readings: Lovett, 2019 EARTH 2.0 https://cosmosmagazine.com/space/earth-2-0-same-same-but-better

Friday (Nico)

False alerts.

Reading: ALH 84001 https://www.lpi.usra.edu/lpi/meteorites/The_Meteorite.shtml

Week 8 (Mar 2-6) – Signs?

Monday (Nico, guest)

Conditions for Life elsewhere

Natalie Hinkel – SWRI

Wednesday (Juan)

Science fiction mythbusters

Friday (All instructors)

Introduction to the final poster project.

Week 9 (Mar 9-13) – Spring Recess

Week 10 (Mar 16-20) – Fiction or Reality?

Monday (Sarah)

Life as we dream it: What it's like to not be on your planet, or fictional representations of humans on Mars and Martians on Earth

Reading: Selections from H. G. Wells's *The War of the Worlds* (1898)

Selections from Weir's *The Martian* (2015)

Recommended Reading: Csicsery-Ronay, "The Seven Beauties of Science Fiction"

Wednesday (Mike)

Philosophical history of possible worlds

Friday (Mike, guest)

Linking reality and fiction – Hawk Ostby (screenwriter for The Expanse, Amazon series)

Week 11 (Mar 23-27) – What do our fantasies about extraterrestrial life say about us?

Monday (Mike)

Ethical implications of ET Life

Readings: *The Moral Status of Extraterrestrial Life*

Erik Persson, ASTROBIOLOGY Volume 12, Number 10, 2012, and Ethics for Extraterrestrials By ROBERT WRIGHT, NYT

Wednesday (Sarah)

Race, Gender, and Sexuality

Reading: "Some Things We Know About Aliens," Istvan Csicsery-Ronay, Jr.

Film: Neill Blomkamp, District 9 (2009)

Friday (Sarah)

Abduction narratives

Readings: Butler, "Bloodchild"

Butler, "Amnesty"

Week 12 (Mar 30-Apr 3) – Interstellar travel, how do we explore space?

Monday (Juan)

Special theory of relativity. Time dilation and length contraction

Wednesday (Juan)

General theory of relativity. Bending space-time, black holes, wormholes.

Friday (Juan)

Technical challenges and limitations of interstellar travel. Propulsion systems and life support.

Week 13 (Apr 6-10) – How and why do we search for life?

Monday (Nico, Mike)

The Fermi paradox - Link to Drake equation

Reading: *WHERE ARE THEY? WHY I HOPE THE SEARCH FOR EXTRATERRESTRIAL LIFE FINDS NOTHING*

Nick Bostrom, Future of Humanity Institute, Oxford University www.nickbostrom.com

Wednesday (Nico, guest)

Economics of space exploration, Guest: B. Gibson

Friday (Mike, guest)

Ethics of space exploration, Guest: Ike

Week 14 (Apr 13-17) – Why do we fear and desire contact?

Monday (Sarah)

Assimilators

Reading: Philip K. Dick, "Beyond Lies the Wub"

John W. Campbell, "Who Goes There?"

(See the Original 1938 pulp magazine with illustrations here .)

Wednesday (Sarah)

Militarism

Readings: Harry Turtledove, "The Road Not Taken"

Charlie Jane Anders, "The Fermi Paradox is Our Business Model"

Friday (Sarah)

Contact Hunger

Week 15 (Apr 20-24) – What does the future hold?

Monday (Nico, guest)

NASA Guest - Europa mission

Reading: https://www.nasa.gov/about/whats_next.html

Wednesday (All instructors)

What does the future hold - disciplinary perspectives

Friday (All instructors)

What if? What if not? Discussion

Week 16 (Apr 27-May 1) – Group work on final project

Monday (Sarah, Mike)

Group Work on Final Project: the humanities angles

Wednesday (Nico, Juan)

Group Work on Final Project: scientific perspectives

Friday (Teaching asssistants)

Group Work on Final Project: Final touches

EXAM WEEK (May 7)

Poster Conference

Imagine Life Somewhere Else