Those long summer days

by Bob Riddle

As we move into the Northern Hemisphere summer months, the length of daylight increases at both ends—sunrise is earlier and sunset is later. During June, we have the earliest time for sunrise, the longest period of daylight, and the latest time for sunset (see the calendar in Figure 1 for dates and times). The calendar shows the dates and times as calculated for 40° north, and these times will vary based on latitude. The times are rounded off when using an online sunrise/sunset calculator; several days may show the same sunrise or sunset times and lengths (see the Sunrise Sunset link in Resources for a calculator). This is because the calculations for sunrise and sunset are rounded up and only shown using hours and minutes, not seconds. For example, on the Sunrise Sunset website, looking up Washington, DC, (39° north) will reveal a range of dates showing the same time because the calculations round off the seconds. However, the earliest sunrise (5:41 a.m. EDT) will be on June 14, the longest day will be on June 21 (14 hours, 54 minutes), and the latest sunset (8:33 p.m. EDT) will be on June 27. An interesting application for this information is to have students use the Sunrise Sunset website and determine not only their local times but also investigate and graph times and dates at other latitudes in the United States or the world.

One of the downsides to the increase in daylight hours and decrease in night hours is that there is less night sky to view. However, there is a celestial symmetry between the number of hours of daylight and night each season (Figure 1).

Another example of this celestial symmetry was discussed in this column last February, where it was pointed out that during the winter months, some summer stars and constellations are visible during the predawn hours as they rise above the southeastern horizon (see Resources). After about one-half year of revolution around the Sun and moving into the summer months, we have "flipped" the sky so that the stars of winter's predawn skies are now the evening stars of summer, and the stars of the winter skies are now in the predawn skies over the southeastern horizon as they rise.

Summer viewing

Despite fewer night hours, this summer will be a good one for planet observing. All of the visible planets will brighten the morning and evening skies as they jockey for position, moving past one another and two bright open star clusters. Interestingly, much of the morning and evening planetary action will take place in the same general region of the sky—somewhat centered on the Gemini Twins.

Open star clusters such as M35 in Gemini and M44 in Cancer are collections of stars held together by their mutual gravitational fields and are arranged in a loose-appearing grouping of up to a few thousand stars. Stars within an open cluster all formed at about the same time out of giant molecular clouds of gases; as a result, they are all about the same approximate age. M35 is at a distance of about 2,800 light-years and covers a space about the size of the full Moon, while M44 is about 600 light-years distant and is twice as bright as M35, so it is more easily seen. Both open star clusters are wonderful stellar objects when viewed with binoculars or low-power telescope eyepieces.

Mercury will begin the summer months near the feet of the Gemini Twins and on June 1 will be closest to the open star cluster M35. As Mercury continues moving eastward, it will pass Venus on June 18 before curving back toward the Sun and inferior conjunction on July 9. Following inferior conjunction, Mercury will reappear in the morning skies toward the middle of July as it moves westward along the stars of the Gemini Twins. On the mornings of August 10 and 11, Mercury will pass by the open star

cluster M44, also known as the Beehive cluster, in Cancer. By June 24, Mercury will be on the opposite side of the Sun in superior conjunction.

Venus will move into the evening skies in June. As it moves eastward, Venus will travel from the feet of the Gemini Twins through the boundaries of Cancer the Crab and Leo the Lion. By summer's end, Venus will be near the blue-white star Spica midway across the boundaries of Virgo the Harvest Maiden. Use binoculars to see Venus pass by the open star cluster M35 in Gemini; it will come the closest on June 4. On July 2 and 3, Venus will pass by another open star cluster, M44 (the Beehive cluster), in Cancer.

Mars will be a morning planet during the summer months, rising ahead of the Sun. However, Mars will not be easily visible until mid-July, when it will be rising about an hour before sunrise. During the summer, Mars will follow nearly the same path as did Venus. Mars will be moving eastward as it traverses the stars of the Gemini Twins. On the mornings of August 16 and 17, use binoculars to see Mars pass by the open star cluster M35. A few days later, Mars will pass by the planet Jupiter.

Jupiter will be low over the western horizon during the first week of June just below Venus and Mercury. However, Jupiter will move into superior conjunction, on the opposite side of the Sun, on June 19 and will not be visible until it starts becoming more so as a morning planet toward the latter half of July. Just before sunrise on the first few days of July, Jupiter will pass by the open star cluster M35 near the feet of the Gemini Twins. Watch for a close conjunction between Jupiter and Mars on the morning of July 20.

Saturn will be visible throughout the night hours as it rises approximately at local sunset time in June. By the end of August, however, Saturn will be setting at about the time of local sunset. This ringed planet spends the three summer months within the boundaries of the constellation Virgo the Harvest Maiden. Saturn will be about 15° east of the bright blue-white star Spica.

FIGURE 1 Approximate dates and times of sunrise and sunset and lengths of daylight and night

Note: The number of hours are rounded, use Eastern Standard Time, and set a general date for each season.

Season and date	Sunrise	Sunset	Daylight (hours)	Night (hours)
Summer: June 21	4 a.m.	8 p.m.	16	8
Autumn: September 21	6 a.m.	6 p.m.	12	12
Winter: December 21	8 a.m.	4 p.m.	8	16
Spring: March 21	6 a.m.	6 p.m.	12	12

The **Perseid meteor shower** is an annual event that happens each August as the Earth passes through debris left behind by Comet 109P/Swift-Tuttle. The Perseids will begin when the Earth enters the fringes of the comet's debris cloud on July 17, peak on August 12, and end as we exit the debris cloud around August 24. At the peak, this meteor shower can average around 200 meteors per hour; however, seeing that number would require relatively dark skies. This year will be a good year for viewing the meteor shower because the Moon will be in the waxing crescent phase during the peak night in August and will have set hours before the "radiant" for the meteor shower rises in the northeast. The *radiant* of a meteor shower is the central spot, or place, within a constellation from which the meteors appear to radiate outward. The constellation Perseus the Hero will rise just before midnight local time; best viewing will be a couple of hours before sunrise, as the part of Earth you are viewing from rotates, so you are seeing the meteors head-on as they enter the upper atmosphere.

Summer reads

Whenever I recommend reading material, I am reminded of a conversation between two characters on the TV show *Cheers*: "As a kid my nickname was Red." "Because your hair was red?" "No, I read a book!" Hopefully, as teachers we are able to encourage students to read more than one book. Given the proliferation of handheld devices capable of displaying reading material, I've compiled a small collection of online and e-books that will be of interest to you and your students. Many of the books are on websites that in-

cludes lesson plans and other related resources. Most of these are PDF files; as such, they can be read on nearly every handheld device. Some of the books are also available through the iTunes store specifically for the iPad. In this format, the books are interactive and include videos and other multimedia embedded within the book. (See Resources for additional reading material and reading list information.) ■

June

7 Neptune begins retrograde motion
8 New Moon
9 Moon at apogee (252,587 mi. [406,500 km])
10 Moon near Venus
12 Mercury at east elongation
14 Earliest sunrise (5:41 a.m. EDT)
16 First quarter Moon
First woman in space (1963)
18 Moon near Spica
19 Jupiter at superior conjunction
Moon near Saturn
Latest sunset for NSTA offices
20 Mercury near Venus
21 June solstice (1:04 a.m. EDT)
Longest day (14 hr. 54 min.)
Venus near the Twins
23 Moon at perigee (221,830 mi. [357,000 km])
Full Moon
24 Moon occultation of Pluto
27 Latest sunset (8:33 p.m. EDT)
29 Last quarter Moon
30 Tunguska event (1908)

July

1 Dwarf planet Pluto at opposition
3 Venus near Beehive star cluster
5 Earth at aphelion (94,508,19 mi. [152,096,155 km])
Henrietta Swan Leavitt's birthday (1868)
6 Moon at apogee (252,587 mi. [406,500 km])
8 New Moon
9 Mercury at inferior conjunction
10 *Cassini* flyby of Titan
15 First quarter Moon
16 Moon near Saturn
20 *Cassini* flyby of Titan
21 Mars near Jupiter
Moon occultation of Pluto
22 Full Moon
Venus near Regulus
26 *Cassini* Titan flyby
28 Mercury near Mars
29 Last quarter Moon
30 Mercury at west elongation
31 Spring equinox on Mars

August

3 Moon at apogee (252,152 mi. [405,800 km])
Moon near Jupiter
4 Asteroid Juno at opposition
6 New Moon
9 Moon near Venus
12 Moon near Spica
Perseid meteor shower peak
13 Moon near Saturn
14 First quarter Moon
17 Mars near Gemini the Twins
Moon occultation of Pluto
18 Moon at perigee (225,123 mi. [362,300 km])
20 Full Moon
24 Mercury at superior conjunction
26 Neptune at opposition
28 Last quarter Moon
30 Moon at apogee (251,593 mi. [404,900 km])
31 Moon near Jupiter

Resources

Cassini Solstice Mission at Saturn—http://*saturn.jpl.nasa.gov*

Henrietta Swan Leavitt (female astronomer)—*www.womanastronomer.com/hleavitt.htm*

Mars's calendar—*www.planetary.org/explore/space-topics/mars/mars-calendar.html*

Perseid meteor shower—*http://meteorshowersonline.com/perseids.html*

Riddle, B. 2013. Midwinter skies, planets, and orbits, and the stars of summer. *Science Scope* 36 (6): 84–87.

The Tunguska impact—*http://science.nasa.gov/science-news/science-at-nasa/2008/30jun_tunguska*

Valentina Tereshkova (first woman in space)—*http://en.wikipedia.org/wiki/Valentina_Tereshkova*

Sunrise Sunset—*www.sunrisesunset.com*

E-books and PDFs

Cindi in Space (a story in comic form about an android girl, her two dogs, and the CINDI mission [Counted Ion Neutral Dynamics Investigation] to study our upper atmosphere)—*http://cssepo.utdallas.edu/cindi-in-*

comics-2/cindi-in-space-2.html

The classroom astronomer—*http://classroomastronomer.toteachthestars.net*

Earth as Art (a collection of pictures of our planet taken by several orbiting satellites)—*www.nasa.gov/connect/ebooks/earth_art_detail.html*

The first two of three-book series *Think Scientifically*, part of the Solar Dynamics Observatory's literacy program—*http://sdo.gsfc.nasa.gov/epo/educators/thinkscientifically.php*

Free e-books—*www.freebooksifter.com*

Hanny and the Mystery of the Voorwerp (a comic book about the true story of a young Dutch girl, Hanny Van Arkel, who, in the summer of 2007, was examining galaxies as part of the Galaxy Zoo project when she discovered a mysterious object)—*http://hannysvoorwerp.zooniverse.org/comic-index/comicbook*

Hubble and Webb space telescope books—*http://hubblesite.org/ibooks*

Lawrence Hall of Science books for students—*www.globalsystemsscience.org/studentbooks*

PBS Learning Media—*http://pbslearningmedia.org*

Science fiction stories with good astronomy and physics—*www.astrosociety.org/edu/resources/scifiprint.html*

Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) comic books about solar-terrestrial physics—*www.yorku.ca/scostep/?page_id=366*

What Are Cosmic Rays? (a comic book produced by the Solar-Terrestrial Environment Laboratory, Japan's Nagoya University, and SCOSTEP)—*www.stelab.nagoya-u.ac.jp/ste-www1/pub/nanda/cosmicrays_e.pdf*

What Are the Polar Regions? (a comic book produced by the Solar-Terrestrial Environment Laboratory, Japan's Nagoya University, and SCOSTEP) —*www.arvindguptatoys.com/arvindgupta/scostep-polar.pdf*

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