6 January 2014

AS 100: COSMIC CONTROVERSIES
-- COURSE PERSPECTIVE --
Spring 2014

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	A5:	Wednesday	12:00 -- 1:00		
A3:	Wednesday	4:00 -- 5:00	A6:	Wednesday	11:00 – 12:00	A9:	Tuesday 4:00 -- 5:00
A4:	Friday	11:00 -- 12:00	A7:	Monday	12:00 -- 1:00	B1:	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:

* Mr. Dustin Hickey will handle Discussion Sections: A2, A3, A6 and B1
* Mr. Paul Dalba will handle Discussion Sections: A4, 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.**")
7th Edition (2014), Pearson/Addison Wesley – with Media Update (optional).

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.
http://www.mypearsonstore.com/bookstore/cosmic-perspective-the-coursesmart-etextbook-0321918614

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

Instructor: Professor Mendillo's office is in CAS Room. 603.
AS100 office hours are **Wednesday 9:30-11:00 am**; **Friday 10:00-11:30 pm,**
----- 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:

Dustin's office hours are in CAS 524: Mon 9:30-11 and Thurs 2-3:30

Paul's office hours are in CAS 524: Tues 11-12:30 and Thurs 11-12:30

Teaching Fellow E-mail addresses: dahickey@bu.edu and pdalba@bu.edu

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

The final semester grade depends upon the following four components:

The higher two scores of three "hourly exams" (20% each).....40%
Homeworks (highest 4 of 5 assigned) … 15%
Discussion Section Quizzes and Participation 20%
Final Exam.....25%
100%

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

EXTRA CREDIT Option: Night Observing Reports (two possible @2.5% each)…+ 5%

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:

(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 10TH -----> 12:30 – 2:30 PM
-----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 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?
--- 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?
---- 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*?

----- Some Thoughts About Snow-Days-----

While this course is offered during the so-called *Spring* Semester, we live in Boston and Spring does not come until the week of Final Exams! It is winter and we get snow in Boston. Hardy New Englanders know how to cope with and thrive in snow. We can do the same.

Every now and then, administrators at Boston University cancel school due to a snow storm.
Right there on morning TV, as the K-through-12 school names roll by with cancellations, somewhere between the cities of Belmont and Brockton, Boston University appears. These are not our peer institutions! Most Boston University students live within walking distance of the CAS building, and most faculty really know how to commute in the snow. So, these are the AS100 rules for any announced Snow Days:

(1) There are no make-up classes. I will distribute the daily class notes to you at our next scheduled class. You are responsible for the reading assignments that deal with the material that would have been covered in class that day. That material remains as exam material. Should you want any help in that matter, I will be in our classroom at the usual time to give that day's lecture on a snow-day [unless the Governor bans driving in the Commonwealth]. Feel free to come to lecture on a snow day.
(2) Should you feel that there is a safety issue, by all means stay in your dorm, apartment or in bed and avoid danger. You can come subsequently to my office hours and I will review the material presented in the snow day lecture. If you cannot come to regular office hours, we can schedule one by appointment.

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