The Pocket Planetarium ★

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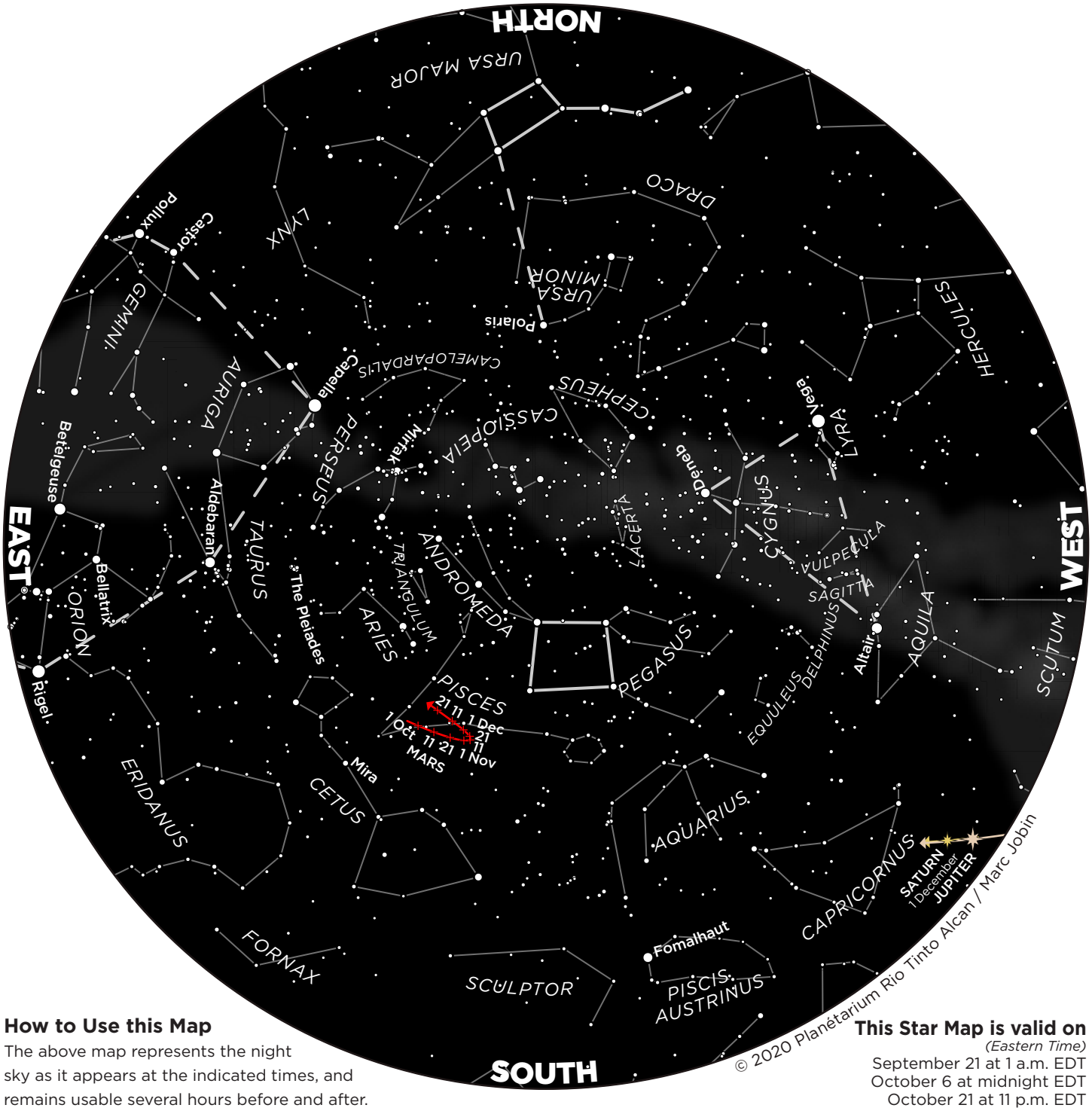
Astronomical Information Newsletter of the Rio Tinto Alcan Planetarium

The Starry Sky — Autumn 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 Time)

September 21 at 1 a.m. EDT
October 6 at midnight EDT
October 21 at 11 p.m. EDT
November 6 at 9 p.m. EST
November 21 at 8 p.m. EST
December 6 at 7 p.m. EST

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The 2020 opposition of Mars: Act 2

Fall 2020 offers the best conditions in 15 years for observing Mars, so make sure to get out there and take a look. Let us guide you!

The Red Planet is so tiny that Martian oppositions are eagerly awaited by astronomers hoping for a chance to capture hints of obscure surface details. These viewing periods during which Earth and Mars are on the same side of the Sun only last a few weeks and occur about every 26 months. The gap between the two planets closes to a minimum, and Mars finally grows to a respectable size (as seen through our telescopes). But some oppositions are much more favourable than others, first because the Earth-Mars distance is much narrower than usual, but also because the Red Planet climbs much higher in the sky, which is great for telescope viewing.

The 2020 Mars opposition meets the criteria for an exceptional event. In October, Mars will come to within just 0.415 a.u. of Earth (one a.u., or astronomical unit, is about 150 million kilometres) and grow to an apparent diameter of 22.6 arc seconds as viewed through a telescope. That's 10% smaller than during its record-close opposition in August 2003 (25.1 arc seconds), but this time, Mars will peak at an altitude of more than 50 degrees in the sky—far better than the 30 degrees it reached 17 years ago. Quebec astronomers have much to look forward to!

Mars with the naked eye

Usually inconspicuous, the Red Planet brightens dramatically as it approaches opposition. This year, it will even outshine Jupiter for a few days (magnitude –2.6 for Mars compared to –2.4 for Jupiter). (Note, however, that at the time of its own opposition last July, the giant planet was somewhat brighter, at magnitude –2.7.) You can't miss this orange dot that appears to be the only orb shining among the stars of the vast but unremarkable constellation Pisces!

In early fall, the Red Planet can be spotted above the eastern horizon at 8:30 p.m. and culminates around 2:30 a.m. In the days around opposition, Mars rises at twilight, culminates in the south in the middle of the night, and sets at dawn. Mars rises increasingly earlier with each passing week: As fall progresses, the planet climbs high enough (more than 30 degrees above the horizon) at a more convenient hour, making it easier to observe in the evening. By late October, the Red Planet will be well positioned between 8 p.m. and 3 a.m.

From September 9 to November 13, Mars is in retrograde motion, i.e., moving westward (to the right) with respect to the background stars. This is an illusion caused when the Earth, closer to the Sun and moving faster in its orbit, catches up with and overtakes the Red Planet in a sort of unfair race around the Sun. Pay particular attention to the stars around Mars (binoculars will help): These guideposts can help you track the Red Planet's path through the sky over the coming weeks and even months.

The Moon encounters Mars

Our Moon approaches Mars several times this fall, and some of these encounters will be spectacular. For example, **on the night of October 2-3,** a few days before opposition, the waning (but still full-looking) gibbous Moon moves to within just 1 degree below the brilliant Red Planet; the pair can be found in the south-southeast in the middle of the night. **On the evening of October 29,** the waning gibbous Moon lies a mere 4 degrees below Mars, but the gap between the two widens throughout the night. **On the evening and night of November 25-26,** the waxing gibbous Moon passes 5 degrees below the Red Planet; the closest approach occurs around 9:30 p.m., with both celestial bodies shining very high in the south-southwest.

Mars through the eyepiece

The opposition of Mars—when the Sun, Earth and Red Planet are aligned when projected on the plane of the Solar System—officially occurs on the night of October 13-14, 2020. At that moment, the Earth-Mars distance is 0.419 a.u. (62.7 million kilometres), and Mars (at magnitude –2.6) spans 22.33 arc seconds across. But the Red Planet actually gets closest to Earth a week earlier, on October 6, when it is 0.415 a.u. (62.1 million kilometres) away from us and reaches an apparent diameter of 22.56 arc seconds. This difference of several days between geometric opposition and the moment when Earth and Mars reach their closest point happens because the orbits of the two planets are not perfectly circular and concentric.

The conditions for observing Mars will be excellent in the first half of fall: The planet's disc has been more than 20 arc seconds wide since September 4 and will remain so until November 3; its apparent diameter will be greater than 15 arc seconds until November 30. Moreover, at our latitudes, Mars culminates about 50 degrees above the southern horizon, allowing us to catch a glimpse as it hangs above the most turbulent layers of our atmosphere.

The rotational period of Mars (24 hours 37 minutes) is slightly longer than that of Earth (23 hours 56 minutes). This means that we need to look up 37 minutes later each evening in order to observe the same Martian hemisphere that faced Earth the day before. But if we look up at the same time every evening, the Red Planet doesn't have enough time to complete a full rotation and return to the same point as the previous night: This is why Mars doesn't always show us the same face from one day to the next. In addition, Mars culminates a few minutes earlier every evening, so we'll want to increasingly move up our viewing time to enjoy this great opportunity: All in all the longitude of the Red Planet's central meridian recedes by about 10 degrees per day when consistently observed at its most favourable moment. This stroboscopic effect makes Mars appear to turn backwards. After about 35 days, or 5 weeks, the entire planet will have passed before our eyes. In reality, though, unless you just want a quick glance, telescope observing sessions are not typically a snappy activity, but rather one that should extend over many minutes, if not hours!

Exploring the Red Planet

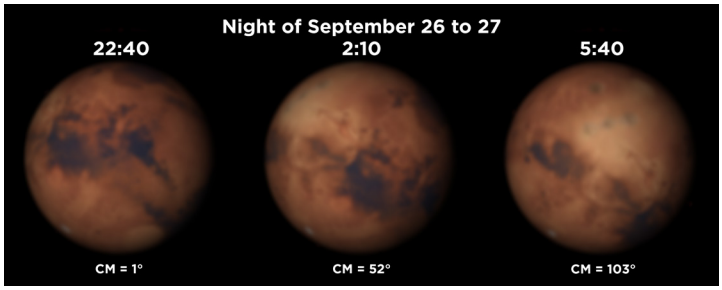
The sequence of images in **Figures 1, 2, and 3** (facing page) show the Red Planet's rotation over several hours during a given night, in the most favourable weeks surrounding Mars's opposition. In each trio of images, the first and last show the planet's appearance when it reaches 30 degrees above the horizon, and the middle image shows when it culminates in the south. Since Mars climbs high enough in the sky, the planet is visible for several hours under very good conditions; this provides an opportunity over a period of four weeks to observe a large portion of the Red Planet's rotation and to discover most of its surface features.

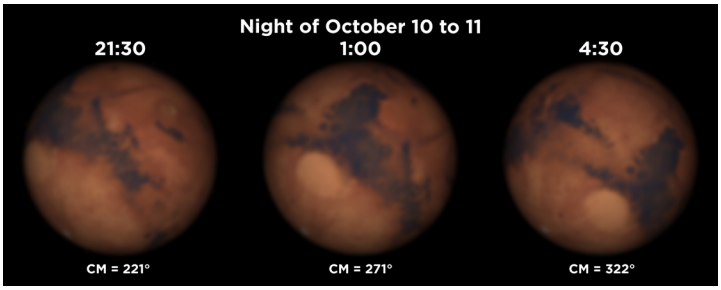
For a few hours on the night of September 27-28 **(Figure 1),** we'll be able to explore the regions to the west of Meridiani Planum: Valles Marineris, Solis Planum ("the Eye of Mars"), Terra Sirenum, the Tharsis volcanoes and the famous Olympus Mons volcano, whose peaks rise above the occasional fog in the low-lying areas. The frost or clouds that crown their summits sometimes make them shine brighter.

On the night of October 10-11 **(Figure 2),** Syrtis Major Planitia steals the show right in the middle of opposition: This vaguely triangular-shaped region is one of the darkest on the Martian surface and perhaps the easiest to spot. Curiously, its neighbour Hellas Planitia is one of the brightest regions, effectively providing a dramatic contrast. Moreover, Hellas is also enveloped in fog, which reflects the Sun's light particularly well.

Finally, the night of October 24-25 **(Figure 3)** will be a good time to examine Solis Planum, Terra Sirenum, the Tharsis and Olympus Mons volcanoes, as well as Elysium Planitia and the Elysium Mons volcano.

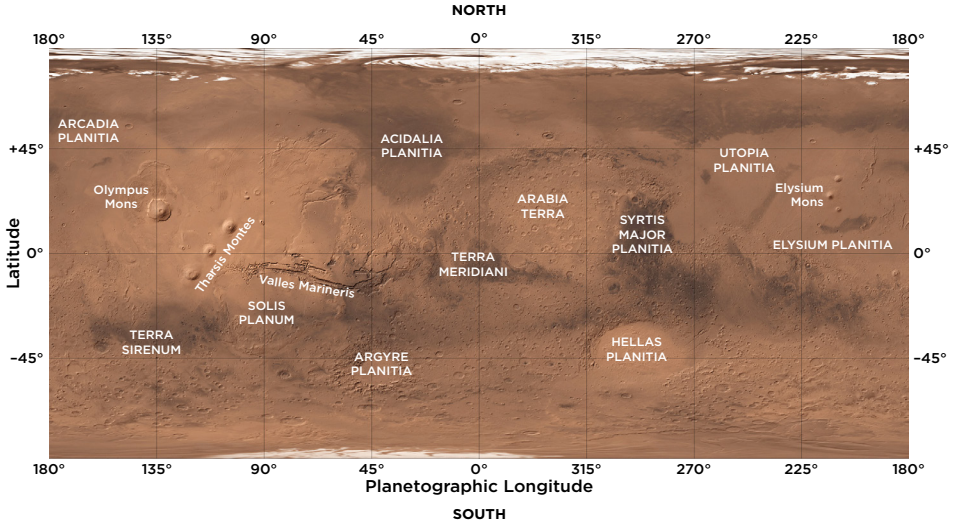
The October 2020 Martian opposition is especially promising, even exceptional. We can only hope that the dust storms that interfered with viewing during the previous opposition don't hinder our efforts this time around; after all, it *is* dust storm season in the Red Planet's southern hemisphere. ★





Figures 1 to 3 (left to right, top to bottom). *The rotation of planet Mars over a period of several hours on three nights chosen at two-week intervals around the time of opposition. In ech set of three images, the first and last show the red planet as it will appear when it reaches 30 degrees above the horizon, while the middle one corresponds to culmination, i.e. when Mars is highest in the sky above Montreal. Celestial North is at top. The "CM" figures indicate the planetographic longitude of the central meridian of the martian disk at these selected moments, which allows a direct comparison of the visible surface features with the planisphere in Figure 4, below. For example, Syrtis Major Planitia and Hellas Planitia are prominent on the middle view for the night of October 11 to 12.*
(Ill.: Rio Tinto Alcan Planetarium/Marc Jobin; Mars images: Stellarium.org)

Figure 4 (at right). *This Planisphere of Mars can be used to identify the most prominent features visible from Earth; they are labeled according to the modern nomenclature.*
(Map: Rio Tinto Alcan Planetarium/Marc Jobin; Base map: NASA/USGS)



PHASES OF THE MOON

*(Eastern Daylight Time, except * = Eastern Standard Time)*

New moon	First quarter
September 17 at 7:00	September 23 at 21:55
October 16 at 15:31	October 23 at 9:23
November 15 at 0:07*	November 21 at 23:45*
December 14 at 11:16*	December 21 at 18:41*
Full moon	**Last quarter**
October 1 at 17:05	October 9 at 20:39
October 31 at 10:49	November 8 at 8:46*
November 30 at 4:30*	December 7 at 19:37*
December 29 at 22:28*	January 6 at 4:37*

Trio of fall meteor showers

Fall is known for its succession of moderately active meteor showers, but astronomical conditions are not always favourable, and the often dreary weather can dampen viewing efforts! Here are the top three to watch out for, in order of appearance date:

The Orionids will reach their peak on October 21. Although considered one of the least showy of the annual meteor showers, the Orionids are long-lasting, with a very broad maximum. Here's an interesting fact: Their claim to fame comes from being the product of the famous Halley's Comet (just like the Eta Aquarids in May). While generally faint, Orionid meteors are among the fastest, entering the Earth's atmosphere at a blazing speed of 67 kilometres per second! They often explode in terminal bursts that sometimes leave persistent trains behind them. The radiant is in the upper left portion of the constellation Orion; it rises around 10 p.m., reaches a reasonable height after midnight and culminates at dawn. This year, the waxing Moon sets early, making for good viewing conditions after 11 p.m., with rates reaching from 10 to 15 meteors an hour under dark country skies.

The famous Leonids are expected to peak in the early hours of November 17, at about 6 a.m. ET. Aside from the spectacular "meteor storms" that have made the Leonids famous, it is typically a weak meteor shower. It comes from the dust grains left behind by the comet 55P/Tempel-Tuttle, which last passed perihelion in 1998 and is only due to swing past the Sun again in 2031. This year, the models forecast that Earth will cross a stream of dust left behind by the comet in the year 1600; this encounter will take place between 1:50 a.m. and 3:13 a.m. during the night of peak activity, but the meteors are expected to be rather faint, so the spike in activity will be difficult to detect. The Leonid radiant rises above the horizon only after midnight and culminates at dawn. The thin lunar crescent will set during the early evening hours, making for perfect viewing conditions.

The Geminids are expected to peak around 8 p.m. on December 13. They're considered the most consistent and reliable meteor shower year after year, and are also one of the most prolific, alongside the Quadrantids, even surpassing the well-known Perseids. The Geminids produce slow-moving but brighter meteors. In 2020, the moonless sky (the new Moon occurs on the 14th) will provide near-perfect conditions at nightfall during peak activity. In fact, the Geminid radiant is visible all night long and culminates around 2 a.m. And with the maximum expected in the evening hours, this could be a banner year for the Geminids, with rates exceeding 50 meteors per hour under clear and reasonably dark skies.

Although peak activity is rather short, remember that each of these meteor showers remains active over a much longer period of time, sometimes up to several weeks. This means you should definitely be able to spot a few meteors from any one of these showers during fall nights spent under the stars. So keep an eye on the sky!

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

The Sky This Autumn

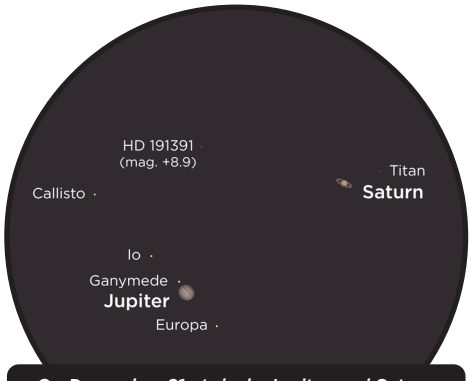
Mars is the undisputed star of the autumn sky, but don't overlook the other bright planets: Jupiter and Saturn slowly converge on each other at nightfall, and Venus is spectacular at dawn. Even Mercury makes a fine morning appearance.

Jupiter and Saturn draw closer together

As they make their journeys around the Sun this year, the gas giants **Jupiter** and **Saturn** are slowly converging on each other in the sky. Come fall, this majestic duo can be found in the eastern part of the constellation Sagittarius, near the boundary of Capricorn. Until the end of October, Jupiter (the brightest of the pair, on the right) and Saturn (on the left) appear above the southern horizon shortly after sunset, so early evening is a great time to check them out in a telescope while you wait for Mars to climb high enough for a good view. You'll be wowed by Jupiter's clouds and moons and Saturn's famous rings. During the evening, Jupiter and Saturn sink into the southwestern horizon, setting there around midnight in late September and increasingly earlier as fall progresses.

Pay special attention to the gap between both planets—no instruments needed. After spending a few weeks this summer in retrograde motion, Jupiter has resumed its direct (eastward) motion with respect to the background stars, and Saturn follows suit on September 28. But Jupiter moves faster and is catching up to Saturn (orbital period of about 12 years compared to more than 29 years). In early fall, the giant planet lies a little less than 8 degrees to the right of the ringed planet. This gap gradually narrows as the weeks go by, until the ultimate meet-up between the two: **On December 21 at twilight,** Jupiter passes a mere 6 arc minutes below Saturn, or the equivalent of just one-fifth the diameter of the Moon! Although this conjunction takes place low on the southwestern horizon at twilight, you'll get a very rare chance to view both planets in the same telescope field of view: A truly magical moment!

The Moon snuggles up to the Jupiter-Saturn pair several times this fall. **In the late evening on September 24,** the waxing gibbous Moon swings 3 degrees below Jupiter. **The next evening, on September 25,** it can be seen 3½ degrees below Saturn, with Jupiter on the right to complete the triangle. **On the evening of October 22,** the lunar crescent, Jupiter and Saturn form an outstanding triangle. The crescent Moon rejoins our planetary duo **on the evenings of November 18 and 19,** and again **on December 16 and 17 at twilight** when Jupiter and Saturn will be a scant ½ degree apart!



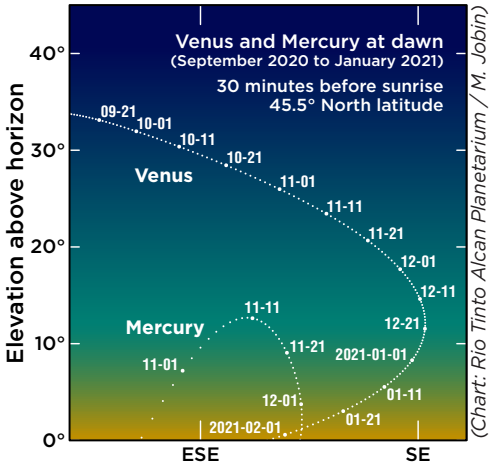
On December 21 at dusk, Jupiter and Saturn share the same telescopic field of view. (Ill.: Rio Tinto Alcan Planetarium/Marc Jobin; base image: Stellarium.org)

Venus, the beautiful Morning Star

Since early summer, dazzling **Venus** has been dominating the horizon at the end of the night and at dawn. Its glorious apparition continues throughout the fall, but the Morning Star gradually loses altitude while gliding ever so slowly towards the southeast. In early October, Venus shines like a spotlight about 25 degrees above the eastern horizon, one hour before sunrise. One month later, it sinks to a height of 20 or so degrees in the east-southeast. By early December, the planet stands only a dozen degrees high in the southeast. It then rapidly falls downward in December and in early 2021; this is unsurprising, since Venus will pass behind the Sun (superior conjunction) come March.

A small telescope is all you need to clearly make out Venus's phases, much like those of the Moon, from Earth's perspective. This fall, the planet appears "gibbous" and increasingly "full," while its disc decreases in size (from 16 to 11 arc seconds) the farther away it gets from us.

During its orbits, the Moon swings relatively close to Venus every month. Some of these encounters are quite impressive. **On the morning of November 12,** at the end of the night and at dawn, the thin waning Moon can be seen shining 6½ degrees above Venus in the east-southeast. **The next morning, on November 13,** the very thin crescent will appear much closer to the horizon, this time positioned between Venus (7½ degrees above) and Mercury (5 degrees below). Observe the scene at dawn, 45 minutes before the Sun comes up. Also at dawn, **on the morning of December 12,** the very thin crescent Moon will hang only 4½ degrees to the upper right of Venus, low on the southeastern horizon.



(Chart: Rio Tinto Alcan Planetarium / M. Jobin)

An excellent morning apparition for Mercury

Mercury is the closest planet to the Sun, so the only way to catch a glimpse is to take advantage of the short windows of opportunity when the planet is at its farthest from the Sun and sufficiently high above the horizon. Both conditions are met throughout November, when Mercury makes its best appearance of the year in the morning sky. Look for the tiny planet on the east-southeastern horizon at dawn, about 45-60 minutes before sunrise. Too faint to be easily detected before November 1, Mercury is much brighter at the end of this appearance, but it quickly loses altitude after December 1. Its best visibility occurs around November 10, when it reaches greatest elongation 19 degrees west (to the right) of the Sun: At that moment, the tiny planet can even be spotted in a still-dark sky, 90 minutes before sunrise. Binoculars can help you locate it, but you should be able to see it with the eye alone. **On the morning of November 13,** the very thin crescent Moon lies 5 degrees above Mercury and 7½ degrees below Venus.

Clear skies!

Research and text: **Marc Jobin**

SEASONAL MILESTONES

The **autumn equinox** occurs on September 22 at 9:31 a.m. EDT, and the **winter solstice** on December 21 at 5:02 a.m. EST. Autumn 2020 will last exactly 89 days 20 hours 31 minutes.

We return to Eastern Standard Time early on Sunday morning, November 1: Clocks are set back one hour.

The Pocket Planetarium *is a seasonal information newsletter published by the Rio Tinto Alcan Planetarium, 4801, avenue Pierre-De Coubertin, Montréal (Québec) H1V 3V4*
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