AS 100: COSMIC CONTROVERSIES  
-- COURSE PERSPECTIVE --  
Spring 2015  

The goal of this course is to understand our place in the physical Universe. Since we know neither the final answer, nor a nearly-complete one, in AS100 we will examine how to frame such questions and how to approach their answers from a natural science perspective. Science is arguably the only human activity for which progress, technically or quantifiably defined, has occurred. Yet, the scientific method has its foundations in philosophy and religion, as well as with simple observations, bold hypotheses, careful experiments, personal rivalries, and luck. At each juncture, competition between proposed modes of understanding helped frame and solve pieces of the puzzles. For the astronomical universe, these are indeed Cosmic Controversies. In AS100, we will examine what constitutes evidence, how it is obtained and evaluated for reliability, and how one can draw implications from validated evidence.

AS 100 will explore three ageless themes central to the human experience. What can we say with confidence about our physical origins and future? Where do we place our planet in the context of all other known worlds? How do we deal with life beyond Earth as a scientific possibility?

Instructor: Professor Michael Mendillo

Meeting Times: Lectures (A1) on Monday, Wednesday and Friday, 1:00 – 2:00 PM.  
Meeting Place: Room 522 in CAS Building, 725 Commonwealth Avenue.

Discussion Sections:
A2: Monday 11:00 -- 12:00  
A3: Wednesday 4:00 -- 5:00  
A4: Friday Closed
A5: Wednesday 12:00 -- 1:00  
A6: Wednesday Closed  
A7: Tuesday 12:30 -- 1:30  
A8: Friday 12:00 -- 1:00  
A9: Tuesday 4:00 -- 5:00  
A10: Monday 2:30 -- 3:30

Discussion Sections meet every week in the Astronomy Department's “Solar Lab”— CAS Room 521.

Graduate Student Teaching Fellows for the course:
* Ms. Eunkyu Han will handle Discussion Sections: A2, A8, B1  
* Ms. Luisa Capannolo will handle Discussion Sections: A3, A5, A7 and A9

Required Textbook: Ordered in the Boston University/Barnes&Nobel Bookstore in Kenmore Square.  
THE COSMIC PERSPECTIVE:  
by Bennett, Donahue, Schneider and Voit (“Bennett et al.”)  

Note #1: This is the “full text” of the book, not the smaller editions that deal with (a) only the Solar System or (b) only Stars, Galaxies and Cosmology.

Note #2: There is a lower-cost electronic edition of the text that is really a rental for 6 months.  

--------------------------------OFFICE HOURS--------------------------------

Instructor: Professor Mendillo’s office is in CAS Room. 603.  
AS100 office hours are Monday 3:30-5:00 pm; Thursday 10:00-11:30 am,  
----- or by appointment-----  
Telephone: 617-353-2629  Email: mendillo@bu.edu
**Teaching Fellow Office Hours:** Two graduate students in the Astronomy Department’s Ph.D. program will be assisting Professor Mendillo and you with this course:

Eunkyu’s office hours are in CAS 524: Tues 11-12:30 and Wed 11-12:30

Luisa’s office hours are in CAS 524: Mon 5-6:30 and Fri 10:30-12:00

Teaching Fellow E-mail addresses: eunkyuh@bu.edu and luisacap@bu.edu

----------GRADES----------

The final semester grade depends upon the following four components:

The higher two scores of three “hourly exams” (25% each) ......................50%
Homeworks (highest 4 of 5 assigned) ..............................................15%
Discussion Section Quizzes and Participation .................................20%
Final Exam ..................................................................................15%

100%

**Note About Grades:** Each component of the course must be completed to earn a non-F-grade. (e.g., you cannot skip homeworks or Discussion Sections and rely mostly on exams).

EXTRA CREDIT Options: Night Observing Reports (two possible @2.5% each) + 5% to final grade (details in class) Planetarium Night---extra grade for Discussion Section.

RULES-OF-THE-ROAD: Since the lowest grades for hourly exams and for homeworks are dropped, no make-up exams or make-up homeworks will be given.

The Homework sets handed out in class must be handed in on their due-dates in order to be graded for full credit (see Day-by-Day Course Schedule). Possible acceptances of late assignments, with late-grading penalties, are determined by Professor Mendillo on a case-by-case basis. Homeworks may be handed in at the end of class on a due date, or by end of that day (5 PM) in the Astronomy Department Office located in Room CAS 514. The AS100 homework “drop-off box” is in the Reception Area to the right of the entrance.

**Note About Exams and Travel Plans:**

(1) The three hourly exams will be given on Fridays (see schedule), including the Friday prior to Spring Break. Adjust your travel plans accordingly. There are no make-up hourly exams. You can decide not to take an hourly exam since the top two scores will count.

(2) The AS 100 Final Exam is SATURDAY, MAY 9TH ——> 12:30 – 2:30 PM (Last Day of Exams) ——Adjust Travel Plans Accordingly. There are no make-up Final Exams!

**Academic Misconduct:**

It is my expectation that each and every student does his or her own work. Group study efforts are encouraged, but they should not result in students submitting the same/copied homework or Night Lab answers. All cases of suspected misconduct on exams or assignments will result in an official report to the Dean's Office for possible disciplinary action. Copies of the Academic Conduct Code are available in room CAS 105.
OVERVIEW OF AS100 ----- COSMIC CONTROVERSIES
How Can We Answer These Three Questions?

(1) Why do astronomers think that Dark Matter and Dark Energy exist—and in quantities far greater
than the “regular” matter and energy we are familiar with?

(2) Do the reasons astronomers give for no longer considering Pluto to be a planet make sense?

(3) Does the so-called “Goldilocks Principle”—that conditions for life are so special that only Earth
is “just right” for them—imply that life is not plentiful throughout the Universe?

--------------------Specific Approaches and Topics--------------------------

(1) Why do astronomers think that Dark Matter and Dark Energy exist?
These remarkable topics of current-day Astronomy arise from observational evidence that is
inconsistent with past hypotheses. There are a number of sub-questions that are key to
understanding how we got to this point:
---- How did the Universe form? Was it by a Big Bang?
---- The Universe is expanding. What are the types or models of expansion?
      Why are they important?
---- What is a “model” in science? What are the roles of observation, experimentation,
      validation and falsification? What is the difference between an hypothesis,
      a theory and a law?
---- Creationism and Intelligent Design—Should an alternate approach to the
      scientific method be considered in a university-level science course? In K-12?
--- Role of Complexity: Are some natural things just too complicated to have
      come into existence naturally?
---- Falsification: Can one test beliefs?
---- Hypotheses for the Celestial System without the physics of gravity:
      --Geocentric Models; The Heliocentric model.
---- The Role of Interim Models: Gilbert and Kepler’s use of magnetism as the
      cause of celestial motions; Rene Descartes’ vortex theory of planetary motions.
----- Galileo’s introduction of telescopic evidence—the onset of modern science.
----- The Theory of Gravity by Newton: The role of forces and action-at-a-distance.
----- The Theory of Gravity by Einstein: New role for mass—warped space-time and the
      equivalence of mass and energy, the equivalence of gravity and acceleration.
----- An application of “known” physics: How Do Stars Form and How Long Do They Last?
----- Galaxies as ensembles of Stars
----- The Universe as an ensemble of Galaxies
----- Motions of the galaxies—what you see is not what you get! Dark Matter & Dark Energy
(2) Why is Pluto no longer a planet?

---- Different types of planets and moons (terrestrial type vs. Jupiter type). Nebular Theory.
---- Roles of the leftovers: Comets and meteors, asteroids and the Kuiper Belt.
---- How would a visitor to our Solar System describe its organization?
---- Testing models: “Fixing” models versus “adjusting” models.
      -- Can “Something hit it” be an acceptable solution to a scientific problem?
---- Scientific decision making: Peer review, publicity, “professional” vs. public policy.
---- Examples: The International Astronomical Union (IAU) and Pluto;
       The US National Academy of Sciences and Global Warming.

(3) Are the conditions for life so special that they appear to be found only on Earth, or are they plentiful in the Solar System? Plentiful in the Galaxy? In the Universe?

---- Is there a plurality-of-the-worlds?
   How do we know that planets exist around other stars?
   Has the long-accepted “Nebular Theory” of solar-system formation been validated or falsified by these new discoveries?
---- What are the physical requirements to host life as we currently understand it.
   Example: The Role of Liquid Water --- Earth is not-too-hot, not-too-cold, but just-right.
   Example: Life in hostile environments.
---- Extra-solar-system planets: Do they offer venues for life as we know it?
---- Estimates of intelligent civilizations in our galaxy.
---- Have we been visited by extra-terrestrials?
---- Does absence of evidence ever become equivalent to evidence of absence?

*************** I look forward to a semester with you discussing Cosmic Controversies!