Current Teaching

This is the syllabus of the course that Eric Chaisson is teaching at Harvard during the 2015-16 academic year (spring term):

Astro E-8 COSMIC EVOLUTION: Origins of Matter and Life

Instructor: Dr. Eric J. Chaisson, Harvard-Smithsonian Center for Astrophysics

Meets Wednesdays, 7:45 - 9:45pm, Harvard College Observatory, 60 Garden St., Phillips Auditorium, Bldg D, across from Radcliffe Quad.

***Course Abstract*: Evolution of the Universe, from its beginning in a cosmic expansion to the emergence of life on Earth and possibly other planets. Big-bang cosmology, origin and evolution of galaxies, stars, planets, life, and society. Scientific discussion of Nature writ large, from quarks to quasars, microbes to minds. Materials largely descriptive, based on insights from physics, astronomy, geology, chemistry, biology, and anthropology.**

***Course Description*: This broad survey course combines the essential ingredients of astrophysics and biochemistry to create an interdisciplinary synthesis called "cosmic evolution." Directed mainly toward non-science students, the course addresses, from a scientific viewpoint, some of the time-honored philosophical issues including who we are, whence we've come, and how we fit into the cosmic scheme of things. Our primary goal is to gain an appreciation for the origin of matter and the origin of life, while seeking unification throughout the natural sciences.**

Harvard Gazette

The course divides into three segments:

- **Part I (~10% of the course) introduces some basic concepts, notably those scientific principles needed for the remainder of the course.**
- **Part II (~ 40%) is heavily astronomical, using the concept of space to describe the many varied objects populating the Universe, from nearby planets to distant galaxies; this *spatial theme* serves as an inventory, explicating known material systems throughout the cosmos.**
- **Part III (~ 50%) uses the concept of time to sketch the central ideas of cosmic evolution—including physical, biological, and cultural evolution—employing a *temporal theme* to describe how matter and life have changed throughout eternity. Indeed, change—*i.e.*, evolution generally—is the hallmark for the emergence of all things, including galaxies, stars, planets, life, and society.**

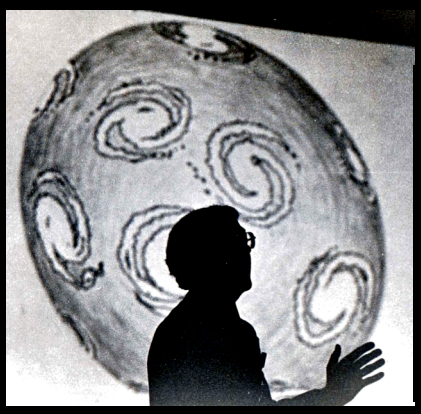
Throughout the course, we shall concentrate on the formation, maintenance, and destiny of all types of known objects—large and small, near and far, past and future. We shall study in some depth, among other things, the early Universe, active galaxies, black holes, relativity theory, 4-dimensional cosmology, the origin and evolution of stars and planets, as well as the onset of life, intelligence, and civilization, including prospects for extraterrestrial life on alien worlds. These and other related topics are probed to the extent needed to sketch the broadest view of the biggest picture: the newly emerging scientific philosophy of cosmic evolution.

***Course Prerequisite*: Persistent curiosity. (High-school mathematics also useful.)**

***Course Requirements*:**

- **A mid-term exam and a final exam, both generally requiring short paragraph answers. Each exam counts toward $^1/_3$ of the final grade.**

- **An 8-page (10-page maximum) term paper, typewritten, double-spaced, counts toward $^1/_3$ of the final grade. This paper should not be a book review or technical rehash of some known scientific topic. Rather, it should be a concise, high-quality, analytical, yet non-mathematical treatment of any of the wide-ranging, preferably unsolved, subjects addressed in this course. Once a topic has been chosen, students should read carefully and evaluate critically competing arguments in the literature. *Come to your own conclusion and support it.* Paper topics not covered in the course must be approved by the instructor. Papers are due on the penultimate day of class, 4 May 2016. There will be no extensions. Late papers will be penalized one letter grade per 24-hour interval beyond the deadline.**



***Section Meeting*: An optional period—"the third hour"—for discussion and clarification of course material will be held after each class, from 9:45 to 10:30 pm.**

***Web Sites*: Three Web sites are specifically relevant to this course:**

This web site pertains to the course per se and includes a copy of this syllabus, course assignments, and other information pertinent to the administration of the course: https://canvas.harvard.edu/courses/8131

This web site is closely tied to the main textbook for this course, offering much additional material not found in the printed text—images, animations, software, and self-help sections. Access to this site, *which is optional in this course*, may cost money depending upon when/where/how you purchased your textbook; follow the instructions at the front of your textbook to find or purchase an access code, then browse: http://www.masteringastronomy.com

This web site contains material directly related to the interdisciplinary subject of cosmic evolution; it is *required* for Part III of the course and free of charge: https://www.cfa.harvard.edu/~ejchaisson/cosmic_evolution/docs/splash.html

***Instructor's Coordinates*: Eric Chaisson can be reached via any of these routes:**

email: ejchaisson@cfa.harvard.edu
chaisson@fas.harvard.edu
phone (cell): 978.505.2667
internet: http://www.cfa.harvard.edu/~ejchaisson
paper: Harvard College Observatory, Bldg. A, MS-10
60 Garden St., Cambridge, MA 02138 USA

Calendar of Course Events, 2016

Date	Topic	Readings
27 January	Course Overview: An Interdisciplinary Approach	1 AG; (Pro CE)
I. The Introductory Part: The Essentials		
03 February	Radiation and Spectroscopy: Basic Physics	2 AG
10	Telescopes and Geometry: Basic Tools	2 AG
II. The Descriptive Part: A Spatial Theme		
17	The Solar System: Our Home in Space	3,4,5,6 AG
24	Sun: Our Parent Star	8 AG
02 March	Stars: Red Giants and White Dwarfs	9 AG
09	Galaxies: The Grand Assemblages	13,14 AG
16	--- Spring Break ---	
23	--- Mid-term Exam ---	
III. The Evolutionary Part: A Temporal Theme		
30	Universe: Relativity and Cosmology	15 AG; (Pro EE)
06 April	Particulate, Galactic, & Stellar Evolution	10,11 AG; 1,2 W (1,2 CE; 1-3 EE)
13	Planetary Evolution: Birth of Elements & Earth	7,12 AG; 3,4 W (Intro CE; 4 EE)
20	Chemical Evolution: Origin of Life	5 W (3 CE; 5 EE)
27	Biological & Cultural Evolution: Onset of Humans	6,7 W (Discn CE; 6,7 EE)
04 May	Future Evolution: Extraterrestrial Life	8 W; Epi AG (Epi CE; Epi EE)
11	--- Final Exam ---	

Required readings are taken from:

AG = Chaisson & McMillan, *ASTRONOMY: The Universe at a Glance*, Pearson, 2016
W = web site, version 7, *Cosmic Evolution: From Big Bang to Humankind*, 2013
https://www.cfa.harvard.edu/~ejchaisson/cosmic_evolution/docs/splash.html

Optional readings (in parentheses above and only recommended) are taken from:
EE = Chaisson, *EPIC of EVOLUTION: Seven Ages of the Cosmos*, Columbia Univ. Pr., 2006

More technical readings (in parentheses above and meant for students who want to go beyond the level of this course) are taken from:
CE = Chaisson, *COSMIC EVOLUTION: Rise of Complexity in Nature*, Harvard Univ. Pr., 2001

Books AG, EE, and CE can be purchase in the Harvard Coop or elsewhere in the Square. All of them are also on reserve at Grossman Library in Harvard Yard.

Web site W is open access without password, free of charge.