

# INTRODUCTION TO ASTRONOMY - ASTRO 100LC, SECTION 02, HUNTER COLLEGE

JASON KENDALL, HUNTER COLLEGE

## 1. THE MOST CHALLENGING CLASS YOU'LL EVER LOVE.

The science of astronomy is without a doubt the most interesting and fascinating thing you'll ever work on. We will deal with the origin of the Earth, the Sun and the Universe. We'll learn the names of stars, and how to find them in the sky. We'll learn about ancient oceans on Mars and planets around other stars. We'll glimpse the madness of the surface of a neutron star, where you would weigh as much as a mountain if you stood on it. We'll witness the gossamer beauty of interstellar clouds, which are the birthplace of stars. We'll dive into a black hole where space and time crush together into a maelstrom of destruction. We'll learn what a shooting star is, and how you can find them. We'll see distant galaxies, all homes to billions of stars and countless planets. We'll tour Saturn's rings, and Jupiter's Great Red Spot. We'll even take a trip with a spacecraft all the way out to distant Pluto.

In so doing, we'll learn how the physical laws that we measure in the laboratory here on Earth apply to the Moon, the stars and places far beyond. We'll learn how to link physical arguments together to see why things work the way they do. The universe is filled with mysteries, but they are unlocked and made even more mysterious in that we can actually understand them.

Natural Philosophy is the study of how logic and evidence links ideas together to come up with explanations for how things work in the real world. We don't have to rely on demons or gods to tell us how things work, and why they go the way they do. We rely on Newton's Laws of Motion, Einstein's Relativity, Maxwell's Laws of Electromagnetism, and the wildly counterintuitive world of quantum mechanics. For many centuries of human existence, we looked at the sky wondered how it all came to be. Now, in this golden era of knowledge and exploration, humanity is coming close to truly understanding the origin of the universe, and discovering whether or not life could actually have arisen more than once in our Solar System.

Don't get me wrong, the ideas are quite challenging, the vocabulary is odd, and the logic that links things together can take serious mental gymnastics, and you'll have to do more reading than you thought you would ever have to for an intro course. But the rewards are great, with this liberal art class that merges science with the greatest aspirations of human thought.

This class will feed and water your inner 6-year-old, and inspire you with wonder. Every kid loved dinosaurs and planets. Now you get to go back and be that kid again.

## 2. SCHEDULE

Introduction to Astronomy - Astro 100LC, Section 02

(3 Credits)

Fall 2017

Instructor: Jason Kendall

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Hunter College

Department of Physics and Astronomy

Lecture Tuesdays and Thursdays: 7:00 pm - 8:15 pm Aug. 25, 2017 - Dec. 15, 2017

SPECIAL NIGHT-TIME STARGAZING. You will go stargazing with the Amateur Astronomers Association of New York and other clubs.

## 3. ON EXCELLENCE

Hunter College is known for its excellence among its alumni. Excellence is not easily achieved, and takes hard work and significant time. This class and your participation in it are part of Hunter College's tradition of excellence.

## 4. COURSE OBJECTIVES

This course is an introduction to astronomy. We'll learn about the concepts of stars, the solar system, and the universe. It will be done in the context of current news in the world of astronomy. We will use not only the text, but will also dig into NASA and astronomy web sites to understand today's amazing discoveries. It is truly a Golden Era of Astronomy, and you'll be exposed to it all. Historical developments in astronomy from ancient mythology to modern science will be covered. Topics include: History of Astronomy, Gravity and Light, The Solar System, our Sun, the Formation and Evolution of Stars, Galaxies, and Frontiers of Exploration.

## 5. TEXT AND SOFTWARE

- "The Cosmic Perspective" (7th Edition): by Jeffrey O. Bennett, Megan O. Donahue, Nicholas Schneider, and Mark Voit.
- OPTIONAL: MyLabsPlus (MLP) for homework: [www.hunter.cuny.mylabsplus.com](http://www.hunter.cuny.mylabsplus.com). We will use it for practice only. The MyLabsPlus access code is specific to Hunter College and won't work unless you get it at the Bookstore. Alternately, you may purchase an access code directly from MyLabsPlus, when you log in for the first time.

Required websites:

- Astronomy Picture of the Day: <http://apod.nasa.gov>
- NASA: <http://www.nasa.gov>
- Amateur Astronomers Association: <http://www.aaa.org>

## 6. STUDENT LEARNING OUTCOMES

Students will be able to...

- (1) Build team learning techniques through collaborative learning.
- (2) Effectively express themselves in written form. Writing is a key component of this class.
- (3) Demonstrate ability to think critically about new ideas and topics.
- (4) Demonstrate ability to integrate knowledge and ideas in a coherent and meaningful manner.
- (5) Understand fundamental physical principles, theories, and methods of modern science as practiced in astronomy.
- (6) Learn the basic observable phenomena of astronomy, and how these have had both practical applications and played a key role in advancing our understanding of the Universe.
- (7) Explain the role of modern technology in the investigation of astronomical phenomena, and the crucial role played by technological advances in extending our knowledge of origin and behavior of the Universe.
- (8) Explore how discoveries in astronomy have implications for how we have come to view our place in the Universe, and by comparing the Earth to other planets in our Solar System provide a physical framework for understanding the possible impacts of our activities on the Earth.
- (9) Finally, it's a LOT of fun. I really hope that you'll become a habitual astronomy buff, looking at Astro stuff frequently, hopefully going to star parties and taking trips out of the City just to see the stars and planets. In short, we hope to add astronomy into your daily life.

## 7. PEDAGOGICAL METHOD

You come to class not to sit and listen to the instructor talk, but to engage the ideas presented in the course. You'll be asked questions, you'll be challenged to answer in person. I will have expected you to read ahead. If you're not reading ahead, you're falling behind. You'll also need to learn how to listen actively, and how to read actively. Reading the textbook is central to the class. The class will rely heavily on your actively reading the book, online homework, additional web site reading and lab work. I look VERY favorably on those who read ahead and are ready with questions. The idea with these discussions is to show where you're not sure about something, or what you found exciting and different; or to chat something about something that really doesn't seem right, or is way outside your comfort zone of thinking. There are a lot of hard ideas in the class and in the reading. It will really help if you read it in advance, then bring something to the table. You'll need to keep up with the reading, because your grade is strongly dependent upon it. Talking to your colleagues and friends and family about the class and its topics will not only improve your grade, but help you to truly enjoy astronomy. There are vast astronomy resources online, and we will use them. I can't stress enough how important it is for you to do reading. Finally, you will see through a telescope and how to find things in the sky.

## 8. USE OF ELECTRONIC DEVICES DURING LECTURE

Texting and other distractions are strongly discouraged during the lecture session, because I regard using a laptop or mobile electronic device during my lecture as rude. The light and inevitable internet access that comes with any mobile device is distracting not just to you but to everyone behind and near you. Bring a notebook and pen. Leave the laptop closed.

## 9. YOUR HAND-WRITTEN NOTEBOOK

The way to actually learning is not through typing, but reading and writing. There are only a few people for whom typing is the way to learn, and only because of their diligence. Of those few people, you're not one of them. Scientific studies have conclusively shown that using a laptop in class is a sure sign that you are not engaged in learning. Also, everyone behind you is distracted by your glowing, flickering screen. To that end, laptops in class as well as mobile devices that emit light and have screens as not allowed, unless I specifically tell you to take them out. However, I do understand that in the real world, you are allowed to access information at will to help you do your jobs and in any area of life. Therefore, to each exam, you may bring one bound composition notebook, containing any **hand-written** notes you wish to write. That's a lot of pages. You may not share your notebook during an exam, but it is expected that you will work with each other to create these notebooks. Since the class will not go in the book order, it is critical that you take notes in class and read the book at the same time. As a result of this policy, you will be tested on material from the book that has not been covered in class. You may also be tested on the same material more than once. Your notebook should be brought with you and kept up to date of current class items. Presentations used in class may or may not be put online for your use later. I will ask to look at your notebooks to assure that there are no printed-out pages or stapled-in pages. The notebook must be a standard composition notebook between 70 and 100 pages. It cannot be a homemade bound book. The process of writing this notebook will amplify the learning process. The notebook is not mandatory to create or use, but the standard composition notebook is the only thing that will be allowed in the exam. Anything else will be asked to be placed off to the side.

## 10. GRADING

- “A” students go above and beyond the assignments, achieving mastery over knowledge with enthusiasm. They also challenge themselves to learn something really new for them. This means that getting an “A” will mean that you’ve been keeping up on current items suggested in class and read the entire book.
- “B” students essentially do what they’ve been assigned and do it well.
- “C” students get some and miss some, but know the core concepts.
- “D” students don’t understand most of the material, and don’t turn in some or most of the assignments.
- “F” students participate only marginally, and what they happen to do shows no understanding or effort.

## 11. OFFICE HOURS

I don’t hold regular office hours, but will stay late after class, and I am responsive to emails in a normal time-frame. I also have extensive online resources through my youtube channel and dedicated Facebook page. **All official communication for the class must be through my Hunter email address.** I cannot, by New York State Educational Standards and by CUNY College Policy, answer any class-related questions posed to me through any other medium. My email for all class correspondence: jk2406@hunter.cuny.edu

## 12. REQUIREMENTS AND GRADING

**Examinations:** There will be three midterm exams. I will keep the two highest midterm exams for the final grade. Each of these two exams is worth 20% of your course grade. The midterms are standard written exams with 40 multiple choice questions. Midterm exams cover the material in the lectures and assigned readings since the previous midterm, as indicated in the Lecture and Exam schedule of the semester. The final exam is cumulative, with approximately 40 of the questions covering the new material, and about 40 of the questions covering the material in the first three midterms. In that sense, the first part of the Final is much like the other midterms. The Final is worth 35% of your course grade

**Daily Quizzes:** There will be a three question quiz at the beginning of every class lasting exactly five minutes. The sum of all the scores through the entire semester is worth 20% of your final grade. It is expected that you'll keep up with the reading and that anything in the class up to that point is fair game for the quizzes. Hunter College also asks I take attendance. Taking the quiz is the proof of attendance. No late quizzes will be accepted for grading. There are no make-ups for these quizzes. In short, show up to class to be able to get a grade better than a "C."

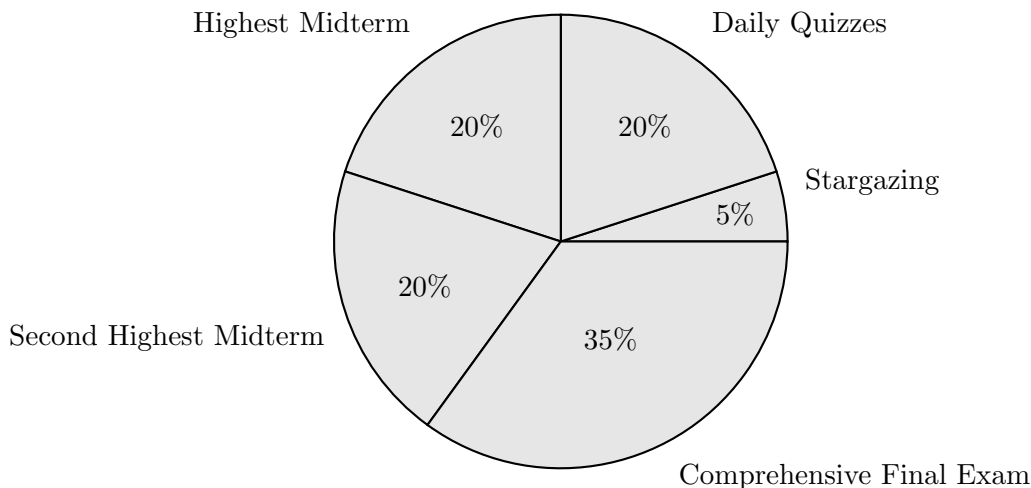
**Required Stargazing Event:** In this class, you'll be going outdoors once on your own to go stargazing with the Amateur Astronomers Association of New York. All you need to do is go, take a number of pictures of yourself at the telescope, find out who is running the telescope, and take note of the objects that you saw in the telescope. Once you have that, then upload it all to your favorite social media and let me know where to go to see it. If you don't do social media, then hard copies of your pictures are OK, too. **This one activity is worth 5% of your course grade**, so you're going to want to make sure you do it. To see where to go, visit this page: <http://www.aaa.org>. Also, on Blackboard, there is a list of other locations that you can go to that will also suffice for credit. There are two special events that are the best bets: October 1, the AAA will be hosting its annual Starfest in Central Park. To get credit, find me there. On October 14, I will be giving the public talk at the UACNJ. It's the only place where you can see the Milky Way. Finally, I will do sporadic events uptown on off-nights in Inwood that count as well. Lastly, I will also occasionally bring a telescope to class and we'll walk over to Sheep Meadow in Central Park. This is entirely optional, and doesn't count as an "on-your-own" stargazing event.

**MyLabsPlus Resources:** MyLabsPlus is only for your study purposes. There are a lot of great resources there, but I won't be grading any of them. It's all up to you whether or not you wish to do it. They don't take much time, and they will help you by asking you direct questions related to all aspects of the course. To view it, use MyLabsPlus (MLP): [www.hunter.cuny.mylabsplus.com](http://www.hunter.cuny.mylabsplus.com)

**Stargazing Event as Midterm Booster:** You may also use specific stargazing outings for one "Midterm Booster." There will be a list of events on Blackboard where if you attend them shall give you a 25% boost on one of the three midterms. Proven full attendance will raise the grade of one midterm by 25%, to a maximum of 90%. You can only do one Booster for credit. These are separate from the Stargazing Event and act as a kind of extra credit. See Blackboard for all details for the Boosters. These won't be easy, and will require extra time and resources to accomplish.

**Exam Structure for the Course:**

|                            |   |
|----------------------------|---|
| Daily Quiz Midterm:        | The sum of the scores of all the daily quizzes                    |
| Written Midterm September: | Latest lecture topics, and chapters 1,2,3,4                       |
| Written Midterm October:   | Latest lecture topics, and chapters 5, 6, 7, 8, 13                |
| Written Midterm November:  | Latest lecture topics, and chapters 14, 15, 16, 17, 18            |
| Final Exam:                | Comprehensive final with emphasis on chapters 19, 20, 21, 22, 23. |

**Grading Structure for the Course:****13. MAKEUP POLICY**

There are no make-ups for the daily quizzes. However, each are worth only three points, so missing one or two won't be a big problem. There will be no makeup for any of the midterm exams for any reason. Should you miss a midterm exam, you will receive zero score for that exam. However, as you can see in the Grading Policy section, you are only graded on two of them. If you miss two midterm exams, however, you greatly reduce your chance to pass the course, so make sure you come and take all the midterms. If you miss the final exam for a valid reason, e.g. serious medical condition and you present a proof of your condition prior to the exam, then you will receive a grade of incomplete (IN). In this case, to complete your course requirements you must take a written makeup exam on the scheduled makeup exam day in the following semester. If you miss all the midterm exams or the final exam for a non-valid reason, or you fail to present a proof of your valid reason for not attending on the final, then you will receive an F as your final grade.

**14. CHANGING TO PASS-FAIL IN THE COURSE**

All pass-fail changes to the grade of your course will be accepted only up until the grade for the third midterm. After grades are given out, you'll have one week to make the change. No changes to pass-fail will be given 2 weeks prior to the final exam, or during the final exam week.

**15. ATTENDANCE**

Attendance at all lectures is required in this course. You already know that regular class attendance plays a major part in achieving success in this course. While the text is comprehensive, lectures are an important part of learning the material. If you are not in class you could miss important scheduling and other changes. Another important part of learning is following the development of information. You cannot learn all of

astronomy the night before the exam; you must keep up with the material as it is presented and discussed in class.

## 16. DISABILITIES

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical and/ or Learning) consult the Office of AccessABILITY located in Room E1124 to secure necessary academic accommodations.

## 17. ACADEMIC INTEGRITY

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The college is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Academic Integrity Procedures.

## 18. FALL 2017 CLASS CALENDAR

| Tuesdays               |                       | Thursdays              |                                      |
|------------------------|-----------------------|------------------------|--------------------------------------|
|                        |                       | August 24              | First Day                            |
| August 29              |                       | August 31              |                                      |
| September 5            |                       | September 8            |                                      |
| September 12           |                       | September 15           | Midterm 1                            |
| September 19           |                       | September 22           |                                      |
| September 26           |                       | September 29           |                                      |
| <del>October 3</del>   | Campus Holiday        | <del>October 5</del>   | Class not scheduled                  |
| <del>October 10</del>  | Campus Holiday        | <del>October 12</del>  | <b>Friday, October 13 Makeup Day</b> |
| October 17             |                       | October 19             | Midterm 2                            |
| October 24             |                       | October 26             |                                      |
| October 31             |                       | November 2             |                                      |
| November 7             |                       | November 9             |                                      |
| November 14            |                       | November 16            | Midterm 3                            |
| November 21            |                       | <del>November 23</del> | Thanksgiving holiday                 |
| November 28            |                       | November 30            |                                      |
| December 5             |                       | December 7             |                                      |
| <del>December 12</del> | Reading day: no class | December 14            | Final Exam                           |

## 19. CLASS TOPICS: NOT NECESSARILY IN ORDER, AND SOME MAY BE DROPPED

**FOUNDATIONS - FROM ANCIENT TO MODERN ASTRONOMY:** We will trace the development of astronomical thought from the geocentric view of the universe to modern astronomy covering the contributions made by Copernicus, Tycho Brahe, Kepler, Galileo, and Newton. Other topics include: The significance of Newton's laws of Motion and Universal Law of Gravitation; our view of the sky from the planet Earth and the apparent motion of celestial objects; the diurnal paths of stars; and the apparent annual motion of the sun and planets.

**SPACESHIP EARTH: OUR HOME IN SPACE:** We'll also cover the three basic motions of Earth – rotation, revolution and precession from a heliocentric point of view and the adoption of Newton's laws; proofs for the Earth's motion. Other topics include: what causes seasons; our view of the sky from different places on Earth; circumpolar stars; and the midnight sun.

**LIGHT THE COSMIC MESSENGER & TOOLS OF THE ASTRONOMER:** We'll learn about the basic properties of light and matter that enables astronomers to understand so much about the universe. Other topics include: astronomical twilight; how the atmosphere affects the observation of celestial objects; astronomical instruments; reflecting and refractor telescopes; and radio telescopes.

**THE MOON:** We'll study of the Moon as viewed from Earth and concludes with what we know about our nearest neighbor in space. Among the topics covered are: aspects of the Moon; lunar phases; sidereal and synodic months; lunar tides; solar and lunar eclipses; physical properties of the Moon; lunar surface features; the geology of the Moon; origin of the Moon; unmanned and manned expeditions.

**EXPLORING THE SOLAR SYSTEM - THE TERRESTRIAL PLANETS:** Looking at the four innermost planets of the Solar System: Mercury, Venus, Earth, and Mars. Among the topics covered are: physical properties of the terrestrial planets; classifying planets; and spacecraft missions .

**EXPLORING THE SOLAR SYSTEM - THE JOVIAN PLANETS:** We'll cover the study of inner gas giants of the Solar System, Jupiter and Saturn. Among other topics covered are: physical properties of the Jovian planets; and spacecraft missions to the outer Solar System planets. The moon systems of Jupiter and Saturn; and planetary ring systems. Other topics include the study of the outer gas giants of the Solar System, Uranus and Neptune; the physical properties of the minor Jovian planets; and spacecraft missions to the outer regions of the Solar System; and ring systems.

**SOLAR SYSTEM VAGABONDS - EXOPLANETS, COMETS, AND DEBRIS:** Not to be left out, we'll study the myriad other objects, including comets, that were left over from the origin of the Solar System. Among the topics covered: meteors and asteroids; the mystery of Pluto; trans-Neptunian and Kuiper belt objects.

**ORIGIN OF THE SOLAR SYSTEM AND EXOPLANETS:** How did the Solar System form?

**THE SUN: OUR NEAREST STAR IN SPACE:** We'll learn about the structure of the Sun and its effect on the planet Earth. Among the topics covered: The origin of the Sun; What makes the sun shine? The sun's visible surface; and sunspots.

**STELLAR PROPERTIES: CHARACTERIZING THE STARS:** We'll cover the distances and motion of stars; stellar parallax and proper motions; stellar magnitudes; spectral classification; color-temperature relationships; stellar masses and binary stars.

**STELLAR EVOLUTION: BIRTH, LIFE, AND DEATH OF STARS:** We'll learn about the lives of stars from birth to death. Among the topics covered: The HR diagram; giant and super giant stars; dwarf and neutron stars; pulsars; nova and super nova explosions; mysterious black holes in space.

**THE MILKY WAY GALAXY - AN ISLAND AMONG ISLANDS:** We'll analyze the structural features of the Milky Way Galaxy. Other topics include: rotation of the Galaxy; stellar populations; and radio view of our home galaxy; and nebulae and star clusters.



**THE GALAXIES: OTHER ISLAND UNIVERSES:** We'll learn about the structure of other galaxies in the universe. Other topics include: classification of galaxies; distribution of galactic systems; the local group; clusters of galaxies; Quasars; and active and radio galaxies; and Dark Matter.

**COSMOLOGY: THE ORIGIN AND EVOLUTION OF THE UNIVERSE:** We'll also learn about the theories for the origin of the universe. Other topics include: evolution of galaxies; the cosmological principle; the age of the universe; the red-shift; Big Bang Theory; dark energy; space and time.