NAU NORTHERN ARIZONA UNIVERSITY
College of the Environment,
Forestry, and Natural Sciences

FYLI

Department of Astronomy and Planetary Science
AST 180: Introduction to Astronomy
Fall 2019

Meeting Times & Location
Section 2 — MWF 12:40 to 1:30 pm, Physical Sciences Building Rm 103

Credit/ Pre- or co-requisites
3 credit hours, no pre- or co-requisites

Mode of Instruction
Face-to-face. Some of class time will be spent on lecture and demonstrations; Most of the time will be spent on interactive group activities and tutorials. There will also be observational exercises and projects throughout the course. You should constantly check your grades on BBLearn.

Instructor Contact & Availability (see Contacts & Hours on BBLearn menu)
Dr. Lisa Chien
Email: **Lisa.Chien@nau.edu**
Phone: 928-523-0422
Office: Bldg. 19, Rm. 311
Office Hours: **MW 11 am - 12 pm and Thu 1 - 2 pm**
Please email me your name and class (AST180). I much prefer email communications when it is outside of office hours, whether you like to schedule a different time to meet or for course questions. I will get back to you within 24 hrs.

Teaching Assistant
Benjamin Pieczynski (bdp85@nau.edu)
Office hour & location: will be announced on BBLearn

Course Purpose & Student Learning Outcome

"Introduction to Astronomy" presents the astronomical phenomena of the universe—i.e., the night sky, planets, stars, galaxies, cosmology—in the context of physical science. Core topics include the scale of the universe, technological tools of astronomy, the Copernican revolution, gravitation and the motion of the planets, electromagnetic radiation and spectra, contents of the solar system, the life cycle of stars, origin and structure of galaxies, and big bang cosmology. The order of topics will also be chosen by the instructor as guided by the textbook.

This liberal studies course meets a 3-hour Science and Applied Science requirement if taken by itself; and meets the Lab-science requirement if the separate lab, AST 181, is also taken. This course will address several of the liberal studies essential skills, focusing on the logic of scientific inquiry.

The overarching goals of this course are for you to:
1. understand the nature of science through the eyes of astronomy
2. understand the big ideas in astronomy
3. develop a lifelong interest in astronomy and current events surrounding astronomy.

Required Materials & Technology

1. Top Hat (see Top Hat Access on BBLearn menu)

Click on the link on BBLearn, or go to our course website https://app.tophat.com/e/444291 on your laptop, or download the app on your device. The code to join is 444291. If you have purchased Top Hat already, either for this semester or one year subscription, no need to buy it again. Just join the course! If this is your first time, please signup and it is $26 for this semester (or pay $38 for one year).

Should you require assistance with Top Hat at any time, due to the fact that they require specific user information to troubleshoot these issues, please contact their Support Team directly by way of email (support@tophat.com), the in app support button, or by calling 1-888-663-5491.

2. OpenStax: Astronomy e-text (see Syllabus & Info on BBLearn menu)

Good news: your textbook for this class is FREE available for online, in web view and PDF format! Once you register for Top Hat, you should see the assigned textbook readings and questions on Top Hat. Each chapter will be released as we go along.

You can also choose to download to read offline, however note that questions are ONLY accessible in Top Hat. Click on the link in BBLearn above, or download from here: www.openstax.org/details/astronomy. If you prefer to purchase a print version, get the official OpenStax print version. (Simple printouts sold by third parties on Amazon are not verifiable and not as high-quality.)
Astronomy from OpenStax, Print ISBN 1938168283, Digital ISBN 1947172247

Grading System

Assessment	Percentage	
Class Participation	**20%**	
In-class Tutorial	**20%**	
Midterm Exam	**20%**	
Final Exam	**20%**	
Project	**10%**	**10-15%***
Three Observatory Visits	**5%**	**0-5%***
Homework	**5%**	

Grade	Score
A	89.5 – 100
B	79.5 – 89.5
C	69.5 – 79.5
D	59.5 – 69.5
F	0 – 59.5

* This alternative plan is ONLY for students who are definitely NOT able to attend ANY Observatory Visits at night. You are then REQUIRED to do ONE MORE project (Project #4) due the end of the semester. I strongly encourage you not to choose this plan if you don't have to. Visiting our NAU Observatory not only will enhance lots of your understanding, but many times what you will see and experience is unforgettable and life-changing!

Assignments & Assessments

Students will be assessed on the objectives through the following methods. The grading rubrics for each method will be discussed in class or posted on BBLearn. **Only institutional or written medical excuses will be accepted for any missed assignments** listed below. Students with official excuses must contact the instructor to make alternate arrangements prior to the due of the assignment.

1. Class Participation & Attendance (through Top Hat)

We will use Top Hat as **attendance**, so please bring your device or laptop to every class! Please don't forget to charge your devices, and make sure it has connection to internet. Each attendance is 1 point.

We will also have **concept questions (Think-Pair-Share)** using Top Hat throughout the class, and correct answer is worth 1 point. You will not be able to make up ANY points if you miss any questions in the class, under any circumstances. There will be NO extra credit work given to make up your points. This score should solely depend on your whole semester's participation in class.

Your participate score is calculated using the TOTAL of attendance and concept questions, and is updated regularly on BBLearn. You are allowed to have **TWO UNEXCUSED ABSENCES** in the semester without them counting against your grade.

IMPORTANT: If you have malfunction or need assistance anytime in class, please grab this paper (that looks like the left figure) from me, and continue to participate in class. Write down your answers in the back of the paper and hand it back to me at the end of class. However, I do take **1 POINT OFF** from your answers to be fair. You can then attend any extra credit opportunities (see more detail below) to make up the points you missed in this category. Alternatively, you can use one unexcused absence on this day that your device malfunctioned.

2. In-class Tutorials

Astronomy is a verb! I don't believe you can learn and love science simply by watching me talk about it. I believe that you can best learn astronomy—and love science—if you DO astronomy. Therefore, I have designed this class around you completing a series of experiences where you look at what astronomers look at, measure what astronomers measure, and use scientific models the way astronomers use them. Although there will be lectures for you to attend to throughout the class, the majority of your intellectual effort needs to be spent not on memorizing notes, but on reviewing the activities we do during class.

We will do lots of collaborative classroom activities, called Lecture Tutorials from the book above, which target specific ideas presented in lecture. These are designed to be completed in pairs during class by talking through the questions and writing a detailed consensus response. You will submit the activities done in class for grading when you finish, and the scores are the same for both students. The questions are quite similar to the questions you will find on the course exams, and you are therefore strongly encouraged to consider these activities as a critical component to your success in the course. Again, you CANNOT make up these activities unless you have institutional or medical excuses.

3. Exams

Midterm Exam: Oct, 11, Friday
Final Exam: Dec, 9, Monday, 12:30 - 2:30pm

This course consists of one mid-term examination and one cumulative final examination. **IMPORTANT:** You **MUST** attend all of the exams with no exceptions. If you have an institutional excuse or written medical reason, please contact me as soon as you can so we can arrange alternative exams. The format of two exams will be discussed in the class.

4. Projects

Throughout the semester there are three projects related to observing the night sky or the celestial objects. They are simple but some does require you to physically be outside and look the night sky. To help you get used to sky viewing, and just for fun, here are some free (lite version), helpful and highly recommended apps/software (NOT required for the class). All these apps/software allow you to point your device to the

sky, and displays and identifies objects right on your device!

SkyView— I recommend this one among the two below, since it overlays on what you see through your camera, and you can take a quick picture with labels on your picture!

Night Sky— This app has incredible visualization, and when you pinch or tap on the constellations, or any objects, it takes you to a 3D view of the stars in space and shows you more than enough of information you want to know about the object.

Star Chart— It's simple and easy to use (without information overload), and when you tap on objects, it give you nice simple astronomical data about them.

Stellarium— Stellarium is a free open source planetarium for your computer (which also has a web form: stellarium.org/ and a non-free app called Stellarium Mobile Sky Map). It shows a realistic sky in 3D, just like what you see with the naked eye, binoculars or a telescope.

If you choose the alternative plan where your percentage for Observatory Visits are 0-5%, you MUST do ONE more project (project #4) due the end of the semester. This project will be consist of researching astronomy topics and writing an essay.

5. Three Required NAU Observatory Visits (See Observation Log Worksheet on BBLearn menu)
During the semester, you are required to participate in an evening of observing the night sky at the NAU Campus Observatory (Bldg. 47; on San Francisco, behind Reilly Hall). The observatory is open to the public, free of charge, on clear **Friday nights from 7:30 pm – 10:00 pm**. *Additionally, one evening each week, rotating Monday-thru-Thursday, will be reserved for AST180. The schedule will be posted to BbLearn once it is ready.* On Fridays, the NAU Astronomy club discuss the constellations, astronomical objects, as well as use the telescope to observe. It is a great chance to learn about the telescope on campus (even Apollo astronauts, including Buzz Aldrin, visited before)!

Each student is expected to go to **THREE** different sessions throughout the semester to complete this portion of the grade, so please do not wait until late in the semester to do this. For these assignments, **take the worksheet "Observation Log Worksheet" on BBLearn to the telescope. Be sure to have the telescope operator sign your worksheet.** Although we recommend that you submit your Observing Log very soon after completing your night of observing, they will also be accepted in class through Friday, Dec 6th. No late worksheets will be accepted for ANY reason beyond the end of class on Dec 6th.

6. Online Homework Review Questions (through Top Hat)
These simple questions are embedded within the assigned OpenStax Astronomy textbook in Top Hat, in order to encourage you to read the textbook. Carefully see when each assignment is due. It is important to remember that the exams will cover materials in the textbook that may or may not be discussed in class.

★ Extra Credit Opportunities towards your Class Participation!

There are many opportunities outside of the classroom to participate in local night viewing events and learn more about our sky and relate to our course materials. There are no limits of how many times you go to these events or places. Besides what are listed below, new timely opportunities may be announced in class and posted on BBLearn. If you cannot do either of these for personal reasons and still want to complete an extra credit assignment, please contact me as soon as you can to make alternative arrangements.

1) NAU Campus Observatory Public Nights (free)

As described earlier, you MUST visit the Campus Observatory 3 times for this class. Then any **ADDITIONAL** visits will count **5 points** every visit.

If you attend any of the events or sites below, you can earn 10 points for each events towards your Class Participation! Please write a brief summary address the following: What did you attend and where did you go? What is the event about? Can you relate the event back to anything we've covered in class? If not, tell me something new that you learned and would be interesting to cover in the future classes. If you observed, what objects did you see and what did you learn about them? Was it an object that we talked about in class? Is there anything you can tell about it from your naked eye observations? Color? Brightness?

2) 30th Flagstaff Festival of Science Events (Sep 20 to 29 only!)

This year is the celebration of 50th anniversary of Apollo 11 moon landing nationwide, so lots of exciting events to go to! The festival begins with the keynote talk about *To the Moon and Beyond!* ,with speaker of the 10th and youngest person to ever walk on the Moon, Apollo 16 Lunar Module Pilot General Charlie Duke (request free tickets from NAU Central Ticketing Office). Visit the website: https://www.scifest.org, and attend any events that are related to Astronomy.

3) Flagstaff Lunar Legacy Events (through Dec 2019)

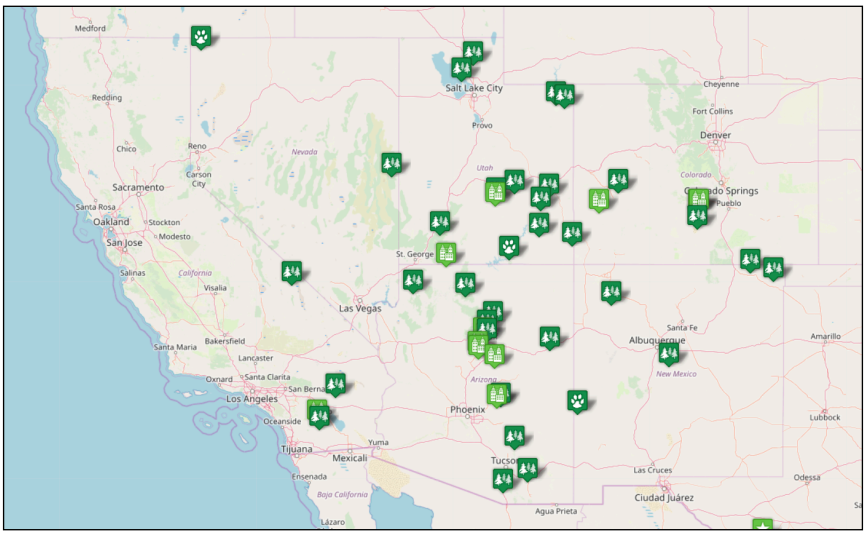
Throughout the town there are also various locations that have events related to the Flagstaff Lunar Legacy. Flagstaff actually has a long history and close connection to the Apollo Lunar missions; attend the events to celebrate the 50th anniversary of Apollo 11 moon landing, and find out more! Visit the website: https://www.flagstaffarizona.org/lunarlegacy/.

4) Lowell Observatory Evening Programs ($16; see me or Dept. Office for coupons)

Lowell Observatory at Mars Hill, Flagstaff offers a variety of night sky viewing programs **from 5 to 9:30pm, Monday to Saturday**, however the visit will cost $16 (you can find coupons from me, the Dept. Office, or in local newspapers, advertisements, websites). Visit: https://lowell.edu.

5) International Dark Sky Places

Since the day you arrived in Flagstaff, you've probably heard that Flagstaff is the world's first International Dark Sky City, recognized by the International Dark Sky Association in 2001. There are more cities, locations, national parks etc that have been recognized, and many are located near us (see below). Visit these websites: http://www.flagstaffdarkskies.org and https://www.darksky.org.



6) Meteor Crater ($18)

The world's best preserved meteorite impact site on Earth, located near Winslow about one hour drive from Flagstaff. Meteor Crater is the spectacular result of a collision that rocked the American Southwest approximately 50,000 years ago with the energy of more than 20 million tons of TNT. Visit their website: https://meteorcrater.com.

7) Any other Observatories or Astronomy-related Facilities/Locations

There are a few public/private observatories in AZ as well as research facilities that are not mentioned above, such as USGS (US Geological Survey) near Buffalo Park, NOAO (National Optical Astronomy Observatory) down at Tucson, Kitt Peak Observatories near Tucson etc. If you get a chance during holidays or breaks, visit the observatories. (Note: visiting Dark Sky Brewing Company, or Roswell UFO museum in NM, do not count…)

Class Tentative Schedule

We		M	W	F	Text	Topics	Project
1	Aug	26				Class Intro	#1 (8/26-8/31)
			28		Ch 1	A Brief Tour	
				30	Ch 2	Observing the Sky: The Birth of Astronomy	
2	Sep	2				**No Class**	
			4				
				6	Ch 3	Orbits and Gravity	
3		9					
			11		Ch 4	Earth, Moon, and Sky	
				13			
4		16			Ch 5	Radiation and Spectra	
			18				
				20			#1 (9/20-9/29)
5		23			Ch 6	Astronomical Instruments	
			25				
				27			
6		30			Ch 7 - 10	Earth, Moon, and the Terrestrial planets	
	Oct		2				#2 (10/1-10/31)
				4	Ch 11 - 12	The Giant Planets	**#1 DUE 10/6**
7		7			Ch 13 - 14	Asteroids, Comets, Meteors	
			9			Planetary Evolution	
	Oct			11		**MIDTERM EXAM**	
8		14			Ch 15 - 17	The Sun and Analyzing Starlight	
			16				
				18			
9		21			Ch 18 - 19	The Stars: A Celestial Census	
			23			Celestial Distances	
				25			
10		28			Ch 20 - 21	The Birth of Stars and Exoplanets	
			30				#3 (11/1-11/30)
	Nov			1			**#2 DUE 11/3**
11		4			Ch 22 - 24	Stellar Evolution and the Death of Stars	
			6				
				8			
12		11				**No Class**	
			13		Ch 25	Milky Way Galaxy	
				15			
13		18			Ch 26	Galaxies	
			20				
				22			
14		25			Ch 27	Active Galaxies and Quasars	
			27			**No Class**	
				29		**No Class**	
15	Dec	2			Ch 28 - 29	Evolution and Distribution of Galaxies	**#3 DUE 12/1**
			4			The Big Bang	
				6			***#4 DUE**
16	Dec	9				**FINAL EXAM 12:30 - 2:30 pm**	

* Project #4- ONLY for those who cannot attend NAU Observatory at night!

Academic Deadlines

- ADD/DROP deadline: Sep 5
- WITHDRAWAL deadline (without petition and fee): Nov 1

Academic Integrity Policy

Please read this section carefully as each student is required to understand and comply with all Academic Integrity rules and standards. Both NAU and this Department have standards which are written and referenced below.

- Passing other's work off as your own (plagiarism) and cheating are not accepted at NAU and are absolutely not tolerated in this class. It is not the professor's responsibility to attempt to describe and prohibit any and all forms of Academic Dishonesty. **It is your responsibility to uphold the highest ethical standards**. If you have any doubt or question about this policy, it is your responsibility to ask the professor in advance and to be clear about the answers and policies.

- If you are caught cheating or if any of your **assignments/exams are found suspiciously similar** (such as exact same wording on written responses— note, changing a few words or the order of certain words is still plagiarism!), **ALL** students involved will receive zero points on that assignment or exam. The bottom line: ***Do your own work and do not let others copy off of you.***

- Academic Dishonesty information will be given to the Dean of Students and a written copy of any such incident may be attached to your official NAU file. If cheating/plagiarism continue, you will receive F in the class and the Dean's office will be notified. University Academic Integrity Policy can be found here.

*"**Education** is the most powerful weapon which we can use to change the world."*
— Nelson Mandela

University Policies can be found at nau.edu/university-policies/.

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 (Academic Credit Policy 2-224), for every unit of credit, a student should expect, on average, to do a minimum of three hours of work per week, including but not limited to class time, preparation, homework, and studying.

DISRUPTIVE BEHAVIOR
Membership in NAU's academic community entails a special obligation to maintain class environments that are conductive 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 breach the peace, 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 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. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's Safe Working and Learning Environment (SWALE) policy. EAO also assists with religious accommodations. For additional information about SWALE 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 via the EAO website at https://nau.edu/equity-and-access.

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 Pamela Heinonen, Director of the Equity and Access Office located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011. 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 928-523-3312 (TTY: 928-523-1006), by fax at 928-523-9977, or by email at pamela.heinonen@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 http://nau.edu/equity-and-access/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.