

SYLLABUS for AST/GLG 190L – The Planets Laboratory

Fall 2021 - F 3:30 – 6:00 pm

College of the Environment, Forestry, and Natural Sciences
Department of Astronomy and Planetary Science
AST/GLG 190L: The Planets Laboratory, 1 credit
Fall, 2021

Meeting time, days, and location:

- F 3:30 – 6:00 pm
- Physical Science (Bldg 19), Room 218

Course Pre-Requisite(s): none

Course Co-Requisite(s): AST/GLG 190

Mode of Instruction: Face-to-face

Instructor: Mr. Lucas McClure

Office: Peterson Hall Room 216

Office Phone: N/A

Office hours (times I'm available to help): Tuesday 2pm-4pm or by appointment

Email: LTM87@nau.edu

Course Purpose:

This course is a laboratory complement to the lecture course “The planets” AST/GLG190, a multifaceted exploration of the rocky and icy geology of planetary bodies in the Solar System. This laboratory course will build on the material presented in AST/GLG 190 by using hands-on activities and one semester-long observing project to further develop that AST/GLG 190 material and enable student to exercise the scientific skills of observation, data collect, reasoning, hypothesis testing, deduction, and inference.

Liberal Studies: AST/GLG 190L is approved as a Liberal Studies laboratory course under the Science and Applied Science Distribution Block. The Liberal Studies program is designed to provide a breadth of understanding to complement the in-depth studies of any particular major. Courses in the Science and Applied Science distribution block enhance students’ understanding of the nature and the use of technology in exploring nature. AST/GLG 190L is uses hands-on learning to promote an intuitive understanding of the nature of our Solar System and of the planetary bodies within it, as well as the technology that humankind has used to explore these worlds. The three essential skills that will be practiced in this course are: i) scientific inquiry, the skills of formulating hypotheses on the basis of observations, obtaining and analyzing data to test hypotheses, and explaining phenomena by means of accepted principles, theories, or laws; ii) critical thinking, the skills – particularly as applied to one’s own work – of articulating the meaning of statement, judging the truth of a statement while keeping in mind possible biases, and determining whether a conclusion is warranted by the evidence provided; and iii) quantitative reasoning, the application of numerical, visual or symbolic reasoning for the purposes of drawing inferences, understanding phenomena or making predictions.

Course Student Learning Outcomes:

Student Learning Outcomes (SLOs) contribute to the programmatic goals of the Astronomy and Planetary Science major and minor), as well as the Liberal Studies Science and Applied Science Distribution Block (indicated by SAS) and the essential skills of scientific inquiry (indicated by “SI”), critical thinking (indicated by “CT”), and quantitative reasoning (QR).

Each exercise has an associated SLO, as follows:

- Lab 1: Scale of the Solar System (SAS, QR)

SLO 1: Understand and be able to describe the scale and structure of the Solar System and

SYLLABUS for AST/GLG 190L – The Planets Laboratory

Fall 2021 - F 3:30 – 6:00 pm

the location the Earth within it.

- Lab 2: Spectroscopy (SAS, SI, CT)
SLO 2: Understand and be able to use the behavior of light to infer the composition of geologic material, including the prediction of spectral shape for individual samples and testing of that prediction with spectroscopic data.
- Lab 3: Material properties (SAS, SI, CT)
SLO 3: Characterize common geologic material on the basis of their properties in hand sample, including the prediction of properties for individual samples and testing of that prediction with data.
- Lab 4: Tectonism (SAS, QR)
SLO 4: Create and correctly identify tectonic structures and the types and amount of strain that cause them.
- Lab 5: Impact Cratering (SAS, SI, CT)
SLO 5: Create various crater forms, including predicting and then testing the different physical processes that operate for these various forms. Compare results from physical experiments to images of planetary impact craters to critique inferences of formation from experiments.
- Lab 6: Relative Age Dating (SAS, QR)
SLO 6: Use crater densities and size frequency distributions to derive relative numerical ages of geologic units with uncertainty estimates.
- Lab 7: Mars Mapping (SAS, CT, QR)
SLO 7: Using images from Mars, map out an area of approximately the size of Arizona, showing distinct geologic units and inferring unit origin, emplacement process, and relative age.
- Lab 8: Volcanism (SAS, SI, CT, QR)
SLO 8: Apply laws of physics to dimensional measurements collected on images of volcanic eruptions to infer properties about the erupted material.
- Lab 9: Entry, Descent, and Landing (SAS, QR, CT)
SLO 9: Develop and exercise judgment and quantitative reasoning regarding the technology needed to land a spacecraft on another planetary body within a budgetary limit. Assess the results and revise as needed, including an identification of unexpected results and reasons why.
- Lunar Observing Project (SAS, SI, CT)
SLO 10: Understand, describe, and correctly interpret the cause for the appearance of the moon over the course of multiple months.
- Trip to Lowell Observatory (SAS, SI)
SLO 11: Understand, describe, and document methods of planetary exploration, including the method of discoveries made at Lowell Observatory.

This course also supports the achievement of Department of Astronomy and Planetary Science learning outcomes as listed at <https://nau.edu/astronomy-and-planetary-science/bs-astronomy/> which include:

- Students will be able to apply the laws of physics in order to understand the:
 - origin and evolution of the Solar System and other planetary systems
 - origin and evolution of stars
- Students will be able to apply mathematical tools such as elementary algebra, geometry, trigonometry to solve physics and astronomy problems
- Students will develop problem-solving capacities. In particular, a student will be able to:

SYLLABUS for AST/GLG 190L – The Planets Laboratory Fall 2021 - F 3:30 – 6:00 pm

- ascertain the known and unknown aspects of a problem
- describe the fundamental physical principles in the problem
- Students will be able to clearly communicate and defend their work in verbal, written, and visual formats to non-scientific audiences

Assignments/Assessments of Course Student Learning Outcomes (grading weights):

Assignments / assessments are designed to support the accomplishment of Course Student Learning Outcomes and will be in the form of i) laboratory exercises, ii) lab quizzes, iii) one multi-month lunar observing project, iv) a trip to Lowell Observatory (or other relevant planetary science site).

i) Laboratory exercises (65%): [SLOs 1-9]

The laboratory exercises will incorporate collected data, simple diagrams, answers to qualitative questions, quantitative calculations, and a section of findings and/or inferences. This common structure will be adjusted to accommodate specific aspects of individual labs.

Labs will be posted to the Canvas site and will be due at the beginning of the following lab meeting, with the exception of the last lab and homework assignments (see schedule). Completing all work during lab time is very much encouraged. All work must be turned in on the provided handouts, or attached scratch papers. If a missed (excused) lab has not been made up within two weeks, it cannot be made up. Labs that are turned in late will be assessed a 20% penalty per day that it is late.

The lowest lab grade will be dropped

ii) Quizzes (10%): [SLOs 1-9]

Each lab meeting will begin with a short quiz covering the material for the lab on that day. Missed quizzes due to an unexcused absence (see above) will be given a grade of zero. Of the 9 quizzes the lowest grade will be dropped, provided it is not a missed quiz. At the discretion of the lab instructor, extra credit may be offered on weekly lab quizzes

The lowest quiz grade will be dropped

iii) Lunar observing project (15%): [SLO 10]

The lunar observing project will include four diagrams showing the lunar observation with accompanying qualitative and quantitative metadata, comparison of observations with expected observations as discussed in class, and a critique of this comparison.

iv) Field trip (10%): [SLO 11]

The Lowell Observatory trip will have a handout of fill-in-the-blank, short answer, and essay questions.

Attendance: Attendance of the lab is mandatory. Please be ready to learn by the start of lab each week. Students must attend the section they are registered for. Except in cases of an excused absence, documented through the dean of students, or proper university channels, missed labs cannot be made up and will be given a grade of zero. Only one excused absence will be allowed and arrangements for makeup work must be negotiated with the lab instructor prior to the absence.

Grading Scale:	89.5-100%	→	A
	79.5-89.49%	→	B
	69.5-79.49%	→	C
	59.5-69.49%	→	D
	≤ 59.49%	→	F

SYLLABUS for AST/GLG 190L – The Planets Laboratory

Fall 2021 - F 3:30 – 6:00 pm

Office Hours: These hours (listed at the top of the syllabus) are times that I will be in my office prepared to talk with students and answer questions about the class. Feel free to drop by during office hours, or you e-mail to make an appointment outside of these hours.

Readings and Materials:

Required laboratory manuals will be provided on the course BBLearn site.

Class Policies.

Behavioral Standards of Conduct: Please silence cell phones before class. Laptops, tablets, and/or phones may be used for class purposes (e.g., taking notes) *only*. Using devices for non-class purposes is distracting to students around you, and creating such disruption to the class learning environment is selfish and unacceptable. If devices are used in ways that are disruptive, the privilege of using them will be revoked (i.e., they will no longer be allowed) for those abusing the privilege.

Extensive research demonstrates that *the human brain cannot multi-task*. Our focus simply shifts back and forth from one task to the other, a switching process that takes time, and so we are less efficient at both tasks, and our brains get worse at switching the more we try to do it. In other words, it is not physically possible to both pay attention to lecture and do something else on your device. Your learning and understanding will be diminished.

In the case of unsafe, inappropriate, disrespectful, or disruptive behavior, the instructor will dismiss you from the classroom after a verbal warning is given. If a student is asked to leave he/she will be given a zero for that assignment and the course instructor will be notified.

Academic Standards of Conduct: Although the lab environment encourages group discussion, students must complete, and turn in, their own work. Cheating of any kind is not allowed and includes: exchanging answers with other students (in and out of lab), showing up to lab with work already completed, using unapproved resources during lab, plagiarizing, or other activities listed in the Academic Integrity policy (<https://policy.nau.edu/policy/policy.aspx?num=100601/>). Failure to comply with the code of conduct will result in immediate disciplinary action, which can include: being given a zero on an assignment, suspension, or an “F” in the course.

The information contained in this syllabus, other than this course’s grade and attendance policies, may be subject to change with reasonable advance notice.

COURSE SCHEDULE

Week	Date	Laboratory Exercise	Text Readings & Assignments Due
1	8/27	Introduction to the Lunar Phases observing project	---
2	9/3	Lab 1: Scale of the SS	Ch 1 (all); Moon Observation #1 Due
3	9/10	Lab 2: Spectroscopy	Ch 7 (all) & Table A16; Lab 1 Due
4	9/17	Lab 3: Material Properties	Morrison & Owen on Bblearn (3-1 to 3-4); Lab 2 Due
5	9/24	No Lab – Exam in lecture	---
6	10/1	Lab 4: Tectonism	Ch 11 (all); Lab 3 & Moon Observations #2-4 Due
7	10/8	Lab 5: Impact Cratering	Ch 10 (10-2 & 10-3, skip Jovian problem); Lab 4 & Moon Observations #5-7 Due
8	10/15	Lab 6: Relative Age Dating	16-4 (Asteroid and Comet Impacts); Lab 5 & (Optional) Moon Observation #8 Due

SYLLABUS for AST/GLG 190L – The Planets Laboratory
Fall 2021 - F 3:30 – 6:00 pm

9	10/22	<i>No Lab – Exam in lecture</i>	---
10	10/29	Lab 7: Mars Mapping	Ch 12 (12-2) ; Lab 6 & Moon Phases Project Final Materials Due
11	11/5	Lab 8: Volcanism	Ch 14-2; Lab 7 Due
12	11/12*	Lab 9: EDL	Ch 5 (5-1, 5-2); Lab 8 due by the <u>start</u> of lab & Lab 9 due by the <u>end</u> of lab.
13	11/19	<i>No Lab – Exam in lecture</i>	---
14	11/26	<i>No Class - Thanksgiving</i>	---
15	12/3*	Field Trip to Lowell Observatory	Answers to Handout Due by the end of the Lab

**The trip to Lowell Observatory will be scheduled at the beginning of the semester with input from students.*

SYLLABUS for AST/GLG 190L – The Planets Laboratory
Fall 2021 - F 3:30 – 6:00 pm



SYLLABUS
REQUIREMENTS

COVID-19 REQUIREMENTS AND INFORMATION

Additional information about the University's response to COVID-19 is available from the **Jacks are Back!** web page located at <https://nau.edu/jacks-are-back>.

SYLLABUS POLICY STATEMENTS

ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full *Academic Integrity* policy available at <https://policy.nau.edu/policy/policy.aspx?num=100601>.

COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (ABOR Policy 2-224, *Academic Credit*), each unit of credit requires a minimum of 45 hours of work by students, including but not limited to, class time, preparation, homework, and studying. For example, for a 3-credit course a student should expect to work at least 8.5 hours each week in a 16-week session and a minimum of 33 hours per week for a 3-credit course in a 4-week session.

DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conducive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's *Disruptive Behavior in an Instructional Setting* policy at <https://nau.edu/university-policy-library/disruptive-behavior>.

NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, or veteran status. Due to potentially unethical consequences, certain consensual amorous or sexual relationships between faculty and students are also prohibited as set forth in the *Consensual Romantic and Sexual Relationships* policy. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's *Nondiscrimination and Anti-Harassment* policy. EAO also assists with religious accommodations. For additional information about nondiscrimination or anti-harassment or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or visit the EAO website at <https://nau.edu/equity-and-access>.

SYLLABUS for AST/GLG 190L – The Planets Laboratory

Fall 2021 - F 3:30 – 6:00 pm

TITLE IX

Title IX is the primary federal law that prohibits discrimination on the basis of sex or gender in educational programs or activities. Sex discrimination for this purpose includes sexual harassment, sexual assault or relationship violence, and stalking (including cyber-stalking). Title IX requires that universities appoint a “Title IX Coordinator” to monitor the institution’s compliance with this important civil rights law. NAU’s Title IX Coordinator is Elyce C. Morris. The Title IX Coordinator is available to meet with any student to discuss any Title IX issue or concern. You may contact the Title IX Coordinator by phone at 928-523-3515, by fax at 928-523-0640, or by email at elyce.morris@nau.edu. In furtherance of its Title IX obligations, NAU will promptly investigate and equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. Additional important information about Title IX and related student resources, including how to request immediate help or confidential support following an act of sexual violence, is available at <https://in.nau.edu/title-ix>.

ACCESSIBILITY

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-6906 (TTY), 928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at <https://nau.edu/disability-resources/student-eligibility-process> or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU’s Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

RESPONSIBLE CONDUCT OF RESEARCH

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at <https://nau.edu/research/compliance/research-integrity>.

MISCONDUCT IN RESEARCH

As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University’s Research Integrity Officer, Dr. David Faguy, who can be reached at david.faguy@nau.edu or 928-523-6117. More information about misconduct in research is available at <https://nau.edu/university-policy-library/misconduct-in-research>.

SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.