A planetpalooza!

by Bob Riddle

Viewing planets is something like the opening lines of *A Tale of Two* Cities, "It was the best of times, it was the worst of times…" This next two-month period is going to be one of those "best of times" for planet viewing, as four bright planets will group together in the early morning skies before sunrise. During April, the ringed planet Saturn will reach opposition on April 3 and will be visible all night as it rises around sunset and sets around sunrise. During May, the focus will be on Mercury, Venus, Mars, and Jupiter. All four will be relatively close to the Sun as seen from Earth, and all will be moving past one another into very close groupings, or conjunctions, during May. Adding to the view will be the thin, waning crescent Moon, gliding past the group of planets during the last days of April and first days of May.

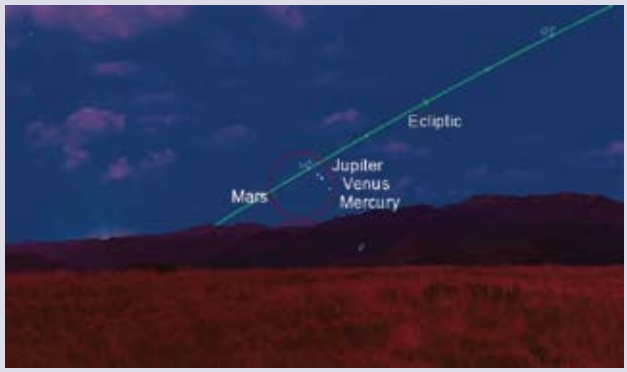
Viewing the morning planetary groupings will be somewhat challenging, as the planets will all be located on the west side, to the right of the Sun, and will rise ahead of the Sun. Each planet will be in motion along its respective orbital path as it jockeys for positions in the predawn skies. With the exception of Mercury, these planets are moving eastward, as is the Sun, albeit as apparent motion. (All planets orbit the Sun toward the east as a result of their respective orbital motions. The Sun appears to move eastward as a result of the Earth revolving around the Sun.) Mercury will be moving in retrograde (or westward) from inferior conjunction, between the Earth and the Sun, toward morning visibility on the Sun's west side. As you watch the planets, you will notice that over a period of days their positions relative to each other are changing. Mercury, in particular, as the innermost planet and fastest-orbiting planet, will only be visible for about two or three weeks; if you have never caught a glimpse of this elusive planet, this would be a good opportunity to do so.

With sunrise at around 5 a.m. local time and getting earlier each day as we move toward the June solstice and summer, the difficulty in observing these planets will increase. Adding to the challenge will be the low altitude of the four planets above the eastern horizon, as their angle relative to the horizon will be low. Despite the location of the four planets ahead of the Sun at sunrise, viewing them will require a relatively flat and unobstructed view toward the eastern horizon. Figure 1 shows a view set for 5 a.m. EDT looking toward the east. Between May 11 and 12, the four planets will be close enough to be seen at the same time with binoculars.

The arrangement of the planets as shown in Figure 2 gives an idea of how they will be positioned with respect to the Sun and Earth, but due to the scale of the drawing, it suggests that these planets are in alignment. The planets are indeed aligned, but they are aligned or arranged along the ecliptic as Figure 1 shows, not in a straight line out from the Earth or the Sun as Figure 2 and the term planetary alignment seem to suggest.

Using Figure 2, your students can increase their level of understanding of planetary motions and how we see this group of planets on the Sun's right side as morning planets. To illustrate this, draw a line straight through the Earth toward and away from the Sun. This would show that Mercury, Venus, Mars, and Jupiter are on the same side of the Sun, while Saturn is in the opposite direction

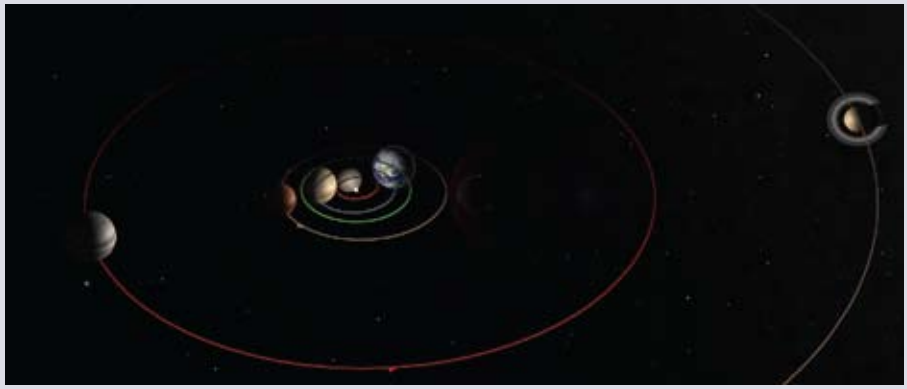
FIGURE 1 Planet grouping along the ecliptic at 5 a.m. EDT on May 11, 2011; the red circle shows the field of view with a 10 x 50 binocular



at opposition. Picture the Earth rotating—from the perspective in Figure 2, the Earth would be rotating from right to left. Put a dot on the Earth to represent your location. As the Earth rotates, the dot (you) would first line up with the planets, then the straight line, then finally the Sun—the four planets would come into view one by one before the Sun does.

Students can plot planet positions using heliocentric coordinates to see how the four planets rise ahead of the Sun. Heliocentric coordinates use a 360° horizontal system and are based on a Sun-centered model of the solar system. Students will need to use polar graph paper to plot the planets' positions as shown in Figure 3 (see Resources for website). Astronomically, the 0° longitude point is at the position of the vernal equinox, where the ecliptic crosses the celestial equator in the constellation of Pisces the Fishes. However, for this activity, students will only need to label the polar graph paper from 0° to 360°. The polar graph paper should have enough circles to show the orbits of the planets and have the Sun in the center. Values have been rounded up, and as students will see, the more distant planets change their positions and orbit more slowly than planets closer to the Sun.

FIGURE 2 Planet arrangement in early May 2011



Space flights

The launch of space shuttle *Endeavour,* the last shuttle mission for NASA, will be in April. The mission will be the 36th for shuttle *Endeavour* and the 134th shuttle mission to low Earth orbit. This flight will carry a crew of six astronauts on a 14-day mission to the International Space Station (ISS), along with some final components for the station.

The Russian Federal Space Agency, Roscosmos, will have two launches to the ISS during April and May. At the end of April, the ISS will be resupplied by way of a regularly scheduled launch of a Progress rocket carrying a Soyuz cargo vehicle. This will be the 42nd launch by the Russian space agency to the ISS from the Baikonur Cosmodrome in Kazakhstan. Approximately one month later, on May 31, a Soyuz rocket carrying a mannedspacecraft with the three-person Expedition 28 crew will travel to the ISS.

April is a special month for space exploration, especially this year, as this month marks the 50th anniversary of the first manned space flight and the 30th anniversary of the first space shuttle flight. On April 12, 1961, Russian Yuri Gagarin became the first person in space as he orbited the Earth aboard *Vostok 1* in a single orbit lasting a little more than one and a half hours. Twenty years later, on the same date, the space shuttle *Columbia* lifted off for its maiden flight, carrying a crew of two astronauts, Robert Crippen and John Young, into an orbital flight that circled the Earth 37 times and lasted for more than 54 hours.

April

1 Launch of STS-134 *Endeavour* to ISS
3 Saturn at opposition
New Moon
6 Jupiter in solar conjunction
7 Waxing crescent Moon near Pleiades
8 Winter solstice on Mars
Pluto begins retrograde motion
9 Mercury in inferior conjunction
11 First quarter Moon
12 Yuri's Night: 50th anniversary of the first person in space
First shuttle launch: STS-1 *Columbia* 30th anniversary
16 Waxing gibbous Moon near Saturn
18 Full Moon
19 *Cassini* Titan flyby
22 Lyrids meteor shower peak
Mercury ends retrograde motion
25 Third quarter Moon
27 Progress launch to resupply ISS

May

1 Thin waning crescent Moon near planet group
2–8 Astronomy week
3 New Moon
6 Space Day
7 Astronomy Day
Mercury at western elongation
8 *Cassini* Titan flyby
9–11 Morning trio of planets: Mercury, Venus, and Jupiter
10 First quarter Moon
12 Mars joins planetary trio
13 It's Friday!
Waxing gibbous Moon near Saturn
17 Full Moon
19 Venus close to Mercury
23 Venus close to Mars
24 Third quarter Moon
29 Thin, waning, crescent Moon near Jupiter
30 Thin, waning, crescent Moon near Mars
31 Soyuz TMA launch to ISS: Expedition 28 Crew

Visible planets

Mercury will become visible as a morning planet toward the end of April and will remain visible over the eastern horizon before sunrise during May.

Venus will be visible during this two-month period as a morning planet over the eastern horizon before the Sun rises.

Mars will slowly become more visible as a morning planet over the eastern horizon at sunrise during this two-month period.

Jupiter will become more visible over the eastern horizon at sunrise during the latter half of May.

Saturn will be at opposition in April and will be visible all night as it rises around sunset and sets around sunrise.

Questions for students

1. Compare the changing longitude coordinates for the planets in Figure 3. The Earth moves at about 1° per Earth day. Using orbital periods expressed in Earth days, how many degrees do the other planets move each Earth day? (*Mercury: 360 °/88 = 4°; Venus: 360 °/225 = 1.6 °; Mars: 360 °/686 = 0.5 °; Jupiter: 360 °/4332 = 0.08 °; Saturn: 360 °/10,759 = 0.03 °*)
2. The angle of the ecliptic relative to the east or west horizon changes throughout the year with a repetitive and regular pattern. What would cause the ecliptic angle to change? *(The Earth is tilted on its axis as it revolves around the Sun. An effect of having an axial tilt is the changing angle of the ecliptic relative to the horizon, as well as the Sun's changing position back and forth from north to south at sunrise and sunset along the horizon.*)

Resources

Astronomy Day—*www.astroleague.org/al/astroday/astroday.html*
Cassini mission to Saturn—*http://saturn.jpl.nasa.gov*
Lyrids meteor shower—*http://meteorshowersonline.com/lyrids.html*
Polar graph paper—*http://incompetech.com/graphpaper/polar*
STS-1 Columbia—*www.nasa.gov/mission_pages/shuttle/shuttlemissions/archives/sts-1.html*
STS-134 Endeavour—*www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts134*
Space Day—*www.spaceday.org*
Yuri's Night—*http://yurisnight.net*

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FIGURE 3 Heliocentric longitude coordinates (in degrees)

Planet	April 7	April 17	April 27	May 7	May 17	May 27	June 6	June 16	June 26
Mercury	189	222	251	278	309	347	38	100	155
Venus	292	308	324	340	356	12	28	44	60
Earth	196	206	216	226	235	245	254	264	274
Mars	354	0	6	12	19	25	31	36	42
Jupiter	16	17	18	19	20	21	22	23	24
Saturn	193	194	194	194	195	195	195	196	196