Syllabus Summary
and
To-Do Page

- ❑ Purchase textbooks
- ❑ Agree to the flexibility requirements of Astronomy Lab
- ❑ Understand the attendance policy
- ❑ Understand the homework policy
- ❑ Turn off my audible ringer on my phone before class starts. If using a laptop computer for taking notes, turn off instant messagering.
- ❑ Actually read the syllabus

NaSc 109 *Introduction to Astronomy* Summer 2019

Instructor: Dr. David Green
Office: RAC 128 Ext. 4355 (messages only)
E-mail: david.green@pepperdine.edu
URL: seaver-faculty.pepperdine.edu/dgreen
Lecture: M-Th 2:30-6:00 p.m.; KSC 130
Lab: Mon - Thurs, 7-10 p.m. but possibly earlier or even later (more on that below) KSC 200

Texts: Freedman, Geller, Kaufmann, *Universe* 10th Ed
(Optional) Moché, *Astronomy: A Self-Teaching Guide*

Lab: (Provided in class) Edmund Scientific, *Mag 5 Star Atlas*

Other: Small flashlight (Don't purchase until after 1st class)
Scientific Calculator (Required. Cell phone calculator is not acceptable)

TENTATIVE EXAM SCHEDULE	
Test 1	Thur, May 9
Test 2	Thur, May 16
Test 3	Thur, May 23
Test 4	Wed, May 29
Final	Thur, May 30

I have no special talents. I am only passionately curious.
- Albert Einstein

LEARNING OUTCOMES FOR GENERAL EDUCATION LABORATORY SCIENCE

This course fulfills the following student learning outcome for the laboratory science requirement in the general education curriculum.

Upon completion of this course students will have demonstrated the ability to identify and apply the basic skills of the practicing scientist and, after acquiring a necessarily limited dataset, distinguish between facts and inferred conclusions or measurements and calculated results through analysis of the dataset.

The practice of scientific inquiry is naturally not limited to nor defined by a passive classroom environment but, rather, to active discovery in the laboratory, be that in-house or in the field. This course is designed to enable the students to achieve the learning outcomes.

Additional goals, specific to this course are summarized below.

PREREQUISITES

If you're a senior, you may have put off your lab science course because you may not like science, are scared of science, or it just didn't fit in the schedule until this year (yeah, right). Maybe you had a bad experience (or two... or three) in previous science courses. Perhaps you just need another science course and this one sounded good. Or, maybe, you really like science but don't like chemistry or biology. Whatever reason you are here, the only prerequisite for the course is that you want to learn about the universe in which we live and at the same time have some fun doing it.

GOALS

Success in this class starts with your own inquisitive nature. Learning how things work and questions about self are innate in nearly everyone from the time they can form a question. For many, the desire to understand nature and the universe is lost early in life because of personal preferences, experiences, societal or peer pressures, or many other reasons. In this course, some of the mystery and awe of the universe will be explored in, hopefully, a

non-threatening environment. Past and current scientific thought will be presented as well as methods used to collect and analyze data which lead to our modern theories of the universe. (See also **Introduction to Astronomy: Approximate Chapter Coverage**.)

FOREMOST, THIS IS A COURSE in science and technology. However, every person brings to this class their own concepts and biases about science and technology, many of which will be explored as a natural consequence of the content of this course. Relevant to the study of astronomy and the history of science are questions of how religion has shaped our concept of the universe and how religion has both quickened and impeded the evolution of scientific thought. Without necessarily committing to any specific religious dogma, we will address questions such as the concept of infinity, attempts at proving the existence of God, and using biblical scripture or other religious texts to "prove" a scientific principle (or *vice versa*).

Astronomy is the oldest of the sciences, dating back to the time of the Babylonians. Modern astronomy has developed explosively over the last 50 years. The overall goal of this course is to provide participants with a sufficient understanding of the principles, laws, and theories of basic modern astronomy and astrophysics and to, at least partially, eliminate the mystery of scientific exploration in the field, laboratory, and classroom. Participants in this course will gain the competence to read and understand the popular scientific literature and should attain the skills to differentiate authentic scientific exploration from "pseudoscientific" conjecture.

In addition to these goals, the specific goals are that every participant will…

- ✓ recognize and appreciate the technical challenges faced by research scientists.
- ✓ be able to use some common laboratory equipment.
- ✓ understand that the success of any of any scientific endeavor may depend upon teams of scientists, engineers, and technicians (perhaps from divergent countries, cultures, or academic specialties) working together to investigate the problem.
- ✓ have an operational knowledge of the origins, usefulness, and limitations of past and current astronomical and astrophysical theories – knowledge which transcends the potential obsolescence of current theories.

The theoretical and practical aspects of each unit will be studied through both a traditional didactic, a cooperative, and a hands-on approach in a highly collaborative environment.

THE THEORETICAL BACKGROUND of some current astronomical and cosmological models will be discussed in lecture and found in the readings. Emphasis on the practical methods of data collection and analysis will be studied in the laboratory. Except where necessary for understanding subtle points of an observation or theory, scientific principles will be covered sufficiently to provide an adequate understanding of the topic under discussion without being unnecessarily overwhelming by details.

Everyone who successfully completes this course should be able to:

- ✓ understand the principles underlying celestial motion, modern cosmology, and stellar evolution.
- ✓ describe the terrestrial results of celestial events – including (but not limited to) lunar phases, seasons, sunspots, solar flares, solar prominences, and planetary alignments.
- ✓ carry out simple experiments related or similar to those performed by active professional scientists.
- ✓ use techniques for recording and evaluating data derived from experiments and appropriately report the results of a given experiment.
- ✓ solve a variety of simple numerical and non-numerical astrophysical problems dealing with planetary motion, stellar and galactic distances and sizes, light, and optics.
- ✓ Identify some constellations and stars in the late winter/early spring night sky.

ATTENDANCE

Lecture augments and does not replace the readings. Also, since the content of exams and homework problems is often covered in lecture, missing class is not advised. Tardiness is disruptive and you may miss a quiz – please try to be to class on time. **Every unexcused absence will result in no less than 1% reduction in total course points.** Excused absences are only those in which you are representing the university for atheletics or forensics. Absences for family events are not excused.

In the event of an illness – with required documentation from a physician or the University Health Center – or University sponsored event, contact the course instructor as soon as is practical to make appropriate arrangements.

> ***Knowledge, and understanding, are wild things, to be hunted down and subdued.***
>
> ***Ignorance, stupidity and superstition are infectious, treatable conditions; but their successful treatment requires the cooperation of the patient.***
>
> ***- John N. Cooper, Professor of Chemistry***
> ***Bucknell University***

OFFICE HOURS

Office hours will be announced. The instructor obviously prefers you to come to scheduled office hours, **but if you cannot make it please make an appointment, stay after class for awhile, or even try just dropping by.** Appointments are made quite liberally for most hours. Those who avail themselves of in and out of office help usually do better in the course. You may use e-mail to get non-immediate help as well. My e-mail address is given above.

You are on the electronic mailing list for "last minute" course information: please check your Pepperdine email daily: this is the only address that course email correspondence will be sent to. Up-date-information sent by email will also be posted on the web (select "*Late-Breaking Announcements*" from the home page).

HOMEWORK

Homework will be assigned as we go. Homework is due on the assigned date at the assigned time. **Late homework will not be accepted – please don't ask.** You must keep up with the reading and homework. Getting behind usually results in intense frustration later. Homework sets from Moché will also be assigned. *You should work as many of the chapter problems in* Freedman and Kaufmann *and* Moché *as possible beyond those assigned* to achieve the best results in mastering the material, developing intuition and creativity, and personal accomplishment. DO NOT try to do the problems until you have read the chapter at least once completely. Some students have grown accustomed to simply copying someone else's homework in the last moments before it is due – this is unacceptable, has regularly been observed by this instructor, and can result in the posting of zero for that assignment (see also *PLAGIARISM AND CHEATING*, below).

EXAMINATIONS

Four tests and a final will be given. So that one bad day on an exam will not ruin your course grade, your lowest test grade will be discounted by one-half, provided you take all 4 exams. If you do not take all 4 exams, no exam will be discounted. And, of course, the final cannot be discounted. If you score 15 points below the mean on any two tests, please see the professor concerning your status in the course. There is no mechanism built into the class to make up a missed exam. **Missed exams for any reason cannot be made up.** Exam keys will be posted on the website. Questions and/or disputes about the grading of exam questions must be settled within 3 days of the examination. This policy does not include clerical errors (such as the adding of scores incorrectly) which can be settled at any time up to the end of the semester.

Occasional unannounced short quizzes will be given during the first few minutes of class so that you can track your progress and improve on deficiencies, if necessary. If you miss a quiz, it cannot be made up.

GRADING

It is important to remember that grades are not wages. You will not be graded on how hard you work – you will be graded on mastery of the assigned material. Your course grade is broken down as follows:

3 tests @ 100 pts	=	300 pts
1 test @ 50 pts	=	50 pts
Final exam	=	150 pts
Homework	=	100 pts
Lab	=	200 pts
Discretionary	=	25 pts

Total	=	825 pts

Take this course as seriously as you would a course in your major. It is very easy to let things slide since, after all, it's only a non-major's course, and then WHAM! – you find yourself behind, confused, and lost. This takes the fun out of the course and makes it nothing but a survival course.

> ***If you think education is expensive, try ignorance.***
>
> **- Derek Bok, President, Harvard University**

CURVING

You may be accustomed to being "graded on a curve." What this is usually assumed to mean is that if an average test score is not at an arbitrarily determined level, the teacher will adjust the scores or grade range-breaks so that the average does meet this numerical criterion. It makes little statistical sense (on which a *curve* depends) to curve a class of less than 100 students. A curve also tends to promote unhealthy competition which interferes with an atmosphere of cooperativity and friendly competition.

In this course your grade will be based on your final course average and determined by a fixed scale:

Course Average	Grade
100-92%	A
90-92%	A-
87-89%	B+
84-86%	B
80-83%	B-
77-79%	C+
74-76%	C
70-73%	C-
etc.	

Scores on the borderline will be handled individually by the instructor.

LABORATORY

There are a total of 12 scheduled lab times with 2 alternate days. Lab is scheduled for Monday through Thursday from 7-10 pm. Lab will sometimes be held indoors in the laboratory and sometimes outdoors observing the sky. Indoor labs will consist of laboratory investigations, computer simulations, construction, etc. Outdoor observation will be of the sun, moon, any planets that may be visible, and deep-sky objects, using the naked-eye, binoculars, and telescopes. Night-sky observation labs will start at about civil twilight and will run beyond the 10:00 p.m. hour. Because of the nature of the weather and other astronomical factors, make no plans on lab nights for the duration of this class. We will try strenuously to avoid extending past the 10:00 p.m. hour for any observation lab but **please be flexible**. Each missed lab is approximately 5% of the course grade.

READ THIS: If you cannot agree to the policies of the laboratory schedule, please drop the course and let someone on the waiting list in.

PLAGIARISM AND CHEATING

Fortunately, in all likelihood, no one in this class will be subject to this paragraph. Plagiarism and cheating are professionally and ethically wrong. There exists a fundamental difference between working cooperatively (*e.g.* working together with friends or in a study group on homework problems which this instructor not only approves of but also encourages) and simply copying someone else's work. Cheating on an exam or plagiarizing the work of others is an offense of considerable magnitude. Students suspected of cheating or plagiarism will be referred to the University Academic Ethics Committee. *It's not worth it – trust me on this – I've been through it and it's very ugly!*

CELLULAR TELEPHONES and INTERNET MESSAGING

If you bring a cell phone with you to class, please turn it off or deactivate any audible signals before class starts. Even in vibrate mode, when the phone rings it sounds a bit like an electronic cow mooing. It is very distracting (and collosially inconsiderate) to have incoming calls during class time. ***Your course grade will be affected if your phone audibly rings more than once during the duration of this class.*** Some people like to use their computer to take notes in class – a practice which your professor does not discourage. There is a strong temptation to accept internet messaging requests during class – **a practice which your professor strongly discourages**. Using the computer during lecture for anything not directly and immediately related to class is also discouraged.

OTHER PET PEEVES

There are really very few things that bother this professor during class time. An open and friendly classroom that allows for discussion and dialog is desired and, even, encouraged. However, there are a few behaviors that can elicit a strong and negative response. The chances of getting along with this and other professors are greatly increased if you avoid…

…continued chatter past the scheduled start of class time.
…talking when the instructor is talking or another student is asking a question or speaking.
…habitually arriving late to class.
…chronically leaving and returning to the classroom during lectures.
…making any noise while chewing gum.
…eating loud food or slurping through a straw during lectures.
…failing to laugh at your professor's jokes regardless of their humorous quality.

> ***The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'Eureka!' (I've found it!), but 'That's funny...'***
>
> **-- Isaac Asimov**

IMPORTANT INFORMATION THAT DOESN'T FIT ELSEWHERE

The incomplete grade (I) will be assigned only in cases of an extreme emergencies and only in the last 3 days of class (after Exam 3 but prior to the final exam). According to university policies, the grade of incomplete will not be assigned to allow extra time for a student improve their grade but, rather, only in the case where an emergency prevents a student from completing a course's culminating assignments and exams. Supporting documentation is required. Should the need arise for non-emergency situations, there are 3 opportunities during the semester to withdraw from this course.

There is no "extra credit" beyond that which is available to every student in class. No exceptions; please, don't ask. Consider the rationale: If someone hasn't yet earned the available credit, how then can they be eligible for "extra credit"?

SAVING GRADED MATERIAL

It is your responsibility to save all graded materials (exams, homework, etc.) for this class. As per university policies, all grade disputes must be settled by the midpoint of the next non-summer semester which immediately follows this course.

> ***There is a theory which states that if ever anybody discovers exactly what the universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarre and inexplicable. There is another theory which states that this has already happened.***
>
> **- Douglas Adams, "The Hitchhiker's Guide to the Galaxy"**

COUNSELING CENTER and DISABILITY SERVICES

Students who feel that they may suffer from "test anxiety" or other academic obstacles despite exercising reasonable study and social habits may benefit by speaking to one of the staff in the Counseling Center.

Any student with a documented disability (physical, learning, or psychological) needing academic accommodations should contact the Disability Services Office (TCC264, x6500) as early in the semester as possible. All discussions will remain confidential. Visit www.pepperdine.edu/disabilityservices/ for additional information.

PARTING NOTE

If you are having any problems in the class, do not hesitate to come see me (this applies equally to out-of-class problems). No question is too dumb and I will attempt to accommodate the best I can if you need help outside of office hours.

COURSE EVALUATIONS

Course evaluations are part of the responsibility of each participant of this course. This professor does not coerce or bribe students to complete course evaluations. He expects and encourages each student to express their opinion – good or bad – about the course.

MISSION OF PEPPERDINE UNIVERSITY AND THIS COURSE

The mission, objectives, and student learning outcomes of the general education program support the mission, objectives, and student learning outcomes of Pepperdine University. **Pepperdine University is a Christian university committed to the highest standards of academic excellence and Christian values, where students are strengthened for lives of purpose, service, and leadership**.

> ***A professor is one who talks in someone else's sleep.***
>
> **(unknown)**

A Note On Grades

Most students believe their course grade is important, and rightly so. However, many will try to "earn" an 'A' with a minimum amount of work, or with procrastination, cramming, etc., and perhaps even cheating. One goal of this instructor is to help you make the attainment of knowledge and its wise use your ambition. When you make learning *personal* and not simply a short-term goal to get you to the next class, job, etc. then the grade will have a new significance and be a by-product of (rather than) the goal. If you have recently graduated from high school, this "university" perspective of grades may be somewhat alien to your way of thinking. With this in mind, the guidelines for the definition of the course grade is outlined below. These will be the criteria used to determine your course grade:

A is the highest academic grade possible. This honor is **not** automatically given to a student who ranks highest in the course, but is reserved for accomplishment that is truly distinctive and demonstrably outstanding. It represents a superior mastery of course material and is a grade that demands a very high degree of understanding, originality, and/or creativity. Further, the student is characterized as one who takes initiative in seeking new knowledge outside the formal confines of the course.

B is a grade that denotes achievement considerably above acceptable standards. Good mastery of course material is evident and student performance demonstrates a high degree of originality, creativity, or both. Student works well independently and often shows initiative. Oral and written analysis, synthesis, and critical expression are considerably above average.

C indicates a satisfactory degree of attainment and is the acceptable standard for proceeding to more advanced work in the field. It is the grade that may be expected of a student of average ability who gives to the work a reasonable amount of time and effort. This grade implies familiarity with the content of the course and acceptable mastery of the material. Student displays some evidence of originality, creativity, or both. Student works independently at an acceptable level and **completes all requirements in the course**, including attendance and participation.

D denotes a limited understanding of the subject, meeting only the minimum requirements for passing the course. It signifies work which in quality and/or quantity falls below the average acceptable standard for the course. Performance is deficient in analysis, synthesis, and critical expression and lacks in originality and creativity. This grade is insufficient to proceed to higher level courses in the discipline. For most students this grade is the result of insufficient devotion of time to the course.

F indicates inadequate or unsatisfactory attainment of and a serious deficiency in understanding of material. This grade also indicates the student cannot work independently and/or fails to complete assignments. This grade is usually earned by students who do not attend class or devote sufficient time to study. This grade, like the 'D', is inadequate for proceeding to higher level courses in the field.

Generally Observed Student Characteristics

(Adapted from John H. Williams, *The Teaching Professor*, 1993, pp 1-2)

	The "A" Students…
Attendance	…have nearly perfect attendance.
Preparation	…are prepared for class. Their attention to detail is superb and they usually read the material prior to class.
Curiosity	…show a high level of interest in the subject matter whether they actually like the subject or not. They look up or search out answers to topics that they don't understand. They often ask interesting questions or make insightful comments.
Retention	…are able to retain new material and consciously connect past learning to the present.
Attitude	…have an attitude that displays both the determination and self-discipline required for success. They also show initiative and do things without being told.
Talent	…possess a special talent. It may be exceptional intelligence and insight or it may be unusual creativity, organizational skills, commitment and perseverance - or a combination thereof. These gifts are evident to the professor and usually to the other students as well.
Results	…make the highest grades on tests and their work is neat and generally a pleasure to grade.

The "C" Students…

Attendance	…put other priorities ahead of academic work and may miss class frequently.
Preparation	…prepare their assignments consistently, but in a perfunctory manner. Their work may be sloppy or careless and at times is incomplete or late.
Attitude	…are not visibly committed to the class. They participate, if at all, without enthusiasm and their body language often expresses boredom.
Talent	…vary enormously in talent. Some have exceptional ability, but show undeniable signs of poor self-management or bad attitude. Other are committed and diligent, but are simply average in academic ability.
Results	…obtain mediocre or inconsistent results on tests. They have some concept of and familiarity with the material, but clearly do not show mastery of the subject matter while insisting otherwise.

I cannot teach anybody anything, I can only make them think.

-Socrates

Some Important Dates

Tuesday	5/7/2019	Last day of Add/Drop
Wednesday	5/8/2019	Last day of CR/NC
Monday	5/20/2019	Last day to withdraw with a grade of W
Monday	5/27/2019	Memorial Day; no classes meet
Wednesday	5/29/2019	Last day to withdraw with a grade of WP/WF
Thursday	5/30/2019	Final Exam. The final exam may not, for any reason, be taken at any time other than the scheduled exam time

Frequently Asked Questions

I have never liked science. Am I at a disadvantage? Can I still get a good grade?

You are at very little disadvantage and, of course, you can get a good grade. *Introduction to Astronomy* is taught as if you have little background in science. We have discovered that a good attitude and a curious spirit is more essential for success in astronomy. In any case, with diligent study almost everyone can succeed in this course (or in any course, for that matter).

What is the key to success in this course?

Practice, practice, practice. This means putting in quality study time every day. Astronomy is like a foreign language or a musical instrument. **If you don't practice, don't expect to get really good at it.**

How should I "practice" astronomy?

Every day, spend at least one and one-half to two hours (eeek!) reading the chapter and taking notes, rewriting your lecture notes neatly and more completely, and ***working as many problems as possible*.** Even redoing problems you have already completed - even in prior chapters.

Take Saturday *or* Sunday off from studying astronomy if you have put in 1.5 - 2 or more quality hours per day during the week. **4 hours on Tuesday does not cover the 2 hours you didn't do on Monday!** The point is... KEEP UP with the material so you don't have to cram the couple of nights before the exam.

"Cramming" does not work! Trust me.

It sounds like you want us all to be science majors, judging by all this work.

Not at all. This is the minimum amount of time you must put in. Science majors will probably put in more (naturally).

> ***A little nonsense now and then, is cherished by the wisest men.***
>
> **- Willy Wonka in**
> **"Charlie and the Chocolate Factory"**

Do I have to take notes?

Consider the possibilities:

a. You have a photographic memory and have total recall of anything you see; then there is no need to take notes.
b. What the instructor does in class is done to dazzle and impress you and is not designed in any way to contribute to your understanding of the material; then, sit back, relax, be dazzled and impressed, but don't bother taking notes.
c. The premises of 'a' and 'b' are false; then, take careful, detailed notes that allow you to reconstruct and study what has been covered in lecture.

Do you collect homework?

Yes... but read on. The purpose of homework is to practice and master the course material. You would not expect to master tennis solely by watching someone else play without yourself practicing. The instructor of this course really does not need to see your practice work; however, to insure that you are indeed practicing, homework is assigned, collected, and graded. Be aware that homework may not be returned before an exam. Thus, it is important that you make a copy of your work or do extra problems and be sure that you are doing them correctly. Office hours are useful for checking your work on unassigned problems.

"Is this going to be on the exam?"

Fortunately, I haven't heard this question in a long time, but let's understand the rules of the game anyway. It is the job of course instructors to coerce you into studying all the material they think is important. This normally includes reading material, handouts, and lecture topics. It is the task of the course instructor to determine if you have learned the material. This is normally done by giving exams in which questions representative of the material are asked. There is insufficient time to ask every possible question. If you have learned the important material, you should be able to answer the representative questions. If I tell you in advance which questions are on the exam, it

a. spoils the surprise (just like spoiling Christmas).
b. tempts you to study only the material on the exam. (As hard as it is to believe, given the opportunity, some less motivated individuals will actually do this.)
c. decreases the content of the course to only those topics tested.

I was not in class. Did you do anything important?

Yes.

OK, then it sounds like we are going to work hard.

Yes. You may work harder in this course than you have worked in any other course. Maybe not. But I (we in the Natural Science Division) want you to extend yourself intellectually farther than you think you can. You are capable or you wouldn't be here.

But I work to pay the school.

I know. If you work or join a club or play a sport, you **must** organize your time to include study when you are awake, fresh, well-fed, sober, not high, undisturbed, unruffled, and, well... you-get-the-point. Every activity you do must be weighed against how it will affect your success in your coursework.

Do you flunk anyone?

I don't take credit for any good grades earned; I won't take credit for poor grades. See also the instructor's feeling on grades below.

So... do... you... give... 'F's?

Yes.

You're kidding about all this - I mean the "time" stuff, the "organization", "keeping up" and all that. After all, it is *just* a general ed course.

No.

No, really. This is just to scare us.

No.

Why are you so mean?

Just am.

But this doesn't give me time for the other things I do.

You will have plenty of time for your other activities... if you budget your time carefully. Look at this way… it's only 4 weeks.

What is your feeling on grades?

Please don't fret and worry about your course grade - let me, I'm better at it. Please fret and worry (well, be concerned with) learning astronomy. If you learn the subject, the grade will follow (sort of the *Field of Dreams* approach). Part of the grade is not only how well you learned a topic but also how fast you can use the information in a new setting (see **A Note on Grades**). Keep in mind, too, that your grade will be assigned by the quality of your work, not your good intentions. **Grades are not wages earned by the number of hours you work.**

Introduction to Astronomy
Approximate Chapter Coverage

We will not proceed through the book in exactly chapter order. These are the concepts that you must master. Refer to this occasionally to check on your progress.

Chapter	
1	***Astronomy and the Universe:*** **Introductory but essential background and foundational knowledge** Definitions The *Scientific Method* Distance and scale
2,3	***Knowing the Heavens:*** **Basic motions of celestial objects** The sky Motions of the sun, moon, planets, stars The seasons Telling the correct time Precession
4	***Gravitation and the Motions of the Planets:*** **Historical review of the science of astronomy** Historical Perspectives Geocentricism/heliocentricism/modern experimental astronomy
5	***Nature of Light and Matter:*** **The Birth of Astrophysics** Electromagnetic radiation Blackbody radiation Emission/Absorption Spectra Spectroscopy - how we know what we know Basic Atomic theory
6	***Optics and Telescopes:*** **Our Looking-glass to the Cosmos. The tools of the astronomer - amateur and professional alike** Observing with Optical telescopes Infrared/UV/X-ray telescopes Radio telescopes Interferometric methods
16	***Our Star, the Sun:*** **The Star We Call Home** Primordial dust nebula Structure Sunspots Comets Models of star systems Thermonuclear reactions

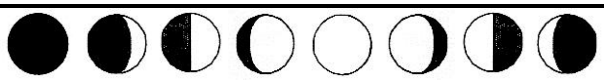
17-22	**Stellar Birth, Life, and Death** Sol Gases Spectroscopy Energy Distance and parallax Brightness, luminosity, and magnitude Classification H-R diagrams binary and ternary systems Interstellar medium Models of stars Life and Death Novae and supernovae Heavy elements and nucleosynthesis Black holes
24	**Galaxies** Structure Evolution Types Distribution The Milky Way Galaxy – the galaxy we call home Other galaxies in the cosmic zoo
26. 27	**Cosmology and Einstein's Relativity: A Model of the Universe** Big Bang Hubble Law Background radiation and other evidence Relativity Space-time The future of the universe - open or closed? How will it end, or will it?
And if we make it this far this semester…	
9	***Our Living Earth:*** **The Planet We Call Home** History of the Earth's creation Interior and exterior of the planet Plate Tectonics The atmosphere
10-16	**The Other Planets** Moon Venus Mars Jupiter Saturn The Outer Gas Giants Pluto

Laboratory Activities

Specific dates given are estimates based on potential observing nights. This schedule is subject to change. Be prepared on all lab days to go to the field for observing.

Week	Date	Activity
1	May 6	**Motion of the Night Sky** The Diurnal Motion of the Sky Preparing the flashlight for use in the field **This lab is all indoors. Bring your Mag 5 atlas**
1	May 7	***Tools of the Observer: Star Atlas and Flashlight*** Using the star atlas **Meet at the top of Corral Canyon. Bring your Mag 5 atlas and flashlight**
1	May 8	***Observing the Night Sky*** Stars Constellations Planets **Meet at the top of Corral Canyon. Bring your Mag 5 atlas and flashlight**
1	May 9	***Observing the Night Sky*** The celestial sphere Moon Stars Constellations **Meet at the top of Corral Canyon. Bring your Mag 5 atlas and flashlight**
2	May 13	***Distance and Scale*** Parallax **This lab is all indoors**
2	May 14	***Observing the Night Sky*** Stars Constellations Planets Deep-sky objects **Meet at the top of Corral Canyon. Bring your Mag 5 atlas and flashlight**
2	May 15	***Telescopes and Optics*** Focal Length Simple Telescope Building Magnification **This lab is all indoors**
2	May 16	**TBA**
3	May 20	***How We Know What We Know: Spectroscopy*** Gas Discharge Line-Spectra Molecular Absorption Spectra **This lab is all indoors**
3	May 21	***Observing the Night Sky*** Stars Constellations Planets Deep-sky objects **Meet at the top of Corral Canyon. Bring your Mag 5 atlas and flashlight**
3	May 22	***Our Sun and Sunspots*** Solar Telescope Diameter of the sun using a *camera obscura* **This lab is outdoors during the day**

Week	Date	Activity
3	May 23	***Griffith Planetarium*** **Details to be announced**
4	May 27	**Memorial Day: No Lab**
4	May 28	***Observing the Night Sky: Sky Quiz*** Stars Constellations Deep-sky objects Meet at the top of Corral Canyon. Bring your Mag 5 atlas and flashlight
4	May 29	**TBA**
4	May 30	**No Lab**



https://www.calendar-12.com

Astronomy Observation Lab

Purpose

Astronomical observation is an important part understanding the universe. Aside from the historical significance of the constellations, direct observation of the planets, deep-sky objects such as star clusters and nebulae, and “island universes” (galaxies millions of light years external to the Milky Way), observation helps us to understand our place in the universe. Direct observation is also the easiest, requiring relatively inexpensive equipment for a pleasurable jaunt through the sky. Finally, application of lecture concepts can often be performed right at the telescope or even through binoculars.

Goals

At first glance, the sky appears to be a random distribution of bright white dots (stars) with a monthly appearance of a very bright crescent or circle (moon), punctuated by the daily trek of the sun across the southern sky. But in all of this seeming randomness is order. Some of the order is dictated by physics (the movement of the planets, moon, and sun) and some has been devised by humans (the constellations). In the observation lab, we will learn many of the constellation and star names and some of the history and mythology of the constellations. The constellations provide our “road map” to explore other night sky features such as the colors and types of stars, the stellar nurseries (nebulae), and galaxies external from our own.

We sincerely hope that this short course will help you to understand the scientific process better and perhaps spark your inquisitive nature in scientific principles and the universe around you without necessarily becoming a professional scientist.

Requirements

During one of the observing sessions, there will be an **oral examination covering constellations and stars**. It is a good idea that you use and become proficient with your star atlas outside of class and study the spring/summer constellations and stars at your convenience. Depending on the demand, there may also be other optional telescopic observing times.

It is anticipated that the observation sessions will run 2-3 hours starting at about 7:00 p.m. This is so that observation is performed as early as possible with the darkest skies available. Observation sessions may run longer if the

Observation Nights

Celestial observation labs will be held at either Alumni Park or at the top of Corral Canyon. In the event of inclement weather, the session will be moved to a Conejo Valley sight or postponed at the instructor’s discretion. The evenings are cool in California, even in the late summer and fall. You should bring or wear the following items:

- **Warm clothing, layered in case of warmer or colder weather.**

  Warm **jeans or sweat pants**, possibly even over long johns if it has been cold
  Cool shirt with a warmer shirt (or 2) over that
  Jacket
  Warm socks
  Fully enclosing shoes
  A ski cap or other head covering without a brim is a plus (a brim or bill on the hat interferes with the hardware on the telescopes).
  Cotton gloves are also a good idea in case of cooler than expected weather. Ski gloves are unnecessary during the spring and summer at lower altitudes.

Shorts and sandals are completely out for astronomical observing. You won't be moving around very much so even cool air with a light breeze gets cold quickly.
Mosquito repellant. Spring months bring out the mosquitoes. They may not be bad, but then again...

- ❑ **Your flashlight must have a red filter over the lens.**

  After *Nautical Twilight* begins (brightest stars are visible), you may not use an unfiltered flashlight. The red light of a filtered flashlight protects the night vision of others in the area. An excellent flashlight is the MiniMag Lite with the filter kit.

- ❑ **Something to write on and with.**

  Good for taking notes, logging an observation, drawing a view through the eyepiece.

- ❑ **Star chart**

  It's hard to get to a specific place in downtown L.A. without a map, imagine how hard it will be to move around thousands of light years in the sky without a map! Don't forget your atlas.

OK, I'm Ready. When Do We Go?

There will be at least four observation sessions during the semester (and maybe more), weather permitting. More observing time may be scheduled if the "seeing" is especially good.

Tentative Schedule

Session I:
- Orientation to the night sky
- Terrestrial Coordinate System
- The Celestial Sphere
- RA and Dec
- Meridian, Zenith, Polaris, Circumpolar Stars
- Summer Constellations

Naked-Eye Observation
- Planets
- Moon

Session II:

Observation
- Understanding the Telescope
- Star Hopping vs. Electronic Control
- Planets
- Clusters
- Nebulae
- Externals
- Moon

Session III:

Observation
- Understanding the Telescope
- Binaries
- Planets
- Clusters
- Nebulae
- Externals
- Moon
- Difficult objects

Session IV:

Observation

Star Quiz - 10 constellations and 7 stars minimum

Sky Tour Grading Criteria

Goal: Student takes the instructor on a tour of the summer night sky. Along the tour, the student must identify and name at least 10 constellations and 7 stars.

Grading criteria:

***Excellent* (10 pts.)** Tour is delivered confidently and systematically without error, including constellations or stars not presented by the instructors. Able to start anywhere in the sky as a starting point. Can quickly identify terrestrial and celestial north and all points on the compass rose based on celestial cues. Use of correct angular measurements (using finger and handwidths, etc.) demonstrated during the tour. **More than the minimum naming requirements fulfilled** including some significant deep-sky objects found in a constellation. Uses nomenclature such as zenith, declination, meridian, etc. correctly during the star tour. Highly confident and capable with a star chart or sky atlas and, in the instructor's judgement, could easily move to the sky of a different season and easily learn the constellations. Student may know the mythology and history of the constellations observed.

***Very Good* (9 pts.)** Tour of constellations and stars is delivered confidently and systematically with few, if any, errors. Only constellations and stars presented in prior labs named, although **more than the minimum requirements fulfilled**. Is able to identify terrestrial and celestial north (and, thus, S, E, and W as well) and use the terrestrial coordinate system naturally. Use of finger and handwidths, etc. to move around the sky demonstrated during the tour although not accurately presenting the angular measurements. May identify deep-sky objects in constellations by name or number but does not know the class of object. Uses a star chart or sky atlas capably and can see new constellations in the current sky when referencing the atlas.

***Good* (8 pts.)** **This is the typical *Sky Tour* score.** Tour of constellations and stars is delivered with some errors. Only constellations and stars presented in prior labs named. Can find north with astronomical cues. Can use the terrestrial coordinate system (N,S,E,W) with thought. **Minimum requirements fulfilled.** Is able to use a star chart or sky atlas.

***Adequate* (7 pts.)** Tour of constellations and stars is delivered with difficulty and errors. **Minimum requirements fulfilled** but only by attempting to name more than the minimum constellations or stars. Can find north eventually with astronomical cues. Is able to use terrestrial coordinates with difficulty. The celestial coordinate system remains mysterious and elusive.

***Poor* (5 pts.)** Sky tour poorly delivered. **Minimum requirement unfulfilled**. Uses a star chart or sky atlas with difficulty, if at all. Has difficulty finding even the brightest constellations. Knows that deep-sky objects exist but not their relevance. Cannot find terrestrial north with celestial cues.