

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

Required: "The Cosmic Perspective: Stars and Galaxies" (8th Edition): by Jeffrey O. Bennett, Megan O. Donahue, Nicholas Schneider, and Mark Voit.

<https://www.amazon.com/Cosmic-Perspective-Galaxies-Bennett-Science/dp/0134073827/>

ISBN-13: 978-0134073828, ISBN-10: 0134073827

Acceptable: "The Cosmic Perspective" (8th Edition): by Jeffrey O. Bennett, Megan O. Donahue, Nicholas Schneider, and Mark Voit.

<https://www.amazon.com/Cosmic-Perspective-8th-Jeffrey-Bennett/dp/0134059069/>

Optional: MyLabsPlus (MLP) for homework: 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.

Optional: Planisphere

<https://www.amazon.com/Guide-Stars-Ken-Graun/dp/1928771017/>

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 expect 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, possible online homework, additional web site reading and even maybe lab work. I look VERY favorably on those who read ahead and are ready with questions. I like being interrupted in class during lecture. I like taking a good tangent to a new curious place. 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. You'll bring it into your life as a hobby or just keep some good memories in your pocket for later. There are vast astronomy resources online, and we will use them. 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

You cannot retain or learn by typing. It is not possible. The way to actually learning is through reading, writing and chatting. 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 are 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

Midterm Examinations: There will be three midterm exams. They are “reading exams.” A reading exam means that there will be tested material covering only the reading assigned. The three exams will span the entire textbook, so reading will constitute a large part of the course grade. Due to the non-standard nature of this type of testing, I will drop one of the three midterms, keeping your best two out of three exams for the final grade. Each of these two exams is worth 20% of your course grade. The midterms are standard written exams with 30 to 40 multiple choice questions, with one or two short-answer questions, and even math problems that appear in the textbook. Midterm exams cover the material in the assigned readings, as indicated in the Lecture and Exam schedule of the semester. You may bring your hand-written, bound notebook to the midterm. Hand-written means in your own handwriting. Photocopies are not acceptable, and may be taken away or you may have a grading penalty against you.

Final Examination: The final exam is cumulative, with approximately 60 the questions covering the lecture material of the entire course. The Final is worth 35% of your course grade. You may bring your hand-written notebook to the final exam. Hand-written means in your own handwriting. Photocopies are not acceptable, and may be taken away or you may have a grading penalty against you.

Daily Quizzes: There will be a three question quiz at the beginning of every class lasting exactly five minutes. These daily quizzes will cover the lecture material and the book reading. 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.” You may use your notes, your book and your classmates for these quizzes. You may not use electronic devices. I will make the font of the quiz very small which will compel you to come to the front seats in the class. The real goal of these quizzes is to get you talking to your classmates about the class and to forge relationships with them. This class isn’t easy, and teaming up is how you will succeed. In fact, it is expected that you will team up in this class to study and chat. Chatting about the material outside of class is the best possible way to study for this class, and these quizzes help you to find those people.

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 or emails 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, and is a truly special place to me. 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.

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

BlackBoard Resources: I will be placing many good study materials, including PDF’s of my lecture notes on Blackboard. It will be the clearinghouse for graded quizzes and reading exams.

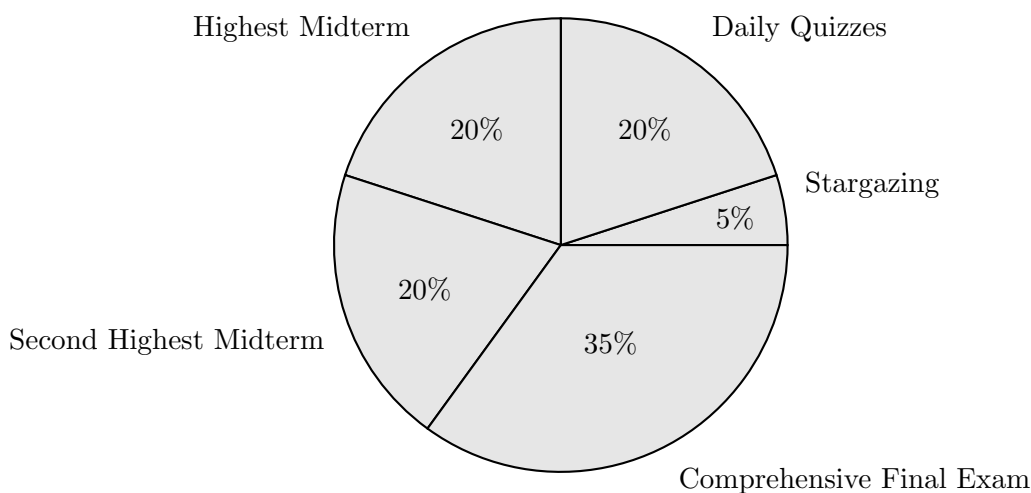
Stargazing Event and Study Activities as Midterm Boosters: You may also use specific stargazing outings for two “Midterm Boosters.” There will be a list of events or study activities on Blackboard where if you attend them shall give you a 10% boost on the two lowest scores of the three midterms. You can only

do two Boosters for credit. See Blackboard for all details for the Boosters. These won't be easy, and will require extra time and resources to accomplish. The study activities are graded pass-fail. They'll need to be done exactly to spec, with all correct answers. The study activities may, and probably should, be done as a group. If you do work with someone, you still must turn in your own work, but you must indicate with whom you worked.

Exam Structure for the Course:

Daily Quiz Midterm:	The sum of the scores of all the daily quizzes
Midterm September:	Reading exam over chapters 1, 2, 3, 4, 5, 6.
Midterm October:	Reading exam over chapters S2, S3, S4, 14, 15, 16, 17, 18.
Midterm November:	Reading exam over chapters 19, 20, 21, 22, 23.
Final Exam:	Comprehensive final over the Lecture material.

Grading Structure for the Course:



13. MAKEUP POLICY

There are no make-ups for any aspect of the course. There will be no makeup for any of the daily quizzes, midterm exams, stargazing events, study boosters, or final exam 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, it will not be possible to get higher than a "D" in the course. 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	
October 3	Campus Holiday	October 5	Class not scheduled
October 10	Campus Holiday	October 12	Friday, October 13 Makeup Day
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		November 23	Thanksgiving holiday
November 28		November 30	
December 5		December 7	
December 12	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 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.