

PHY 109: Astronomy and Cosmology  
(21:750:109)  
Spring 2021

Meeting Times: Tuesday and Thursday 2:30-3:50 PM  
Canvas Course Page: <https://rutgers.instructure.com/courses/115650>

Instructor: Dr. Sheehan Ahmed  
E-mail: sheehan.ahmed@rutgers.edu  
Office Hours: Wednesdays 2:30 - 3:50 PM  
                  Thursdays 11:30 - 12:50 PM  
Credit Hours: 3

**Text:** Jay M. Pasachoff, Alex Filippenko *[The Cosmos: Astronomy in New Millennium 5<sup>th</sup> Edition.](#)*

Astronomy and Cosmology is a first look at all the wonders of the celestial objects and processes that populate our Universe. The course starts with basic physical phenomena, understanding which are key to learning about objects that are too far away to study directly. The course then systematically goes through larger and larger scales of objects and situations, starting with our Earth and the Moon, going through the solar system, exploring stars, galaxies and then the structure of the Universe as a whole. The course assumes no formal training in physics or mathematics but does require basic mathematical operations and focuses more on qualitative critical thinking skills.

**Learning Outcomes:**

- Identifying differences between different stellar objects (i.e. stars, planets, etc.)
- Learn about the solar system and the properties of its bodies
- Understand the geometric causes of day/night, eclipses, stars rising and setting, years and seasons.
- An introduction to important physical phenomena such as the Blackbody spectrum, Newton's Law of Gravitation, Kepler's Laws, and the Doppler Effect
- The general structure and processes of a star, the ability to interpret an H-R diagram and identify the different stages of stellar evolution
- Identify the differences between different compact objects from the end of a star's life, such as white dwarfs, neutron stars and black holes
- Learn about the structure of galaxies
- A general overview of Cosmology. Learn about the origin and evolution of the Universe
- Learn about the main components of our Universe (dark energy, dark matter, and baryonic matter) and how they affect the fate of our Universe
- Learn to appreciate the beauty and the scale of the Universe around us

**Pre-requisites:** None

## Structure of the course and expectations

**All material and links will be available on the [Canvas Course Page](#). Please make sure you have access to the course. The course will be a combination of synchronous and asynchronous activities.**

**Attendance:** You are expected to attend the live online discussion regularly. Our classes are held through zoom, and the links can be found on the [Canvas Course Page](#). A good practice is to read over some of the relevant parts of the textbook before coming to the discussion and bringing up any questions or interesting observations that you might have. In class, along with discussing the material, we will watch videos, run simulations and do practice questions. I will post all relevant links on Canvas or on the PowerPoint. You should actively participate in class and ask questions if anything needs clarification. It is encouraged for you to use chat or voice. The live discussions are meant to be interactive. The goal of the class is to foster a healthy scientific and learning environment and to make sure that you leave with interesting and valuable knowledge. The live sessions will also be recorded, and the recording posted on Canvas if you need to attend asynchronously.

**Assessment quizzes and activities:** At the end of each weekly topic there will be an online assessment quiz and a few activities that you are expected to complete before the start of the next topic. Some weeks will have a few activities, some weeks will have none. These quizzes and activities will constitute 50% of the grade. The assessment quizzes will test whether you are comfortable with the topics covered in class and will constitute of multiple choice, matching, fill-in-the-blanks and other similar types of questions. The activities will be interactive and interesting visualizations of the topics that you can explore.

**Learning Surveys:** At the end of each weekly topic you will be expected to fill out a small learning survey. The learning survey is a way for you to reflect on what you have learned over the week and to raise any questions that you may still have. The learning surveys constitute 10% of the grade.

**Midterm:** There will be one midterm covering about the initial half of the course material and will be worth 20% of the total grade. You will be allowed to do corrections on this after it is graded and you can gain back up to half the points that you lost.

**Final:** The final exam will be comprehensive and cover the whole semester. The final will be similar in format to the assessment quizzes/midterm and will constitute of 20% of the total grade. Any exceptions to the time will need to be discussed with me **2 weeks in advance**.

**Office Hours:** Dedicated office hours are listed on the previous page. However always feel free to email me with any issues. I am also open to meeting by appointment.

### Grading Scheme:

Assessment type	Grade percentage
Quizzes and Activities	50%
Learning Surveys	10%
Midterm	20%
Final Exam	20%

Letter Grade	Range
A	90.0+
B+	87.0 - 89.9
B	80.0 – 86.9
C+	77.0 – 79.9
C	70.0 – 76.9
D	60.0 – 69.9
F	< 60.0

## PHY 109 List of Topics<sup>1</sup>

Week	Topic	Content
Week 1: Jan 19 & 21	Introduction to Astronomy	Introduction, the scientific method, scientific notation, physical quantities (Chapter 1)
Week 2: Jan 26 & 28	Light, Matter and Energy I	Waves and the nature of light, the electromagnetic spectrum. (2.1)
Week 3: Feb 2 & 4	Light, Matter and Energy II	Blackbody radiation, emission and absorption spectra, Doppler effect & the Bohr atom (2.2-2.5)
Week 4: Feb 9 & 11	The Earth-Sun-Moon system and Coordinate Systems I	Lunar phases, eclipses, Celestial coordinates, seasons, leap year, and geographical coordinates (Chapter 4)
Week 5: Feb 16 & 18	Coordinate Systems II, Telescopes and observation methods	More on Coordinate systems, history of Telescopes, lenses, types of Telescopes, optics. (Chapter 4, 3)
Week 6: Feb 23 & 25	Gravitation and orbits	History of early astronomy, Newton's law of Gravitation, Kepler's laws. (Chapter 6)
Take home Midterm		
Week 7: Mar 2 & 4	Terrestrial Planets and their satellites	Characteristics of Mercury, Venus, Earth, Moon, the tides and Mars (Chapter 7)
Week 8: Mar 9 & 11	Jovian Planets, their satellites, Pluto, comets, and asteroids	Characteristics of Jupiter, Saturn, their moons, Uranus, Neptune. Dwarf planets, the Oort Cloud, and the asteroid belt (Chapter 7 and 8)
Spring Break: Mar 16 & 18		
Week 9: Mar 23 & 25	The Sun and Stars	Sun, stars, HR diagram, spectra, temperatures etc. (Chapter 10, Chapter 11)
Week 10: Mar 30 & Apr 1	Stellar Evolution and compact objects	Nebulae, Stellar birth, stellar evolution, white dwarfs neutron stars, black holes, (Chapter 11, 12, 13)
Week 11: Apr 6 & 8	Galaxies, their structure, and dark matter	The Milky Way, types of galaxies, dark matter (Chapter 15, 16)
Week 12: Apr 13 & 15	Cosmology I	Origin and Age of universe, Hubble's Law, Accelerating expansion, geometry & fate of universe, (Chapter 18)
Week 13: Apr 20 & 22	Cosmology II	Cosmic Microwave Background Radiation, Inflation (Chapter 19)
Week 14: Apr 27 & 29	Life in the Universe & Review	The Search for Extraterrestrial Intelligence, Drake Equation, the Fermi Paradox, Kardashev scale (Chapter 20)
Final Exam		

<sup>1</sup> This is the proposed timeline, but it is likely we will slightly deviate from this as the semester progresses depending on the natural pace of the class.

**Academic Integrity:** As an academic community dedicated to the creation, dissemination, and application of knowledge, Rutgers University is committed to fostering an intellectual and ethical environment based on the principles of academic integrity. Academic integrity is essential to the success of the University's educational and research missions, and violations of academic integrity constitute serious offenses against the entire academic community.

- Academic Integrity Policy: <http://academicintegrity.rutgers.edu/>

### **Learning Resources:**

- Rutgers Learning Center (tutoring services) Room 140, Bradley Hall (973) 353-5608  
<http://www.ncas.rutgers.edu/rlc>
- Writing Center (tutoring and writing workshops) Room 126, Conklin Hall (973) 353-5847  
nwc@rutgers.edu <https://www.ncas.rutgers.edu/writingcenter>

### **Accommodation and Support Statement**

Rutgers University Newark (RU-N) is committed to the creation of an inclusive and safe learning environment for all students and the University as a whole. RU-N has identified the following resources to further the mission of access and support:

**For Individuals with Disabilities:** The Office of Disability Services (ODS) is responsible for the determination of appropriate accommodations for students who encounter barriers due to disability. Once a student has completed the ODS process (registration, initial appointment, and submitted documentation) and reasonable accommodations are determined to be necessary and appropriate, a Letter of Accommodation (LOA) will be provided. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [ods.rutgers.edu](https://ods.rutgers.edu). Contact ODS at (973)353-5375 or via email at [ods@newark.rutgers.edu](mailto:ods@newark.rutgers.edu).

**For Individuals who are Pregnant:** The Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy. Students may contact the Office of Title IX and ADA Compliance at (973) 353-1906 or via email at [TitleIX@newark.rutgers.edu](mailto:TitleIX@newark.rutgers.edu).

**For Absence Verification:** The Office of the Dean of Students can provide assistance for absences related to religious observance, emergency or unavoidable conflict (e.g., illness, personal or family emergency, etc.). Students should refer to [University Policy 10.2.7](#) for information about expectations and responsibilities. The Office of the Dean of Students can be contacted by calling (973) 353-5063 or emailing [deanofstudents@newark.rutgers.edu](mailto:deanofstudents@newark.rutgers.edu).

**For Individuals with temporary conditions/injuries:** The Office of the Dean of Students can assist students who are experiencing a temporary condition or injury (e.g., broken or sprained limbs, concussions, or recovery from surgery). Students experiencing a temporary condition or injury should submit a request using the following link: <https://temporaryconditions.rutgers.edu>.

**For English as a Second Language (ESL):** The Program in American Language Studies (PALS) can support students experiencing difficulty in courses due to English as a Second Language (ESL) and can be reached by emailing [PALS@newark.rutgers.edu](mailto:PALS@newark.rutgers.edu) to discuss potential supports.

**For Gender or Sex-Based Discrimination or Harassment:** The Office of Title IX and ADA Compliance can assist students who are experiencing any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking. Students can report an incident to the Office of Title IX and ADA Compliance by calling (973) 353-1906 or emailing [TitleIX@newark.rutgers.edu](mailto:TitleIX@newark.rutgers.edu). Incidents may also be reported by using the following link: [tinyurl.com/RUNReportingForm](https://tinyurl.com/RUNReportingForm). For more information, students should refer to the University's Student Policy Prohibiting Sexual Harassment, Sexual Violence, Relationship Violence, Stalking and Related Misconduct located at <http://compliance.rutgers.edu/title-ix/about-title-ix/title-ix-policies/>.

**For support related to interpersonal violence:** The Office for Violence Prevention and Victim Assistance can provide any student with confidential support. The office is a **confidential resource** and does *not* have an obligation to report information to the University's Title IX Coordinator. Students can contact the office by calling (973) 353-1918 or emailing [run.vpva@rutgers.edu](mailto:run.vpva@rutgers.edu). There is also a confidential text-based line available to students; students can text (973) 339-0734 for support.

**For Crisis and Concerns:** The Campus Awareness Response and Education (CARE) Team works with students in crisis to develop a support plan to address personal situations that might impact their academic performance. Students, faculty and staff may contact the CARE Team by using the following link: [tinyurl.com/RUNCARE](https://tinyurl.com/RUNCARE) or emailing [careteam@rutgers.edu](mailto:careteam@rutgers.edu).

**For Stress, Worry, or Concerns about Well-being:** The Counseling Center has confidential therapists available to support students. Students should reach out to the Counseling Center to schedule an appointment: [counseling@newark.rutgers.edu](mailto:counseling@newark.rutgers.edu) or (973) 353-5805. If you are not quite ready to make an appointment with a therapist but are interested in self-help, check out *TAO at Rutgers-Newark* for an easy, web-based approach to self-care and support: <https://tinyurl.com/RUN-TAO>.

**For emergencies,** call 911 or contact Rutgers University Police Department (RUPD) by calling (973) 353-5111.