# The Pocket Planetarium ★

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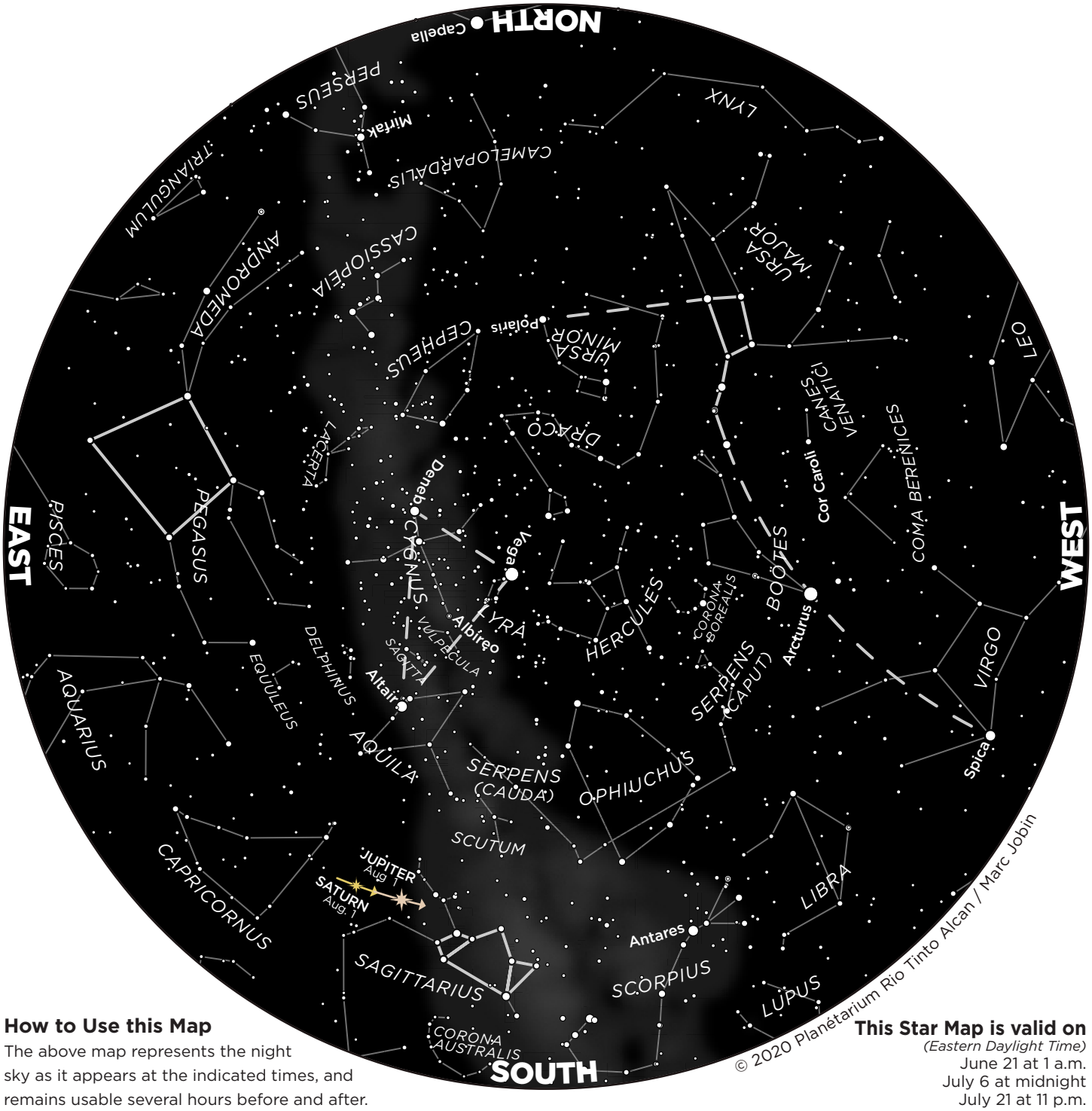
Astronomical Information Newsletter of the Rio Tinto Alcan Planetarium


# The Starry Sky — Summer 2020






## How to Use this Map

The above map represents the night sky as it appears at the indicated times, and remains usable several hours before and after.

Hold the map up to the sky in front of you and turn it so the direction you are facing appears at the bottom. Lines identify the constellations. The light-coloured area outlines the Milky Way.

## This Star Map is valid on

*(Eastern Daylight Time)*
June 21 at 1 a.m.
July 6 at midnight
July 21 at 11 p.m.
August 6 at 10 p.m.
August 21 at 9 p.m.
September 6 at 8 p.m.

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# The 2020 opposition of Mars: Act 1

*Over the summer months, the distance between Earth and Mars shrinks considerably. This interplanetary encounter will culminate in October, when the Red Planet will be at its best opposition in 15 years for observers in the Northern Hemisphere.*

Usually too far away and too tiny, Mars reveals its surface details for only a few weeks every 26 months, when it's in opposition—directly opposite the Sun in the sky. At that moment, Earth and Mars are on the same side of the Sun. But not all Martian oppositions are equal, since Mars's orbit is much more elliptical (elongated) than that of Earth. During opposition, the distance between us and the Red Planet can almost double depending on the years. The apparent size of Mars, as viewed through a telescope, will also vary by the same proportion: This massive fluctuation has a major impact on the level of detail we can expect to discern on the Red Planet's surface.

In principle, the most favourable oppositions occur when Mars is at perihelion (the point in its orbit closest to the Sun). That was the case in August 2003, when Mars made its closest approach to Earth in almost 60,000 years. The July 2018 opposition was also near record levels. Unfortunately, during these so-called "favourable" years, observers at northern latitudes are disadvantaged by the Red Planet's position in the sky, which is in the southernmost constellations on the ecliptic: Sagittarius, Capricorn and Aquarius. Therefore, Mars doesn't rise much more than 30 degrees above the southern horizon, at best. When the planet hangs that low in the sky, its light must travel a longer path through Earth's atmosphere before it reaches us, resulting in much blurrier images.

However, the situation will improve significantly this fall. Even if the Red Planet will be slightly farther from Earth than it was in 2003 or even in 2018, it will be positioned much higher in the constellation Pisces: Mars will peak at an altitude of about 50 degrees for observers in Quebec. Observation conditions will be far better and will largely make up for the planet's slightly smaller apparent diameter. Mars hasn't been this favourably positioned for us in 15 years, so start tracking it this summer!

### Mars with the naked eye

Over the next few months, the Red Planet's brightness changes dramatically with its varying distance from the Sun and the Earth. While Mars at opposition outshines all the stars and even rivals Jupiter in brightness, the Red Planet is rather faint the rest of the time: For months, the planet appears as an inconspicuous, second-magnitude orange star that could easily be mistaken for a background star were it not for its motion, which gives it away to keen-eyed observers.

Throughout the summer and early days of fall this year, Mars becomes increasingly bright: Its magnitude exceeds –1 on July 27 and reaches –2 on September 8. The Red Planet will achieve a maximum brightness of –2.6 in the days surrounding opposition (during the second week of October) before gradually dimming, but it will remain brighter than magnitude –2 until early November. Mars currently resides in a region of sky devoid of bright stars, hence why it outshines other rivals.

You can track the Red Planet's rapid movement among the constellations—it's worth the effort **(Figure 1)**. After spending time in Aquarius since May 8, Mars enters Pisces on June 24 and stays there for the rest of the year, except for a brief foray into Cetus the Whale from July 8 to 26.

Mars begins its retrograde loop on September 9. This phenomenon that so puzzled ancient astronomers occurs when Earth, in its faster orbit, catches up with and passes the Red Planet, which seems to stop moving eastward before reversing course for a few weeks against the backdrop of stars. The same illusion occurs when you pass a car on the highway: The slower car will appear to move backward in relation to the distant landscape. Mars ends its retrograde loop on November 13 and resumes its forward motion.

The Red Planet rises earlier and earlier as summer progresses. At the end of June, you'll have to stay up past 1 a.m. to catch a glimpse of the planet very low on the eastern horizon, but it can be found just over 35 degrees high in the southeast at dawn. In mid-July, Mars finally rises before midnight to an altitude exceeding 40 degrees above the south-southeastern horizon before sunrise. In mid-August, the Red Planet rises before 10:30 p.m. and culminates 50 degrees high in the south around 5 a.m., at which point its diameter is greater than 16 arc seconds. In mid-September, Mars can be found over 30 degrees high in the sky from 11:30 p.m. until dawn; it culminates around 3 a.m. and its disc measures 21 arc seconds across when viewed through a telescope.

### The Moon encounters Mars

In the weeks leading up to the Mars opposition, the Moon will periodically approach the Red Planet. The proximity between the two celestial bodies will make for some truly remarkable encounters. Thus, at around 11 p.m. **on the night of August 8-9,** the waning gibbous Moon rises 2½ degrees away from Mars and inches ever closer with each passing hour: By dawn, high in the south, the Moon lies only 1 degree below the Red Planet. **In the middle of the night of September 5-6,** the waxing gibbous Moon moves to within ½ a degree below Mars: The gap is slightly larger when they first rise around 9:30 p.m. as well as by the end of the night, so you'll be able to watch it change from hour to hour. ➡

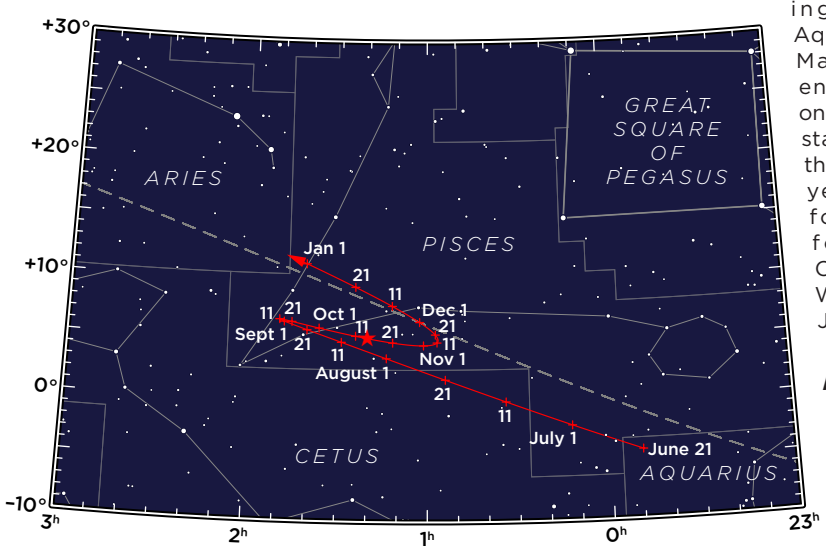



***Figure 1.*** *The map shows the apparent trajectory of Mars through the constellations, from June 21, 2020 to January 1, 2021. We can easily see the retrograde loop of the Red Planet. Crosses indicate its position on the 1st, 11th and 21st of each month. The ★ symbol shows the location of Mars on the night of opposition, next October 13. (Map: Rio Tinto Alcan Planetarium / Marc Jobin)*

### Mars through the eyepiece

The apparent diameter of Mars will be greater than 15 arc seconds from July 31 to November 30 and will even exceed 20 arc seconds from September 4 to November 3. With Mars culminating approximately 50 degrees above the southern horizon, observation conditions during the last weeks of summer will be excellent.

The sequence of images in **Figure 2** illustrates the changing appearance of Mars's disc at four-week intervals from July to December 2020. The first thing you'll notice is that the apparent size of Mars changes drastically over the space of a few weeks. You'll also see that Mars's disc is not a perfect circle in the few weeks before or after opposition: The Red Planet shows a slight phase because of the varying angle between the Sun, Mars and Earth, but that effect disappears at the moment of opposition. Also note that the Martian rotational axis is tilted, just like that of Earth. During this opposition, the planet's southern hemisphere is pointed towards us as well as the Sun (spring began there on April 8 and summer kicks off on September 2): The Red Planet's south polar cap will steadily shrink throughout this period of observation.

The rotational period of Mars (24 hours 37 minutes) is slightly longer than that of Earth (23 hours 56 minutes). If observed at the same time each evening, the longitude of the Red Planet's central meridian recedes by about 9 degrees. As the evenings pass, you'll see Mars turn backwards and, after 40 days or so, the entire Martian surface will have passed before your eyes.

This effect can be seen in the sequence of images in **Figure 4:** Each thumbnail shows how Mars looks at weekly intervals, from the night of August 8-9 to the night of September 19-20, when the Red Planet culminates in the sky over Montreal. It takes about five weeks for the Tharsis volcanoes and the enormous Olympus Mons volcano to come full circle to about the middle of the disc (slightly less than the 40 days mentioned above, because we don't observe the planet at the same time every evening, but rather when Mars culminates). The most famous Martian regions visible to us over the evenings are Terra Sirenum, Solis Planum ("the Eye of Mars"), Terra Meridiani, Syrtis Major Planitia, a rather dark region, and its very bright neighbour Hellas Planitia, Elysium Planitia, among others.

Observe the Red Planet as often as possible, weather permitting. Look through the eyepiece and wait patiently for several minutes at a time to increase your chances of catching good views when the atmosphere settles enough to reveal as many Martian surface features as possible. But remember to take frequent breaks to rest your eye. Practice looking at Mars this summer, while the nights are still mild: You'll train your eye to spot and recognize the planet's various geographic areas. Gazing at the other planets and the rich details of the Moon can also serve as excellent training. These efforts will ensure you're ready for Mars when it's at its best for a few nights this fall. ★

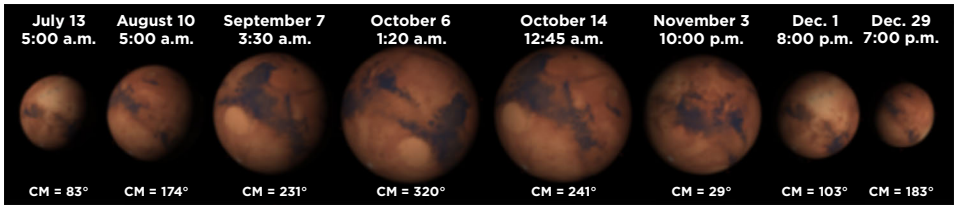



***Figure 2.*** *The disk of planet Mars at four-week intervals, from July to December, 2020. Each image shows the planet as it will appear at the indicated time, which corresponds to culmination in the sky above Montreal. Mars is closest to Earth during the night of October 6, but is truly at opposition one week later, during the night of October 13 to 14. "CM" indicates the planetographic longitude of the central meridian of the martian disk at that moment, which allows a direct comparison of the visible surface features with the planisphere in Figure 3, below. For example, Syrtis Major Planitia and Hellas Planitia are prominent on the views for September 7 as well as October 6 and 14. (Illustration: Rio Tinto Alcan Planetarium/Marc Jobin; Mars images: NASA/USGS)*

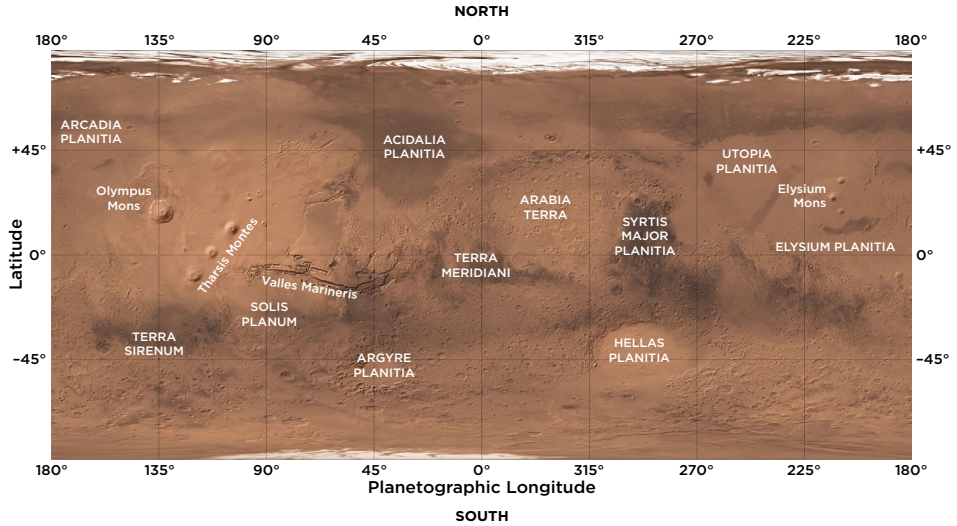



***Figure 3.*** *Planisphere of Mars. The most prominent features visible from Earth are identified according to the modern nomenclature. (Illustration: Rio Tinto Alcan Planetarium/Marc Jobin; Base map: NASA/USGS)*

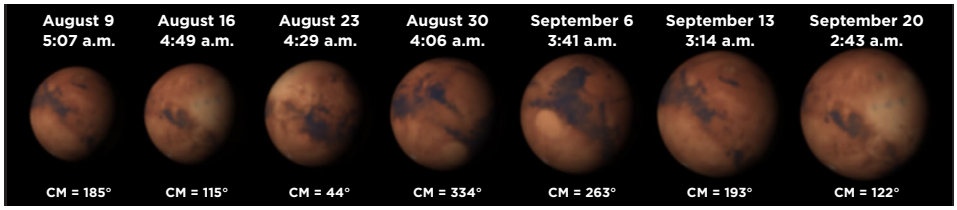
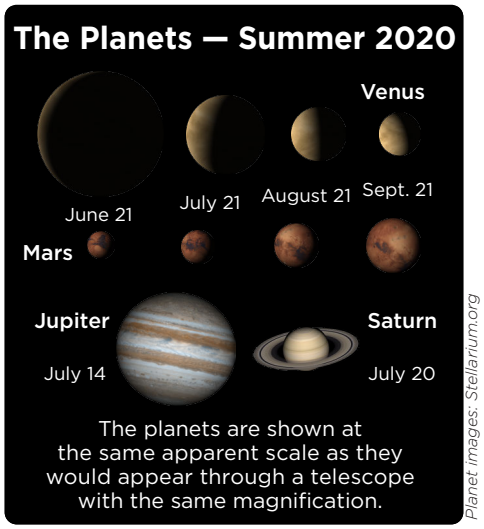



***Figure 4.*** *The disk of planet Mars at seven-day intervals over a period of 6 weeks, at the time it culminates above Montreal. The views for August 16 and September 20 are nearly identical. (Illustration: Planétarium Rio Tinto Alcan/Marc Jobin; Mars images: Stellarium.org)*




## SEASONAL MILESTONES

The **summer solstice** occurs on June 20, 2020 at 5:44 p.m. EDT, and the **autumn equinox** on September 22 at 9:31 a.m. Summer 2020 will last exactly 93 days 15 hours 47 minutes.

On July 4 at 2:35 a.m., Earth is at **aphelion,** its farthest point from the Sun, 152095295 km away.

## PHASES OF THE MOON

*(Eastern Daylight Time)*

| New moon | First quarter |
|---|---|
| June 21 at 2:41 | June 28 at 4:16 |
| July 20 at 13:33 | July 27 at 8:32 |
| August 18 at 22:42 | August 25 at 13:58 |
| September 17 at 7:00 | September 23 at 21:55 |
| **Full moon** | **Last quarter** |
| July 5 at 0:44 | July 12 at 19:29 |
| August 3 at 11:59 | August 11 at 12:45 |
| September 2 at 1:22 | September 10 at 5:26 |
| October 1 at 17:05 | October 9 at 20:39 |

Further details and more phenomena at espacepourlavie.ca/en/monthly-sky



# The Sky This Summer

*Jupiter and Saturn reach opposition within days of each other and form a striking pair in Sagittarius. Venus is now the Morning Star and shines gloriously at dawn, when Mercury pays it a brief visit.*

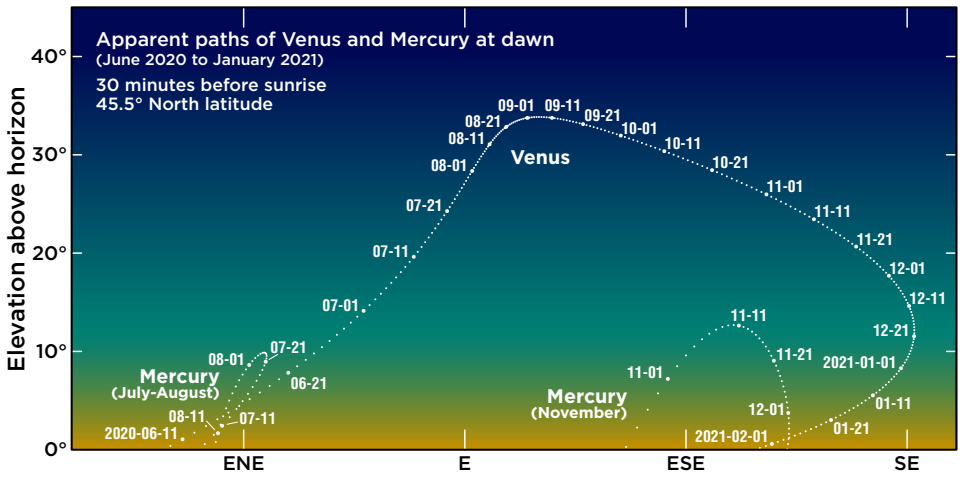
### Jupiter and Saturn, an epic duo

This year, **Jupiter** and **Saturn** form a striking duo as they straddle the border between the constellations of Sagittarius and Capricorn. This region of sky lies in the southernmost part of the ecliptic, so, like the January Sun, the two planets don't rise very high on the horizon, which hinders telescopic observations. For optimal viewing conditions, it's best to point your instruments at the planets when they're at their highest in the sky.

Jupiter undergoes its retrograde loop in the eastern part of Sagittarius from May 14 to September 12. Located a few degrees to the left of Jupiter, the much-fainter Saturn is also in retrograde motion from May 11 to September 28, moving to the right in relation to the background stars all summer long. The ringed planet has been in Capricorn since March 21, but it returns to Sagittarius on July 3 and will remain there until December.

Given their proximity in the sky, the two planets will reach opposition within a few days of each other. Jupiter gets there first, **on July 14,** and passes closest to Earth the next day, at a distance of 4.139 astronomical units (au) and shining at magnitude –2.8. **On July 20,** it's Saturn's turn to reach opposition, more than twice as far away from us (8.995 au) as Jupiter and considerably fainter than its neighbour at magnitude +0.1. In early summer, the two gas giants emerge above the southeastern horizon around 11 p.m., then about 30 minutes earlier each week. Once they reach opposition, in mid-July, the pair rise at sunset, set at sunrise, and remain visible all night. Jupiter and Saturn culminate in the south increasingly earlier as the summer unfolds, providing great observing opportunities.

For an eye-catching show, check out both planets through a telescope. Jupiter appears as a ball, slightly flattened at its poles, with an equatorial diameter of 47.6 arc seconds at opposition, striped with lighter and darker parallel cloud bands revealing a feast of details. Keep a close eye on its four Galilean moons and you'll see their configuration change from hour to hour. Saturn also draws our attention, but for different reasons. The planet itself is already smaller than Jupiter, and since it lies much farther out in space, its disc is only 18.4 arc seconds in diameter. Saturn's atmosphere is also less active than that of Jupiter, and its cloud bands are much less distinct and colourful. On the flip side, its spectacular rings span 41.6 arc seconds and, at equal magnification, appear almost as large as Jupiter. This year, the rings are still tilted about 21.7 degrees toward Earth, showing their northern face.




**On the evening and night of July 5-6,** the waning gibbous Moon forms an outstanding triangle with Jupiter and Saturn; as the hours advance, you'll notice the triangle become slightly distorted due to the Moon's movement throughout the night. A similar scene will play out **on the evening and night of August 1-2,** when the waxing gibbous Moon again forms a nice triangle with the two giants. Finally, **on the evening and night of August 28-29,** the waxing gibbous Moon lies only 2 degrees below Jupiter, forming a long triangle with Saturn. The next night, the waxing gibbous Moon hangs a few degrees to the lower left of Saturn.

### Venus glows at dawn

Following a fabulous apparition in the evening sky throughout winter and spring, flashy **Venus** maintains this momentum and ups its game in the morning sky in the second half of 2020. Because of the ecliptic's favourable inclination to the eastern horizon at dawn at this time of year, the dazzling Morning Star quickly re-emerges after moving through inferior conjunction on June 3: As early as mid-June, it can be seen low on the east-northeastern horizon 30 minutes before sunrise and rises higher each morning (see diagram). Venus reaches its peak during the first week of September, more than 30 degrees above the eastern horizon at dawn; at that point, it rises nearly four hours before the Sun. Come fall, Venus will gradually sink lower as it draws closer to the Sun, eventually vanishing by the end of January 2021.

Be sure to check out Venus through a telescope. You'll see the planet go through phases just like our Moon: As the summer unfolds, Venus transforms from thin crescent to gibbous, while its disc decreases in size the farther away it gets from Earth. At the end of summer, Venus will appear three times smaller than at the start of the season!

**From July 5 to 12,** at the end of the night and at dawn, admire Venus as it glides through the Hyades, a large cluster of stars located in the constellation Taurus and easily visible to the naked eye; grab your binoculars for a spectacular show! **On July 11 and 12,** the Morning Star lies a scant 1 degree from Aldebaran, the alpha star in Taurus. **On the morning of July 17,** the thin waning Moon will hang 2½ degrees to the upper left of Venus. Then, **on the morning of August 15,** it will be 3½ degrees above Venus. Finally, **from September 12 to 14,** Venus passes less than 2½ degrees below the Beehive cluster (M44), visible through binoculars in the constellation Cancer; **on the morning of the 14th,** the thin waning Moon rejoins the show and can be seen 4½ degrees to the left of Venus, just below M44.

### Mercury has a good morning apparition

Like its neighbour Venus, **Mercury** is enjoying favourable conditions for its morning apparitions in the latter half of the year. From mid-July to the first week of August, the tiny planet can be found very low on the east-northeastern horizon at dawn, 30 to 45 minutes before sunrise; it reaches its maximum height above the horizon around July 25. During this viewing window, Mercury slowly gains in brightness and becomes easier to spot in the first glow of daybreak. Binoculars can help you locate it. The thin lunar crescent will lie 4 degrees to Mercury's left on the morning of July 19. An even more favourable apparition above the east-southeastern horizon will occur in November, with the planet reaching its peak on the 11th.

*Clear skies!*

Research and text: **Marc Jobin**

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