

# AS 101 - The Solar System

## Syllabus - Spring term, 2014

**Course Perspective:** AS 101 surveys the historical development of astronomy, the motion of the planets, the formation of solar systems, and the characteristics and evolution of the Sun, planets and Earth. In studying astronomy and the solar system, we will explore one of the most exciting endeavors in human history. Today, we find ourselves in a golden age of astronomical and planetary science, with new discoveries enhancing our understanding of the Cosmos on an almost daily basis.

The first half of this class covers the discovery and implications of some of the most fundamental and well established laws and theories ever made in science - the laws governing motion, gravity, and light. Application of these few simple rules have enabled humans to discover the extraordinary nature of the solar system and the cosmos. In the second half, AS 101 surveys more discoveries and theories pertaining to the past, present and future solar system.

AS 101 fills the natural science distribution requirement of the College of Arts and Sciences. Hence, the primary purpose of AS 101 is not to teach a series of facts about the solar system, but to study the methods and tools with which scientists have unraveled and continue to explore the inner workings and composition of the solar system. These scientific methods enable us to go beyond simply describing the current state of the solar system, allowing us to both understand its past and make predictions about its future.

As the great 17<sup>th</sup> century scientist, Galileo Galilei, stated, “The language of the universe is mathematics.” The physical sciences, (astronomy, physics, chemistry and related fields) rely on the predictive capabilities of mathematics. While the level of mathematics used in this class will not progress beyond high-school algebra, geometry and trigonometry (in other words, pre-17<sup>th</sup> century mathematics), one objective of this class is to illustrate the incredible utility of a mathematical description of the Universe. As it says on the cover of the *Hitchhikers Guide to the Galaxy*, “DON’T PANIC.” We will make every effort to make the math an aid rather than a hindrance in understanding the solar system. Please review Appendix A in the text book.

This introductory level course is intended for students from any college or school at any level. It has no requirements beyond high school level algebra and science. The Department of Astronomy also offers a series of courses more appropriate for prospective or active physical science majors, AS 202 – AS 203. This is followed by a series of advanced courses for majors. We also offer a number of additional courses designed for non-physical science majors. Note, one cannot obtain credit for both AS 101 and AS 105.

AS 101 moves quickly through a great deal of material and each topic builds on earlier material. If you fall behind, you may find it difficult to catch up. If you get stuck on a concept, move on and seek help from the Professor, teaching fellows, or your classmates. Also, read the section entitled, *How to succeed in your astronomy course* in your text book. We hope that the rewards of learning about the mysteries of the solar system will make all the demands and requirements of AS 101 worthwhile.

**Instructor:** Professor Meers Oppenheim

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Office Hours: Mon.: 2:00-3:30, & Wed: 2:00-3:30 or at other times through arrangement.

### Teaching Fellows:

Mr. Jordan Montgomery Office Hours: Tue: 10:00-11:00, Tue: 5:00-6:00, Fri: 1:00-2:00 CAS 524,  
e-mail: montgojo@bu.edu

Mr. Emmet Golden-Marx Office Hours: Mon: 12:30-2:00, Tue: 3:30-5:00 CAS 524, email: em-  
metgm@bu.edu

**Contacting us:** E-mail is usually the easiest method of contacting the professor or teaching fellows.  
We all check our email daily - often hourly. Also, feel free to telephone us or stop by during office  
hours or at other times.

**Class Hours and Location:** Lectures (A1) - Mon., Wed., Fri. 10:30-12:00 pm, CAS 522

**Required Texts: Cosmic Perspective: The Solar System** by J. Bennett, et al, 7th ed. Plus  
access to the MasteringAstronomy.com web site. The book, supplement, and lectures com-  
plement each other and students are responsible for the material in all.

**Solar System Laboratory Exercises**, found at

<http://www.bu.edu/astronomy/academics/undergraduate-studies/manuals/>

**Class www site:** <http://learn.bu.edu/> - The course web site - many of the course handouts will be  
posted here. Also, you can check your grades here.

### Books in Library Reserve: <sup>1</sup>

1. *The New Solar System (3rd edition)* contains more detail on the solar system, edited by J. Kelly Beatty, Brian O'Leary, and Andrew Chaikin, published by Cambridge University Press and Sky Publishing Corporation, Cambridge, UK and MA, 1990.
2. *Introductory Astronomy and Astrophysics* by Zelick & Gregory is a sophomore/junior level text containing more mathematical detail and insight.

### Astronomy Web Sites:

1. [www.masteringastronomy.com](http://www.masteringastronomy.com) (*Course ID: MAOPPENHEIM20520*) - Site associated with the book contains chapter summaries with a hyper-linked glossary, practice quizzes, and resources including movies and animations. The problem sets will be assigned through this site, generally due on Wednesdays.
2. [Saplinglearning.com](http://saplinglearning.com) - Another problem solving and exercise site set up to help with our class. To use it:
  - (a) Go to <http://saplinglearning.com> and click on your country at the top right.
    - i. If you already have a Sapling Learning account, log in and skip to step 3.
    - ii. If you have a Facebook account, you can use it to quickly create a Sapling Learning account. Click Create an Account, then Create my account through Facebook. You will be prompted to log into Facebook if you aren't already. Choose a username and password, then click Link Account. You can then skip to step 3.
    - iii. Otherwise, click "Create an Account". Supply the requested information and click "Create My Account". Check your email (and spam filter) for a message from Sapling Learning and click on the link provided in that email.
  - (b) Find your course in the list (you may need to expand the subject and term categories) and click the link.

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<sup>1</sup>These texts, and others suggested throughout the term as optional resources, will be available in the Astronomy Library located on the sixth floor of CAS above the astronomy department offices.

- (c) Your course requires a key code. It is Venus.
3. [www.colorado.edu/physics/2000/](http://www.colorado.edu/physics/2000/) - Well done site explaining modern physics with cartoon characters and JAVA applets.

**Grades:** The final course grade depends upon four course components:

The better of 2 in-class Exams	20%
Lab and Planetary Exercises (best 8 of 9 labs)	33%
Problem sets	20%
Final Exam	25%
In-class/lab participation	2%

**Exams and Final:** The exams and the final will test your knowledge of ideas discussed, simple problem solving skills, and your ability to write brief essays about the history of Astronomy. We will have 2 in-class exams but will drop the lowest grade. If a student misses an exam, then that exam will be dropped. Hence, no make-up exams will be given. We will hold review sessions and provide practice exams.

Requests for grading corrections need to be made **in writing**.

**Problem Sets:** Weekly problem sets will be assigned during the semester, due typically on Wednesdays. Most of the problem sets will be assigned through the MasteringAstronomy.com web site. You will need access to this site which comes with a new text book or can be purchased from the publisher. This site has strict deadlines, so please avoid missing the deadlines. In order to master the course material, one must be able to answer the types of questions in the problem sets. Therefore, each exam will include an almost verbatim problem from the problem sets. Some of the assigned problems require us to manually grade them. We will thoroughly grade a random subset of the problems in each problem set but a large enough part to give a good statistical sample.

While MasteringAstronomy.com does add to the cost of the class, the benefit of the tutorial, hints, and immediate feedback makes the price worthwhile (so much so that I worked with the publisher to improve the site). If the fee for the site creates a severe problem, the publisher may give out a number of "scholarships" to students who can make the case that they have a substantial need.

**Lab Exercises:** AS 101 is a laboratory course where lab participation and lab reports constitute a major part of your final grade. The Lab Exercises grade will derive from 6 indoor lab exercises and 2 observing lab exercises. We will drop one grade from this set of grades (except for the observing lab exercises) so if you are unable to complete one of the exercises, your grade will be unaffected. A second grade will **not** be dropped.

**Indoor Labs:** The indoor exercises will be performed in assigned sections. Indoor exercises will demonstrate a certain physical principle or elaborate on lecture material. **Each student must be enrolled in one of the lab sections (A2-7) in addition to the lecture (A1)!** Students unable to attend their scheduled lab should discuss possible substitutions with the teaching fellows at the earliest possible time. Typically, the lab write-up will be due one week after completion of the lab. This will be discussed further in your lab section.

**Observing Labs:** Observing the night sky is an essential part of astronomy and the observing exercises constitute an important part of AS 101. The J. B. Coit Observatory can be

found on the roof of the CAS building, two floors above the astronomy department. The observatory has a set of celestial pipes and telescopes. Each lab may be completed in an hour. Because of inclement weather, it is not uncommon to have an entire month with **no** clear nights. Hence, it is essential not to wait until the end of the possible observing sessions to observe. If you miss one of the two observing sessions because the last two weeks are cloudy, no make-up will be possible and you will receive a zero. The outdoor lab is so essential to the course that all students must complete both and neither of the outdoor lab grades can be dropped.

The observatory is outside, unheated, and often bitterly cold, so dress appropriately. Frost-bite can result. We recommend over dressing.

To check if the observatory will be open on a given night, call 617-353-2630 for a recorded message about 1 hour before the lab start time. Choose option #1 to see if the night lab will be held that night and option #2 for other night lab information.

**Planetarium Visit:** The Boston Museum of Science has a planetarium capable of displaying the night sky as seen from any point on Earth at any time of the year with a clarity we cannot match on the roof of the CAS building. We have reserved the planetarium on Jan 30 and Feb 4 from 6:30 to 9:00 and set up a special program for AS 101 students, “A tour of the Night Sky,” followed by a planetarium movie. After the program, you will turn in a simple set of questions for a grade. It is not possible for us to schedule an additional planetarium visit, but if you have an irreconcilable scheduling conflict, send the Professor an email about the problem.

**Labs/Discussion Section:**

Sections	Day	Time	Location
A2-A8	M-F		CAS Room 521
Night labs			
N1: Constellations	Mon, Tue or Thu, Jan 21 – Mar 6	8:30 pm	Observatory
N2: Telescopes	Mon, Tue or Thu, Mar 17 – Apr 29	8:30 pm	Observatory
P1	Jan 30 and Feb 4	6:30 - 9:00 pm	Planetarium show

Note: N1 Lab report due Oct. 27 and N2 Lab report due Dec 10. **Bribe: 10% extra credit on this lab for turning in N1 or N2 report three or more weeks before due date. Due date is generally 1 week after performing lab.**

**Special Dates:**

First class:	Jan 15
No Class:	Jan 20
Planetarium Show	Feb 3 and 4
No Class:	Feb 17
Monday classes held on Wed:	Feb 19
Exam 1 (in class):	Feb 28
Exam 2 (in class):	Apr 11
No Class:	Apr 21
Substitute Class (for missed Mon.)	Apr 24
Last day of classes:	May 1
Final (12:30pm - 2:30pm, in class):	May 8 (Thursday)

**Indoor lab schedule:**

See <http://www.bu.edu/astronomy/academics/undergraduate-studies/manuals/> for schedule and laboratory write-ups. Laboratory reports will be due one week after completion of the experiment. More information about the indoor labs will be available in the sections.

Week	Lab Name	
1	Powers of Ten	(Optional - nothing Due)
2-3	Orrery and Skygazer	
4-5	Gravity 1 Week after your Lab	
6	Review for Exam 1	
7-8	Spectroscopy	1 Week after your Lab
9-10	Reflectance Spectroscopy	1 Week after your Lab
11	Review for Exam 2	
12-13	Cratering	1 Week after your Lab
14	Review	

**Tentative Course Schedule:**

Week	Chapter	General Topic	Lecture Topic
1	1	Introduction	Introduction to AS 101 & Astronomy
	1	Introduction	Science and the scale of the Universe
2	2	Introduction	Scale of Solar System and Planetary Motion
	2	Introduction	Observing the Moon, Eclipses and Meteors
3	2& S1	The Night Sky	Constellations, Celestial Sphere & Navigation
	3 & S1	Fundamental Principles	Ancient Astronomy
4	3 & 4		Motion of the Planets
	3 & 4	Dynamics	From Copernicus to Newton
5	3& 4	Dynamics	Kepler's Laws explained
	4	Dynamics	Newtonian Mechanics
6	4 & 5	Energy	Energy: conservation, sources & sinks
	5	Light & Optics	Electromagnetic radiation I
7	6	Light & Optics	Telescopes & Spacecraft
	7 & 8	Solar System	Overview & Origins
8	8	Solar System	Solar System Origins
	13	Other stellar systems	Exoplanets
9		Other stellar systems	Exoplanets
	14	Sun & Interplanetary	Sun & Solar wind
10	9	Geology of Terrestrial planets	Geo II
		Geology of Terrestrial planets	Geo III
11	10	Atmospheres of Terrestrial planets	Atmos I
		Atmospheres of Terrestrial planets	Atmos II
12	11	Gas Giants	Interiors
		Gas Giants	Atmospheres & Magnetosphere
13		Gas Giants	Satellites & Rings
	12	Asteroids, Comets and Pluto	Asteroids, Meteorites & Comets
14		Asteroids, Comets and Pluto	Pluto & collisions
	24	Life	Life in the Universe

**Note on attendance:** Boston University's policy on attendance is "Boston University expects each student to attend each class session unless they have a valid reason for being absent." Students who miss an occasional lecture should review the material covered with another student. Students who must miss a day or night lab should discuss other times at which the lab can be done with

their teaching fellow at the earliest possible time. In the event of an absence exceeding a few days, please notify the teaching fellow or professor.

**Common Courtesy Guidelines:** For the benefit of your fellow students and your instructors, you are expected to practice common courtesy with regard to all course interactions. For example:

- Show up for class on time.
- Turn off your cell phones before class begins!
- Do not leave class early, and do not rustle papers in preparation to leave before class is dismissed.
- If you must be late or leave early on a particular day, please inform your instructor or TF in advance and then enter, leave and sit by the rear door.
- Be respectful of your classmates and teachers.

**Important Note on Academic Conduct:** Students are encouraged to collaborate with each other when solving the problem sets and/or laboratory exercises. However, each student must independently write-up the problem sets and the labs. If assignments from two or more students are overwhelmingly similar or identical, then that will be considered a form of academic misconduct. Boston University takes a very hard stand on any form of academic misconduct and is prepared to act swiftly and seriously. Accordingly, in instances where you have worked with another student on an assignment, make it painfully clear that the written solutions represent your own understanding of the problem.

