Astronomy 1115 Lab Syllabus

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Welcome to Astronomy 1115L! This online lab section complements the Astronomy 1115 lectures by building your intuition through experiments and theory. As such, please do not hesitate to ask any questions you have on the material; the ultimate aim is for you to understand concepts and be proficient in introductory Astronomy. Please note I reserve the right to change this syllabus if I see it fit to do so throughout the semester. **(pre- or co-requisite: ASTR 1115)**

Objectives

Topics to look forward to include a brief history of Astronomy, an analysis of the behavior of stars and planets as seen from Earth, applying the scientific method, understanding the scales of the universe, how to use tools like telescopes and spectroscopes to observe and quantify the stars, a study of the formation and properties of objects in our solar system, na overview of gravity and electromagnetism, methods of discovery of planets around stars, the structure and activity of the Sun and its contextualization with other stars, the life cycle of a star, the structure of the Milky way and its comparison to other galaxies, the Big Bang theory in the context of recent observations, and the possibility of extraterrestrial life in the universe. Note that the lab is a math-based course, and the math is more math-intensive than the lecture; a knowledge of geometry and algebra is expected. See Appendix B for more exhaustive student learning objectives, and Appendix A for a tentative course schedule.

Title IX

UNM faculty, Teaching Assistants, and Graduate Assistants are considered "reponsible employees" by the Department of Education.[1] This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct, and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). For more information on the campus policy regarding sexual misconduct, see: https://policy.unm.edu/university-policies/2000/2740.html.

[1] See p. 15 - http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf

Tutoring and Support

You are encouraged to send me and your classmates your questions on the topics covered in the course on the UNM Learn discussion page for the appropriate chapter(s); this helps your other classmates who may have the same questions. Please don't make the mistake of thinking you're the only one not to understand a topic—if you don't understand a topic, chances are your peers don't either, and bringing it up will remind me to cover it during office hours or the next lecture. You can access the Astronomy 1115 course website, which is the same URL as the course website for the lab, and watch videos to refresh concepts for labs whether or not you're enrolled in the course.

In-person tutoring is also available at the Learning Center, see http://valencia.unm.edu/campus-resources/the-learning-center/index.html. If you're spending more than four hours on the labs, please let me know.

Online Course

This is an online course, meaning you'll have to schedule the time during the week to watch the lectures, complete the quizzes, assignments, and projects on your own. You should do your best not to fall behind as it will be detrimental to your grade. You should plan to spend 2-4 hours a week for this class.

Grading

Your course grade is determined by your grades in the labs and the three naked-eye observing projects. Each of the 15 labs is 100 points, the observing projects are each worth 100 points, and there is one homework assignment worth 50 points, for a total of 1850 points in the course. The labs will get more challenging as the course goes on, so don't skip any labs. Labs are available on UNM Learn, you can also consult UNM Learn or http://helasraizam.github.io for tentative deadlines. The grading scale is included below:

99-100	A+	87-90	B+	70-80	C
94-99	A	84-87	B	60-70	D
90-94	A-	80-84	B-	0-60	F

Students with Disabilities

Qualified students with disabilities needing appropriate academic adjustments should contact me as soon as possible to ensure your needs ar emet. Handouts are available in alternative accessible formats upon request.

A Tentative Course Schedule

The following is a tentative schedule which is subject to change. Do not use it for reference, instead examine the course schedule online at UNM Learn or http://helasraizam.github.io.

Date	Lab	Misc
01/26	Lab 0: Observing Projects	Pre-lab reading, Entry Survey
02/02	Lab 1: Foundations	Lab 1 Homework
02/09	Lab 2: Properties of Planets	
02/16	Lab 3: Kepler's Laws	Observing Project 1
02/23	Lab 4: Parallax	
03/01	Lab 5: Astro-Photometry and Imaging	
03/08	Lab 6: Spectra and Atoms	
03/15	Lab 7: Properties of Stars	Lab 7 Homework
03/22	Lab 8: Stellar Evolution	Observing Project 2
03/29	Lab 9: Binary Stars	
04/05	Lab 10: Star Clusters and the Milky Way	
04/12	Lab 11: Galaxies & Cepheids	
04/19	Lab 12: Cosmology	
04/26	Lab 13: Quasars	Observing Project 3
05/03	Lab 14: Alien Life	
05/10		

B Course Objectives

By the end of the course, the student should be able to:

1. Discuss the night sky as seen from Earth, including coordinate systems, the apparent daily and yearly motions of the sun, Moon, and stars, and their resulting astronomical phenomena.
   (a) Describe the phases of the Moon based on the position of the Earth, Sun, and Moon.
   (b) Describe the use of various celestial objects in ancient calendars and astrology.
   (c) Desribe and employ celestial and geographic coordinate system and how they relate.
   (d) Describe the cyclical motions of stars and celestial objects and how they can be used to find one's earthly coordinates.
   (e) Explain and employ the motion of the celestial sphere in locating celestial phenomena.
   (f) Explain counterintuitive celestial phenomena such as retrograde motion.
2. List and apply the steps of the scientific method.
   (a) List and explain the steps of the scientific method.
   (b) Explain the importance of the scientific method.
3. Describe the scale of the Solar System, Galaxy, and the Universe.
   (a) Describe different units of measurement such as kilometers, astronomical units, lightyears, and parsecs.
   (b) Ascribe these units appropriately to different celestial scales.
   (c) Compare the scales and distances between comets, asteroids, meteors, dwarf planets, planets, different types of stars, quasars, galaxies, and the universe.

4. Explain telescope design and how telescopes and spectra are used to extract information about Astronomical objects.
   (a) Explain the atomic origin and effects of light and the basics of underlying atomic structure.
   (b) Describe the attributes that characterize different types of electromagnetic radiation.
   (c) Perform basic calculations to determine properties of electromagnetic radiation.
   (d) Employ quantum principles to describe the origin and unique elemental fingerprint absorption and emissions spectra.
   (e) Explain how light from an object can divulge its composition, distance, temperature, and radial velocity.
   (f) Explain how telescopes work in basic terms.
   (g) Explain the criteria for excellence for telescopes measuring varying parameters (e.g., different wavelengths of light).
5. Describe the formation scenarios and properties of solar system objects.
   (a) Describe in detail the models of formation for the solar system and the objects that make it up.
   (b) Explain the connection between solar system formation events and the unique development of planets within it.
   (c) Describe models for the formation and present state of the terrestrial planets.
   (d) Describe how the formation and development of planets relate to Earth's present and future state.
6. Describe gravity, electromagnetism, and other physical processes that determine the appearance of the universe and its constituents.
   (a) List, compare, and briefly explain the four fundamental forces.
   (b) List, explain, and employ Newton's and Kepler's laws in basic problems.
7. Describe methods by which planets are discovered around other stars and current results.
   (a) List methods by which planets are discovered around stars, both in our solar system and in stellar systems so far away they look like just a single dot!
   (b) Describe and employ various methods to detect planets outside of the solar system.

8. Describe the structure, energy generation, and activity of the sun.
   (a) Describe the nuclear fusion processes that provide the Sun with its energy and perform basic calculations.
   (b) Describe the structure of the Sun, its activities, and their effects on our solar system.
9. Compare our sun to other stars and outline the evolution of stars of different masses and its end products, including black holes.
   (a) Explain the difference between meteorites, meteors, comets, asteroids, dwarf planets, planets, stars, and quasars.
   (b) Explain how different starting conditions or phenomena in a celestial object's life cycle leads to its categorization as one of the above.
10. Describe the structure of the Milky Way and other galaxies and galaxy clusters.
    (a) Describe the formation of galaxies and galaxy clusters.
    (b) Compare the structure and formation of our galaxy in the context of other galaxies.
    (c) Describe the compositions, ages, and locations of varying types of celestial objects in our galaxy.
11. Students will describe the origin, evolution, and expansion of the universe based on the Big Bang Theory and recent Astronomical observations.
    (a) Describe the Big Bang model as a model for the origin of the universe.
    (b) Describe the accelerating expansion of the universe.
    (c) Employ the expansion of the universe in basic Hubble's Law calculations.
12. Students will describe conditions for life, its origins, and possible locations in the universe.
    (a) Explain the conditions for life outside of Earth.
    (b) Discuss specific examples of habitable zones outside of the solar system.
    (c) Calculate a rough estimate for the probability of intelligent life in the Milky Way.