

B ASTRONOMY WEBSITES, IMAGES, AND APPS

Throughout the textbook, we suggest useful resources for students on the specific topics in a given chapter. Here, we offer some websites for exploring astronomy in general, plus good sites for viewing and downloading the best astronomy images, and guides to astronomical apps for smartphones and tablets. This is not an exhaustive listing, but merely a series of suggestions to whet the appetite of those wanting to go beyond the textbook.

Websites For Exploring Astronomy In General

Astronomical Organizations

Amateur Astronomy Clubs. In most large cities and a number of rural areas, there are *amateur astronomy clubs*, where those interested in the hobby of astronomy gather to observe the sky, share telescopes, hear speakers, and help educate the public about the night sky. To find an astronomy club near you, you can try the following sites:

- › Night Sky Network club finder: <http://nightsky.jpl.nasa.gov/club-map.cfm> (<http://nightsky.jpl.nasa.gov/club-map.cfm>).
- › *Sky & Telescope* Magazine astronomy clubs and organizations: <http://www.skyandtelescope.com/community/organizations> (<http://www.skyandtelescope.com/community/organizations>).
- › *Astronomy* Magazine club finder: <http://www.astronomy.com/groups.aspx> (<http://www.astronomy.com/groups.aspx>).
- › Astronomical League astronomy clubs and societies: <http://www.astroleague.org/societies/all> (<http://www.astroleague.org/societies/all>).
- › Go-Astronomy club search: <http://www.go-astronomy.com/astro-club-search.htm> (<http://www.go-astronomy.com/astro-club-search.htm>).

American Astronomical Society: <http://www.aas.org> (<http://www.aas.org>). Composed mainly of professional astronomers. They have an active education office and various materials for students and the public on the education pages of their website.

Astronomical League: <http://www.astroleague.org> (<http://www.astroleague.org>). The league is the umbrella organization of American astronomy clubs. They offer a newsletter, national observing programs, and support for how to form and support a club.

Astronomical Society of the Pacific: <http://www.astrosociety.org> (<http://www.astrosociety.org>). Founded in 1889, this international society is devoted to astronomy education and outreach. They have programs, publications, and materials for families, teachers, amateur astronomers, museum guides, and anyone interested in astronomy.

European Space Agency (ESA): <http://www.esa.int/> (<http://www.esa.int/>). Information on European space missions with an excellent gallery of images.

International Astronomical Union (IAU): <http://www.iau.org/> (<http://www.iau.org/>). International organization for professional astronomers; see the menu choice “IAU for the Public” for information on naming astronomical objects and other topics of interest to students.

International Dark-Sky Association: <http://www.darksky.org> (<http://www.darksky.org>). Dedicated to combating light pollution, the encroachment of stray light that wastes energy and washes out the glories of the

night sky.

NASA: <http://www.nasa.gov> (<http://www.nasa.gov>) . NASA has a wide range of information on its many websites; the trick is to find what you need. Most space missions and NASA centers have their own sites.

Planetary Society: <http://www.planetary.org> (<http://www.planetary.org>) . Founded by the late Carl Sagan and others, this group works to encourage planetary exploration and the search for life elsewhere. While much of their work is advocacy, they have some educational outreach too.

Royal Astronomical Society of Canada: <http://www.rasc.ca/> (<http://www.rasc.ca/>) . Unites professional and amateur astronomers around Canada; has 28 centers with local activities, plus national magazines and meetings.

Some Astronomical Publications Students Can Read

Astronomy Now: <http://www.astronomynow.com/> (<http://www.astronomynow.com/>) . A colorful British monthly, with excellent articles about astronomy, the history of astronomy, and stargazing.

Astronomy: <http://www.astronomy.com> (<http://www.astronomy.com>) . Has the largest circulation of any magazine devoted to the universe and is designed especially for astronomy hobbyists and armchair astronomers.

Free Astronomy: <http://www.astropublishing.com/> (<http://www.astropublishing.com/>) . A new web-based publication, with European roots.

Scientific American: <http://www.sciam.com> (<http://www.sciam.com>) . Offers one astronomy article about every other issue. These articles, a number of which are reproduced on their website, are at a slightly higher level, but—often being written by the astronomers who have done the work—are authoritative and current.

Sky & Telescope: <http://skyandtelescope.com> (<http://skyandtelescope.com>) . An older and somewhat higher-level magazine for astronomy hobbyists. Many noted astronomers write for this publication.

Sky News: <http://www.skynews.ca/> (<http://www.skynews.ca/>) . A Canadian publication, featuring both astronomy and stargazing information. It also lists Canadian events for hobbyists.

StarDate: <https://stardate.org/> (<https://stardate.org/>) . Magazine that accompanies the brief radio program, with a useful website for beginners.

Sites that Cover Astronomy News

Exploring the Universe: <http://fraknoi.blogspot.com> (<http://fraknoi.blogspot.com>) . An astronomy news blog by one of the original authors of this textbook.

Portal to the Universe: <http://www.portaltotheuniverse.org/> (<http://www.portaltotheuniverse.org/>) . A site that gathers online astronomy and space news items, blogs, and pictures.

Science@NASA news stories and newscasts: <http://science.nasa.gov/science-news/> (<http://science.nasa.gov/science-news/>) . Well-written stories with, of course, a NASA focus.

Space.com: <http://www.space.com/news/> (<http://www.space.com/news/>) . A commercial site, but with wide coverage of space and astronomy news.

Universe Today: <http://www.universetoday.com/> (<http://www.universetoday.com/>) . Another commercial site, with good articles by science journalists, but a lot of ads.

Sites for Answering Astronomical Questions

Ask an Astrobiologist: <http://astrobiology.nasa.gov/ask-an-astrobiologist/> (<http://astrobiology.nasa.gov/ask-an-astrobiologist/>) . On this site from the National Astrobiology Institute at NASA, astronomer David Morrison answered questions about the search for life on other planets, the origin of life on Earth, and many other topics.

Ask an Astronomer at Lick Observatory: <http://www.ucolick.org/~mountain/AAA/> (<http://www.ucolick.org/~mountain/AAA/>) . Graduate students and staff members at this California observatory answered selected astronomy questions, particularly from high school students.

Ask an Astrophysicist: http://imagine.gsfc.nasa.gov/docs/ask_astro/ask_an_astronomer.html (http://imagine.gsfc.nasa.gov/docs/ask_astro/ask_an_astronomer.html) . Questions and answers at NASA's Laboratory for High-Energy Astrophysics focus on X-ray and gamma-ray astronomy, and such objects as black holes, quasars, and supernovae.

Ask an Infrared Astronomer: http://coolcosmos.ipac.caltech.edu/cosmic_classroom/ask_astronomer/faq/index.shtml (http://coolcosmos.ipac.caltech.edu/cosmic_classroom/ask_astronomer/faq/index.shtml) . A site from the California Institute of Technology, with an archive focusing on infrared (heat-ray) astronomy and the discoveries it makes about cool objects in the universe. No longer taking new questions.

Ask the Astronomer: <http://www.astronomycafe.net/qadir/qanda.html> (<http://www.astronomycafe.net/qadir/qanda.html>) . This site, run by astronomer Sten Odenwald, is no longer active, but lists 3001 answers to questions asked in the mid-1990s. They are nicely organized by topic.

Ask the Experts at PhysLink: <http://www.physlink.com/Education/AskExperts/index.cfm> (<http://www.physlink.com/Education/AskExperts/index.cfm>) . Lots of physics questions answered, with some astronomy as well, at this physics education site. Most answers are by physics teachers, not astronomers. Still taking new questions.

Ask the Space Scientist: <http://image.gsfc.nasa.gov/poetry/ask/askmag.html> (<http://image.gsfc.nasa.gov/poetry/ask/askmag.html>) . An archive of questions about the Sun and its interactions with Earth, answered by astronomer Sten Odenwald. Not accepting new questions.

Curious about Astronomy?: <http://curious.astro.cornell.edu> (<http://curious.astro.cornell.edu>) . An ask-an-astronomer site run by graduate students and professors of astronomy at Cornell University. Has searchable archives and is still answering new questions.

Miscellaneous Sites of Interest

A Guide to Careers in Astronomy: <http://aas.org/files/resources/Careers-in-Astronomy.pdf> (<http://aas.org/files/resources/Careers-in-Astronomy.pdf>) . From the American Astronomical Society.

Astronomical Pseudo-Science: A Skeptic's Resource List: <http://www.astrosociety.org/pseudo> (<http://www.astrosociety.org/pseudo>) . Readings and websites that analyze such claims as astrology, UFOs, moon-landing denial, creationism, human faces on other worlds, astronomical disasters, and more.

Astronomy for Beginners: <http://www.skyandtelescope.com/astronomy-information/> (<http://www.skyandtelescope.com/astronomy-information/>) . A page to find resources for getting into amateur astronomy.

Science Fiction Stories with Good Astronomy and Physics: <http://www.astrosociety.org/scifi> (<http://www.astrosociety.org/scifi>) .

Space Calendar: <http://www2.jpl.nasa.gov/calendar/> (<http://www2.jpl.nasa.gov/calendar/>) . Ron Baalke at

the Jet Propulsion Laboratory keeps a listing of what space events happened on each day of the year; great if you need a reason to have a space-theme party.

Unheard Voices: The Astronomy of Many Cultures: <http://multiverse.ssl.berkeley.edu/multicultural> (<http://multiverse.ssl.berkeley.edu/multicultural>) . A guide to resources about the astronomy of native, African, Asian, and other non-Western groups.

Selected Websites For Viewing And Downloading Astronomical Images

The Top Image Sites

Astronomy Picture of the Day: <http://antwrp.gsfc.nasa.gov/apod/lib/aptree.html> (<http://antwrp.gsfc.nasa.gov/apod/lib/aptree.html>) . Two space scientists scour the internet and feature one interesting astronomy image each day.

European Southern Observatory Photo Gallery: <http://www.eso.org/public/images/> (<http://www.eso.org/public/images/>) . Magnificent color images from ESO's largest telescopes. See the topical menu at the top.

Hubble Space Telescope Images: <http://hubblesite.org/images/gallery> (<http://hubblesite.org/images/gallery>) . Starting at this page, you can select from among many hundreds of Hubble pictures by subject. Other ways to approach these images are through the more public-oriented Hubble Gallery (<http://hubblesite.org/gallery/> (<http://hubblesite.org/gallery/>)) or the European ESO site (<http://www.spacetelescope.org/images/> (<http://www.spacetelescope.org/images/>)).

National Optical Astronomy Observatories Image Gallery: http://www.noao.edu/image_gallery/ (http://www.noao.edu/image_gallery/) . Growing archive of images from the many telescopes that are at the United States' National Observatories.

Planetary Photojournal: <http://photojournal.jpl.nasa.gov/index.html> (<http://photojournal.jpl.nasa.gov/index.html>) . Features thousands of images from NASA's extensive set of planetary exploration missions with a good search menu. Does not include most of the missions from other countries.

The World at Night: <http://www.twanight.org/newTWAN/index.asp> (<http://www.twanight.org/newTWAN/index.asp>) . Dramatic night-sky images by professional photographers who are amateur astronomers. Note that while many of the astronomy sites allow free use of their images, these are copyrighted by photographers who make their living selling them.

Other Useful General Galleries

Anglo-Australian Observatory: <http://203.15.109.22/images/> (<http://203.15.109.22/images/>) . Soon at <https://www.aao.gov.au/public/images> (<https://www.aao.gov.au/public/images>) . Great copyrighted color images by leading astro-photographer David Malin and others.

Canada-France-Hawaii Telescope: <http://www.cfht.hawaii.edu/HawaiianStarlight/images.html> (<http://www.cfht.hawaii.edu/HawaiianStarlight/images.html>) . Remarkable color images from a major telescope on top of the Mauna Kea peak in Hawaii.

European Space Agency Gallery: <http://www.esa.int/spaceinimages/Images> (<http://www.esa.int/spaceinimages/Images>) . Access images from such missions as Mars Express, Rosetta, and Herschel.

Gemini Observatory Images: http://www.gemini.edu/index.php?option=com_gallery (http://www.gemini.edu/index.php?option=com_gallery) . Images from a pair of large telescopes in the northern and the southern hemispheres.

Isaac Newton Group of Telescopes Image Gallery: http://www.ing.iac.es/PR/images_index.html (http://www.ing.iac.es/PR/images_index.html) . Beautiful images from the Herschel, Newton, and Kapteyn telescopes on La Palma.

National Radio Astronomy Observatory Image Gallery: <http://images.nrao.edu/> (<http://images.nrao.edu/>) . Organized by topic, the images show objects and processes that give off radio waves.

Our Infrared World Gallery: http://coolcosmos.ipac.caltech.edu/image_galleries/missions_gallery.html (http://coolcosmos.ipac.caltech.edu/image_galleries/missions_gallery.html) . Images from a variety of infrared astronomy telescopes and missions. See also their “Cool Cosmos” site for the public: <http://coolcosmos.ipac.caltech.edu/> (<http://coolcosmos.ipac.caltech.edu/>) .

Some Galleries on Specific Subjects

Astronaut Photography of Earth: <http://eol.jsc.nasa.gov/> (<http://eol.jsc.nasa.gov/>) .

Chandra X-Ray Observatory Images: <http://chandra.harvard.edu/photo/category.html> (<http://chandra.harvard.edu/photo/category.html>) .

NASA Human Spaceflight Gallery: <https://www.flickr.com/photos/nasa2explore> (<https://www.flickr.com/photos/nasa2explore>) or <http://spaceflight1.nasa.gov/gallery/index.html> (<http://spaceflight1.nasa.gov/gallery/index.html>) . Astronaut images.

Robert Gendler: <http://www.robgendlerastropics.com/> (<http://www.robgendlerastropics.com/>) . One of the amateur astro-photographers who comes closest to being professional.

Sloan Digital Sky Survey Images: <http://www.sdss.org/gallery/> (<http://www.sdss.org/gallery/>) .

Solar Dynamics Observatory Gallery: <http://sdo.gsfc.nasa.gov/gallery/main> (<http://sdo.gsfc.nasa.gov/gallery/main>) . Sun images.

Spitzer Infrared Telescope Images: <http://www.spitzer.caltech.edu/images> (<http://www.spitzer.caltech.edu/images>) .

Astronomy Apps For Smartphones And Tablets

A pretty comprehensive listing of such apps with brief descriptions and links to their websites can be found at: <http://dx.doi.org/10.3847/AER2011036> (<http://dx.doi.org/10.3847/AER2011036>) . The list is now a few years old, but most of the apps are still available.

Listings and Reviews of Apps

11 Best Astronomy Apps for Amateur Star Gazers: <http://www.businessinsider.com/11-best-astronomy-apps-for-amateurs-2013-10> (<http://www.businessinsider.com/11-best-astronomy-apps-for-amateurs-2013-10>) . From Kelly Dickerson (2013).

14 Best Astronomy Apps for Stargazers and Space Lovers: <http://nerdsmagazine.com/best-astronomy-apps-for-android/> (<http://nerdsmagazine.com/best-astronomy-apps-for-android/>) . Viney Dhiman’s recommendations, part of *Nerd’s Magazine* (2014).

15 Best Astronomy Applications for iPhone: <http://www.iphoneness.com/iphone-apps/top-astronomy-applications-for-iphone/> (<http://www.iphoneness.com/iphone-apps/top-astronomy-applications-for-iphone/>) . From iPhoneness.

Apps for Stargazing: <http://appadvice.com/appguides/show/astronomy-apps> (<http://appadvice.com/>)

[appguides/show/astronomy-apps](#)) . App Advice site's reviews.

NASA Apps for Smartphones and Tablets: <https://www.nasa.gov/connect/apps.html> (<https://www.nasa.gov/connect/apps.html>) .

Phone/Tablet Apps and the Practical Astronomer: <http://www.cloudynights.com/page/articles/cat/user-reviews/phonetablet-apps-and-the-practical-astronomer-r2925> (<http://www.cloudynights.com/page/articles/cat/user-reviews/phonetablet-apps-and-the-practical-astronomer-r2925>) . Active amateur astronomer Tom Fowler reviews 22 apps (2014).

Sky & Telescope Mobile Apps: <http://www.skyandtelescope.com/sky-and-stargazing-apps/> (<http://www.skyandtelescope.com/sky-and-stargazing-apps/>) . Apps from *Sky & Telescope* Magazine.

Smartphone Apps Can Make Astronomy as Easy as Point and Gaze: <http://www.heraldnet.com/article/20140511/LIVING/140519988> (<http://www.heraldnet.com/article/20140511/LIVING/140519988>) . Mike Lynch for HeraldNet (2014).