

## Astronomy C10 / Letters and Science C70U: Fall 2015

### Introduction to General Astronomy

4 units; Course Control Number 05915 / 52038

#### I. General Information

**Instructor:** Prof. Alex Filippenko (email alex@astro.berkeley.edu).

**Lectures:** MWF 3:10–4:00 pm, Wheeler Auditorium

**Office Hours:** MWF 4:15–5:10 pm, in 121 Campbell Hall; also, by appointment.

**Discussion Section:** 50 minutes per week, in room 121 Campbell Hall.

**Prerequisites:** None.

**Required Textbook:** *The Cosmos: Astronomy in the New Millennium*, **4th edition** (copyright 2014), by Jay M. Pasachoff and Alex Filippenko (Cambridge University Press), ISBN 9781107687561. Note that you *must* have the *4th edition*; there have been many important changes since the 3rd edition (published in 2007).

**Required Notes:** *Course Reader for Astronomy C10 / L&S C70U*, by Alex Filippenko (i.e., this volume!). **Note: You MUST have the Fall 2015 edition.** (There are significant changes from previous editions.) Available at Copy Central, on Bancroft between Bowditch and Telegraph. You should write your name and phone number on the cover of your *Course Reader* and textbook.

NOTE: This course is cross-listed as Astronomy C10 and L&S C70U (the latter being one of the “Discovery Series” courses). It doesn’t really matter whether you sign up under “Astronomy C10” or “L&S C70U” (it’s the same class!), and they satisfy the same physical science breadth requirement.

#### II. Overview

This course is designed to provide, for both nonscience and science majors, a description of the fantastic Universe in which we live. We cover the structure and evolution of planets, stars, galaxies, and the cosmos as a whole, gaining insights into amazing objects like quasars, exploding stars, neutron stars, and black holes. (Our Solar System and others will be covered only briefly, because the semester is now shorter than it used to be; something had to be cut. Astronomy C12 [3 units] presents our Solar System and exoplanets in much greater detail.) Recent newsworthy events such as the detection of numerous planets around other stars, the New Horizons spacecraft results on Pluto and its main moon Charon, and the discovery of gravitationally repulsive “dark energy” are also featured.

Major themes include our origins (such as the origin of the chemical elements, stars, planets, and life), the methods by which astronomers investigate and eventually understand various aspects of the Universe, the scientific unification of many seemingly disparate phenomena, and the excitement felt by astronomers doing ground-breaking research on some of the most far-out topics imaginable. This course will inspire students to become more inquisitive about the world around them, and it will develop their skills in arriving at conclusions based on logical, physical reasoning.

Astronomy is based on physics, and during the semester you will come to understand many of the physical principles that govern the Universe. No formal prerequisites are required for this course, and reliance on mathematics will not be excessive. However, it is assumed that you are familiar with simple high-school algebra and geometry (including squares and square roots, scientific notation, ratios, proportions, etc.). If you find these topics rusty, don’t panic; the necessary material will be covered in the discussion sections and in TALC (The Astronomy Learning Center; see Sec. VIII), and you can always ask me or the undergraduate/graduate student instructors (UGSIs/GSIs — hereinafter simply GSIs) for help. It will take some effort on your part, but you will also learn much along the way. Remember that astronomy is more than just stargazing, and that we are setting out to explore a physical science together.

The lectures will attempt to present, in simple and understandable terms, explanations of how the Universe “works,” as well as the interrelationships between its different components. I will not ask you to memorize lots of trivial facts, such as the exact surface temperature or diameter of the Sun. Of course, in every subject there is terminology to learn, and important points to remember. You will, for example, be expected to know that the Sun is a garden-variety star, composed primarily of hydrogen, and that nuclear fusion is producing its energy. Moreover, you should understand the fundamental ways in which the Sun differs from very massive stars, and the consequences of these differences. I will emphasize *thinking* about new concepts and being able to figure things out.

One of the major goals of this course is to help nonscience majors develop a better appreciation of *how* science is used to explain natural phenomena. Also, I hope that your perception of, and curiosity about the world around you will become more fully developed. For example, when you go outside and look up at the daytime sky, I would like you to notice that the sky is blue, and then wonder about *why* it is blue. How does a rainbow form? Why does the Moon shine? How far away are the stars if they are intrinsically as powerful as the Sun?

### III. Lecture Structure

The class will consist of three 50-minute lectures per week. There are 44 class meetings, 2 of which will be devoted to midterm exams. (We have 41 regularly scheduled class meetings, MWF 3–4 pm. In addition, in 3 of the weeks will have an extra lecture 4–5 pm, but it will be recorded for those who can’t attend.) A syllabus, with scheduled exam dates, is included on pages 12–13 of this *Reader*; make sure you are present for the exams. Questions during lecture are much encouraged, but of course I cannot spend most of my time answering them. See me or a GSI during the office hours, or come to TALC (Sec. VIII), if you have extensive comments and questions.

The order of the course will closely follow the textbook (Pasachoff & Filippenko 2014, *The Cosmos*, 4th ed.). The textbook is a useful resource because it is very readable and has excellent pictures; it also has homework problems (both assigned and not formally assigned). What I say will be easier to follow if you use the textbook, especially if you do the assigned reading *before* each lecture.

I often tell a few “astronomy jokes” just before lecture begins. These are submitted by you, the students. If your joke is good enough, you might win a prize at the end of the semester!

Please try to sit near the *center* of the row of seats when you come in. This will make it easier for others (especially those arriving late) to find a seat. This will be a full class!

### IV. Lecture Slides

For various reasons, I prefer not to write on a chalkboard or a whiteboard during my lectures. Instead, I prepare color power-point slides that contain summaries of the important information, charts, etc. Black-and-white paper copies of the slides can be found in this *Reader*, to serve as a study guide. Most of the content, in complete sentences, can be found in the textbook.

Because of this, I hope that you will be able to concentrate more on what I am *saying* during the lectures, instead of feverishly scribbling everything down. If you hear anything that you think is especially useful, yet is not in the slides, write it in your *Reader* — but this should generally not be necessary, since the textbook contains most of the information.

Let me stress that the textbook and the slides in this *Reader* are *not* a substitute for the lectures. I often explain things in a different way during lecture, or give additional examples, or synthesize several thoughts. Moreover, I show many photographs of astronomical objects, and I do some demonstrations. Finally, the act of *listening* to the material reinforces it in your mind. *It would be a serious mistake to not view the lectures.*

The lectures will be taped, making them available for playback on your computer at any desired time; the appropriate link will be available through the “bCourses” web page for this course (see Sec. X of this introduction).

## V. Discussion Sections

Students will meet for 50 minutes per week in relatively small discussion sections. These provide the opportunity to ask additional questions, to clarify ideas, to review concepts presented in the lectures or in the reading assignments, and to follow up on topics of special interest. Questions will be asked *by* you, but the GSI will also ask *you* questions to help give you “hands-on” experience with topics covered in class. There will also be two quizzes; see the schedule on page 14 of this *Reader*.

All discussion sections will be held in room 121 Campbell Hall. Discussion sections are an integral part of this course. The currently scheduled sections are listed on page 10 of this *Reader*.

Be sure to go to a section *during the first three weeks of classes*, and sign the enrollment sheet. *This is very important — otherwise you might lose your spot in a given section, even if you are pre-enrolled in that section.* You *must* have a discussion section to obtain credit for this class. We will have an absolute maximum of 33 students per discussion section (but preferably no more than 30), so you may find that the particular section you want is already full. Look for another one, but if you can’t find *any* other alternatives that fit into your schedule, bring the matter to the attention of the GSIs in charge of your first-choice and second-choice sections. You are encouraged to choose the least crowded sections. Note that you should NOT change your section number through Tele-BEARS even if you switch sections; you just need to be officially enrolled in the course.

You do *not* have to keep the discussion section in which you were pre-enrolled. However, students pre-enrolled in a given discussion section have priority over those who are not pre-enrolled, as long as the pre-enrolled students attended section during the first two weeks of classes. You should definitely finalize your choice by the end of the day on Friday, September 18.

## VI. Homework

There will be weekly homework assignments to be handed in on Fridays by 5:30 pm (but certainly no later than 6:00 pm). *Don’t be late!* — we will NOT accept late homework. You should place your written work in the Astronomy C10 homework boxes (marked with the names of GSIs) located in the south corner of the lobby on the ground floor of Campbell Hall.

Make sure you put your work in the correct mailbox. *Staple multiple sheets together*, or they might get lost. Write *your name*, your *SID number*, your *discussion section number*, and *your GSI’s name* at the top of the first sheet (2 points off for each of the above that is not done). For full credit, always show your work and explain how you got your answer.

The homework assignments are included in this *Reader*. Detailed *solutions* will be available on bCourses (see Sec. X), generally by the following Monday. The graders will *not* have time to make extensive comments on your individual papers, so be sure to check the solutions if you have questions.

You may discuss the assigned homework problems with your peers, but please turn in *your own hand-written solutions*, with questions answered in your own way; otherwise you’re guilty of plagiarism. Only the best 8 of your 11 homework scores will be “counted” in your final grade, so don’t panic if you miss two or three assignments. There is one optional homework assignment (#12) on the material covered during the last few lectures. It won’t be turned in or graded, but you are urged to read and answer the questions.

After examining your corrected homeworks, you might get the impression that the graders are harsh, or inconsistent. Let me make a few comments to put things in perspective. (1) It is true that some graders are harsher than others. Over time, things will average out, since we cycle among many graders for each discussion section. (2) There can be genuine differences in what the graders expect. All of us are human! Such subjectivity is often found in the humanities and social sciences, and is not totally unavoidable in the physical sciences. It is not feasible for me to anticipate (and assign points for) every conceivable response to a question. (3) Each homework assignment is “worth” about 3 course points — the equivalent of 3 exam questions. Thus, each “homework point” (out of 50) corresponds to only 0.066 course points. Missing a few points here and there is not going to make any difference. Missing even one complete question (say, 10 points out of 50) is only about two-thirds

of a course point! You should not get too stressed out over homework grades. Make a conscientious effort to do all of the homework, and you will end up performing much better on the exams (which are worth a *lot* more course points). You will also genuinely *learn* more, which is the goal!

To make sure you've learned everything really well, it's a good idea to also read and answer (without necessarily writing out) the *unassigned* questions at the end of each chapter in the textbook. Note, however, that sometimes I did not lecture on the topics covered by those questions — in which case you're not formally responsible for the material.

### VII. Laboratory Exercises

There is a set of “laboratory exercises” in this *Reader*. Some of the labs are worth 6 course points each, but most are 3 course points each. Do any combination of labs so that the *total* is a *maximum* of 15 course points over the entire semester. (Thus, you could do five 3-point labs; or one 6-point lab and three 3-point labs.) If you *miss* some points on labs, you *cannot* turn in extra labs to reach 15 points; you can turn in labs having only a *maximum possible total* of 15 points.

These labs are fun and easy; they are mostly just an excuse to go out and look at the sky! The first due date for labs is Friday, October 23, and the second is Friday, November 20. You should start on some of the labs soon, to guard against foul weather.

### VIII. GSIs; TALC

There are 12 GSIs for this course; their names are Saundra Albers, Louis-Alexandre Couston, Jake Duncan, Kyle Fricke, Deepthi Gorthi, Goni Halevi, Kevin Hayakawa, Doyeon (Avery) Kim, Michael Medford, Imad Pasha, Katherine Suess, Nat Tantivasadakarn, and Michael Yano. The Head GSI is Jake Duncan (jakefduncan@gmail.com).

The GSIs are here to help you get the most out of the class, and I encourage you to talk with them. Each GSI will have regularly scheduled office hours, and will also be available by appointment. Their office numbers and hours will soon be announced on bCourses (Sec. X). The GSIs should be able to take care of most of your one-on-one teaching needs. When you don't understand something, first try to see your GSI. If major problems with grades and other formalities arise which cannot be solved by your GSI, see the Head GSI. By the way, you can attend the office hours of *any* Astronomy C10 / L&S C70U GSI, even if he/she is not your “official” one.

“The Astronomy Learning Center” (TALC) is a large, collaborative “office hour” — a place where students gather to work together on homework assignments or discuss course material. TALC is staffed by various Astronomy C10 GSIs who serve as guides to help student groups with their homework problems. TALC is an excellent place to get math help and to compare methods and answers with your peers. TALC is generally open on Wednesday (7–9 pm) and Thursday (7–9 pm), in Room 121 Campbell Hall (the same room as for discussion sections).

### IX. Exams, Course Grades

There will be two midterm exams, tentatively scheduled for Monday, October 12, and Friday, November 13. Since the exam dates probably *won't* be changed, please plan accordingly. Each midterm will consist of true-false and multiple choice questions. You will need a #2 pencil and a SCAN-TRON form 882 (available in many bookstores, including ASUC). There will be two midterm exams.

There will be review sessions before each exam. Also, there are sample questions in this *Reader* for each of the exams, so you will know roughly what to expect. Check the true/false and multiple-choice questions at the end of each chapter in the textbook, too!

The exams will be closed book and closed notes. However, on the cover of each exam you will find a list of *possibly* relevant equations, formulae, and constants. A copy of the list is included in this *Reader*, so you know exactly what information will be available. You are encouraged to use this sheet when doing the homework assignments, to become familiar with what is actually on it. (Note, however, that most of the information will probably not be of much use during the exams.) *No calculators* will be allowed during the exams; all calculations are simple.

The final exam is scheduled for Tuesday, December 15, 7:00–10:00 pm (“Exam Group 8”) — mark your calendars now. *If you have a DIRECT conflict (i.e., another final exam at exactly the same time), see me during the last week of classes and sign the sheet for the make-up exam.* You will be able to take the final during “Exam Group 7,” 3:00–6:00 pm that same day (Tuesday, December 15) — this is the *only* option that I’ll allow. Note that I *cannot* change the date or time of your final exam *unless* you have a *direct* conflict. (Having two or three exams on the same day, but at different times, does *not* count as a direct conflict.)

Course grades will be based on the final exam (75 points), two midterm exams (25 each), homework (23; note that each of the 8 best homework assignments counts about 3 points), laboratory exercises (15), and work in the discussion sections [17 — this includes two quizzes (7 each) and attendance/participation (3)]. The total number of points in the course is 180.

If a midterm exam is missed, you will receive *zero credit* for those 25 points; **no** make-up midterms generally will be given. In exceptional circumstances (e.g., *well-documented* medical problems), I will not count that midterm when computing your course grade; the new total course grade will be based on 155 points, scaled to 180 for comparison with the overall distribution.

Students who miss the final exam without good reason are unlikely to do well in the course: unless they have an excellent excuse, they will receive zero credit on the final. There will be **NO** make-up final exam! If you miss the final for a very good reason, your grade will be an incomplete (I).

Let me emphasize that in this course, I will *not* grade in the manner typical of high school (A, 90–100%; B, 80–89.9%; C, 70–79.9%; D, 60–69.9%, F, < 59.9%). Instead, I will grade on a curve (but not the strict A–10%, B–20%, C–40%, D–20%, F–10% curve). If my GSIs and I feel that everyone worked really hard and learned a lot, then in principle everyone could get an “A.” By the same token, however, all of you could fail the course. (I seriously doubt this will happen!) It just depends on how much you are willing to put into it. My GSIs and I put a lot of effort into this course, and we expect you to do likewise. If you are looking for a free ride and an “easy A,” you should start searching for a different course to take, because you won’t get one here unless you have already studied astronomy or have natural talent in science. But if you want to encounter some of the most far-out and mind-boggling concepts possible, I urge you to dig in right away and enjoy. I assure you that the rewards will be great if you really make an effort to learn the material.

Note that you must earn a grade of C– or higher if you are using this course to fulfill the breadth requirement in physical science. If you only need the course for units, then D– is the lowest passing grade. However, if you are taking the class P/NP, C– is the lowest grade for a P. Be warned: you *really* have to learn something to get at least a C– in this class!

All students should know the official campus honor code: “As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others.” If cheating is detected, *severe* academic procedures will be followed. The consequences are rarely beneficial for the student involved. *You should be aware of the Astronomy Department’s official policy regarding cheating*; see <http://astro.berkeley.edu/academics/cheating.html> for details.

Also, sexual harassment is unacceptable, and unlawful conduct will not be tolerated. Sexual harassment is unwelcome sexual advance, requests for sexual favors, and other verbal or physical conduct of a sexual nature – including those carried out over computers – from people of authority or colleagues. For more information, consult the UCB sexual harassment policy found under “Files” on the course bCourses page.

## X. bCourses Account

The online component of Astronomy C10 / L&S C70U is run through Berkeley's bCourses interface (<https://bcourses.berkeley.edu/>). Course announcements, message boards, homework and exam solutions, and grades are exclusively on bCourses. All students enrolled or waitlisted in the course automatically already have a bCourses account; see page 13 for detailed access instructions.

Note that the discussion section number listed on bCourses does NOT depend on the section for which you are officially signed up on Tele-BEARS. Each GSI is in control of bCourses enrollment for his/her section, so to change sections on bCourses you should clear it with both your current GSI and the GSI of the section you wish to change to; see Sec. V.

## XI. Stargazing

There will be opportunities for students to learn constellations and look through a telescope at various astronomical objects. These optional "star parties" will be announced throughout the course. They will be conducted by the GSIs. There is a brand new 17-inch telescope right here on campus, on the roof of Campbell Hall, and during some nights we will have a smaller portable telescope set up as well.

## XII. Lick Observatory "Research Trips"

A select few students will be invited to spend a night at Lick Observatory (all expenses paid, and transportation provided) with me and 1–2 of my research team members while we conduct research using the 3-meter reflecting telescope. (*Note that we don't actually LOOK through any telescopes on this trip; research equipment is attached to them.*) Dates will be announced during the semester. We will depart from campus in the late afternoon and return the next day (by around noon). Only students enrolled in Astronomy C10 / L&S C70U are eligible.

If you want to do this, write a roughly one-page essay explaining your motivation, what you hope to get out of the trip, and anything about your background that might be amusing and relevant. I will judge these on various criteria such as creativity, interest in astronomy, sincerity, humor (you'll need to be amusing during the long night!), etc. Poems, drawings, music tapes, or other creative works can be submitted instead of an essay, if you wish. Since very few students will be able to participate (2–3 per trip, 1–2 trips), you should submit something only if you have a *very strong desire* to go.

Essays should be turned in to *me* by 5:00 pm on Mon., October 5. *Be sure to include your name, phone number, and e-mail address. In addition, state your GSI's name and discussion section number. It is very important to give ALL of this information!*

## XIII. Office Hours

I will generally be available on Mondays, Wednesdays, and Fridays 4:15–5:10 pm, in 121 Campbell Hall (the same room as for your discussion sections). If necessary, you can make an appointment for a different time by sending me e-mail ([alex@astro.berkeley.edu](mailto:alex@astro.berkeley.edu)); e-mail is actually the *best* way to reach me. Discussions concerning astronomical concepts and course material are encouraged. I will not, however, be impressed by students who ask questions concerning course structure, grades, etc., if these things are adequately covered in this *Course Reader* or in the lectures. Also, if there are any grading difficulties on quizzes or exams, see your GSI first; the GSIs should be able to handle most situations.

You are welcome to email me short questions, but if they are extensive, it is better to attend my office hours. Please remember that there are about 800 students in the course, so don't send me an email if you have a question about logistics that is adequately covered in this *Course Reader*.

Let me close by saying that I look forward to teaching introductory astronomy, and I hope you are excited about learning the material. Good luck!

Alex Filippenko

Professor of Astronomy

## List of Discussion Sections for Astronomy C10 / L&S C70U: Fall 2015

*All discussion sections meet in 121 Campbell Hall.*

Section 101 (05918/52041), Tuesday 2–3 pm.	Section 102 (05921/52044), Thursday 9–10 am.
Section 103 (05924/52047), Wednesday 1–2 pm.	Section 104 (05927/52050), Tuesday 9–10 am.
Section 105 (05930/52053), Tues. 11 am – 12.	Section 106 (05933/52056), Tuesday 1–2 pm.
Section 107 (05936/52059), Thur. 11 am – 12.	Section 108 (05939/52062), Tuesday 3–4 pm.
Section 109 (05942/52065), Tues. 10–11 am.	Section 110 (05945/52068), Wednesday 9–10 am.
Section 111 (05948/52071), Thur. 10–11 am.	Section 112 (05951/52074), Wednesday 12–1 pm.
Section 113 (05954/52077), Friday 12–1 pm.	Section 114 (05957/52080), Thursday 1–2 pm.
Section 115 (05960/52083), Wed. 11 am – 12.	Section 116 (05963/52086), Thursday 2–3 pm.
Section 117 (05966/52089), Friday 2–3 pm.	Section 118 (05969/52092), Monday 2–3 pm.
Section 119 (05972/52095), Wed. 10–11 am.	Section 120 (05975/52098), Tuesday 4–5 pm.
Section 121 (05978/52101), Monday 12–1 pm.	Section 122 (05981/52104), Friday 9–10 am.
Section 123 (05984/52107), Thur. 12–1 pm.	Section 124 (05987/52110), Thursday 3–4 pm.
Section 125 (05990/52113), Monday 9–10 am.	Section 126 (05993/52116), Monday 10–11 am.

### Additional Resources (Optional)

**Books:** See pages 571–574 in the back of the textbook for recommended books.

**Internet Sites:** The Internet is often the best way to keep up with late-breaking news or to get further information about some of the topics we are studying. It's also a great source of pretty pictures. Many of these sites have links to others of interest all over the world. So explore (after you finish your Astronomy C10 homework)!

(1) *Sky Web Sites:* Check out these *great* new, interactive web sites if you want to roam around in the Universe, via the internet! They allow you to explore on your own, and really appreciate the vastness and beauty of the cosmos.

[www.google.com/sky/](http://www.google.com/sky/) and [www.worldwidetelescope.org](http://www.worldwidetelescope.org)

(2) *Berkeley Astronomy Department:* [astro.berkeley.edu](http://astro.berkeley.edu)

This site gives some useful information about UCB astronomy.

(3) *Astronomical Society of the Pacific:* [www.astrosociety.org](http://www.astrosociety.org)

This organization is a link between professional astronomers, amateur astronomers, teachers, and the general public. They have lots of neat stuff, including an online shop (AstroShop).

You are encouraged to join the ASP! See [astrosociety.org/get-involved/asp-membership/](http://astrosociety.org/get-involved/asp-membership/); the annual cost is only \$55. Membership privileges include discounts on catalog items and an electronic subscription to *Mercury*, a nontechnical astronomy magazine. See the Web site for information on how to join.

(4) *Hubble Space Telescope Pictures:* [hubblesite.org/newscenter/](http://hubblesite.org/newscenter/)

Has lots of beautiful *HST* photos. You can also go to <http://opposite.stsci.edu/>

All sorts of interesting things (e.g., “Black Holes: Science Fiction or Science Fact?”) can be found at <http://amazing-space.stsci.edu/>

(5) *Bad Astronomy:* <http://www.badastronomy.com/index.html>

This site (by astronomy popularizer Phil Plait) debunks various myths and hoaxes, and also discusses exciting news in astronomy; see, in particular, the excellent blog at [http://www.slate.com/blogs/bad\\_astronomy.html](http://www.slate.com/blogs/bad_astronomy.html).

(6) *Preposterous Universe:* <http://www.preposterousuniverse.com/blog/> Another excellent blog, this time by astrophysicist Sean Carroll, who is an expert on cosmology and relativity.

(7) *The “Astronomy Cafe”*: [www.astronomycafe.net](http://www.astronomycafe.net)

Astronomer Sten Odenwald answers questions from the masses. The query that’s been bugging you is probably already answered in the posted replies (over 2000 of them!). But if not, just ask Sten.

(8) *American Astronomical Society*: [www.aas.org](http://www.aas.org)

Mostly a society for professional astronomers, but they have some items that are of potential interest to the general public.

(9) *The Planetary Society*: [www.planetary.org](http://www.planetary.org)

A society you can join, if you are interested in planets and space exploration. There are lots of interesting things on this web site.

(10) *Search for exoplanets*: [www.exoplanets.org](http://www.exoplanets.org)

This has the latest information on various searches for planets around other stars, including the local (and among the world’s best!) search (led by Prof. Geoff Marcy).

(11) *UCB Supernova Search*: [http://astro.berkeley.edu/bait/public\\_html/kait.html](http://astro.berkeley.edu/bait/public_html/kait.html)

This has the latest information on the local (and among the world’s best!) search for nearby supernovae (exploding stars), run by Alex.

(12) *Astronomy Picture of the Day*: <http://apod.nasa.gov/apod/astropix.html>

A cool new astronomy photo each day, along with an explanation and relevant links!

(13) *Solar Eclipses*: <http://eclipse.gsfc.nasa.gov/eclipse.html>

There is lots of good information about solar eclipses here, with links to other sites.

(14) *Mars Millennium Project*: [mmp.planetary.org](http://mmp.planetary.org)

Contributions from artists, scientists (including Alex!), and astronauts on what got them started, what motivates them, what promotes creativity, etc. Also: thoughts on settling Mars.

(15) *Space Day*: [www.spaceday.com](http://www.spaceday.com) — Good for the phases of the Moon, etc.

(16) *Space Weather*: [www.spaceweather.com](http://www.spaceweather.com)

Learn what’s happening about auroras, sunspots, meteor showers, etc.

(17) *Heavens Above*: [www.heavens-above.com](http://www.heavens-above.com)

Allows you to determine when you can see the International Space Station, the Hubble Space Telescope, planets, comets, etc.

(18) *Miscellaneous Space News*: [www.space.com](http://www.space.com)

You can get caught up on what’s new in space exploration.

**Popular Magazines:** The following have lots of great photos and information:

*Mercury* magazine: [www.astrosociety.org/pubs/mercury/mercury.html](http://www.astrosociety.org/pubs/mercury/mercury.html)

*Astronomy* magazine: [www.astronomy.com](http://www.astronomy.com)

*Sky & Telescope* magazine: [www.skyandtelescope.com](http://www.skyandtelescope.com)

Additional magazines that carry stories about astronomy are *Scientific American*, *Discover*, *Science News*, *New Scientist*, and *Physics Today*.

Also, see the astronomy video courses I’ve recorded with *The Great Courses*: <http://www.thegreatcourses.com/tgc/courses/courses.aspx?s=820&ps=910> .