The Pocket Planetarium ★

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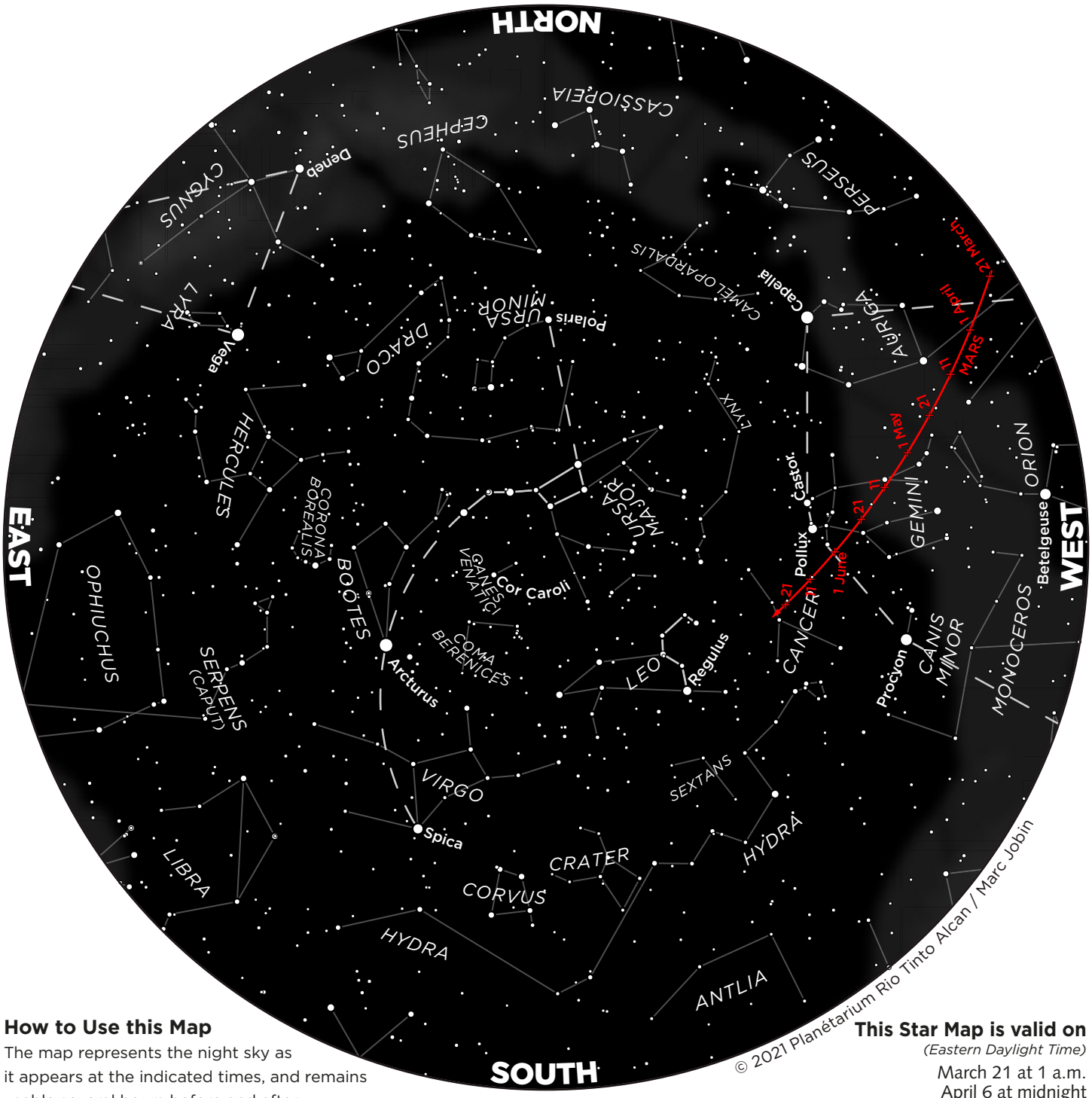
The Starry Sky — Spring 2021



How to Use this Map

The 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 grey shaded area outlines the Milky Way.

This Star Map is valid on

(Eastern Daylight Time)

March 21 at 1 a.m.
April 6 at midnight
April 21 at 11 p.m.
May 6 at 10 p.m.
May 21 at 9 p.m.

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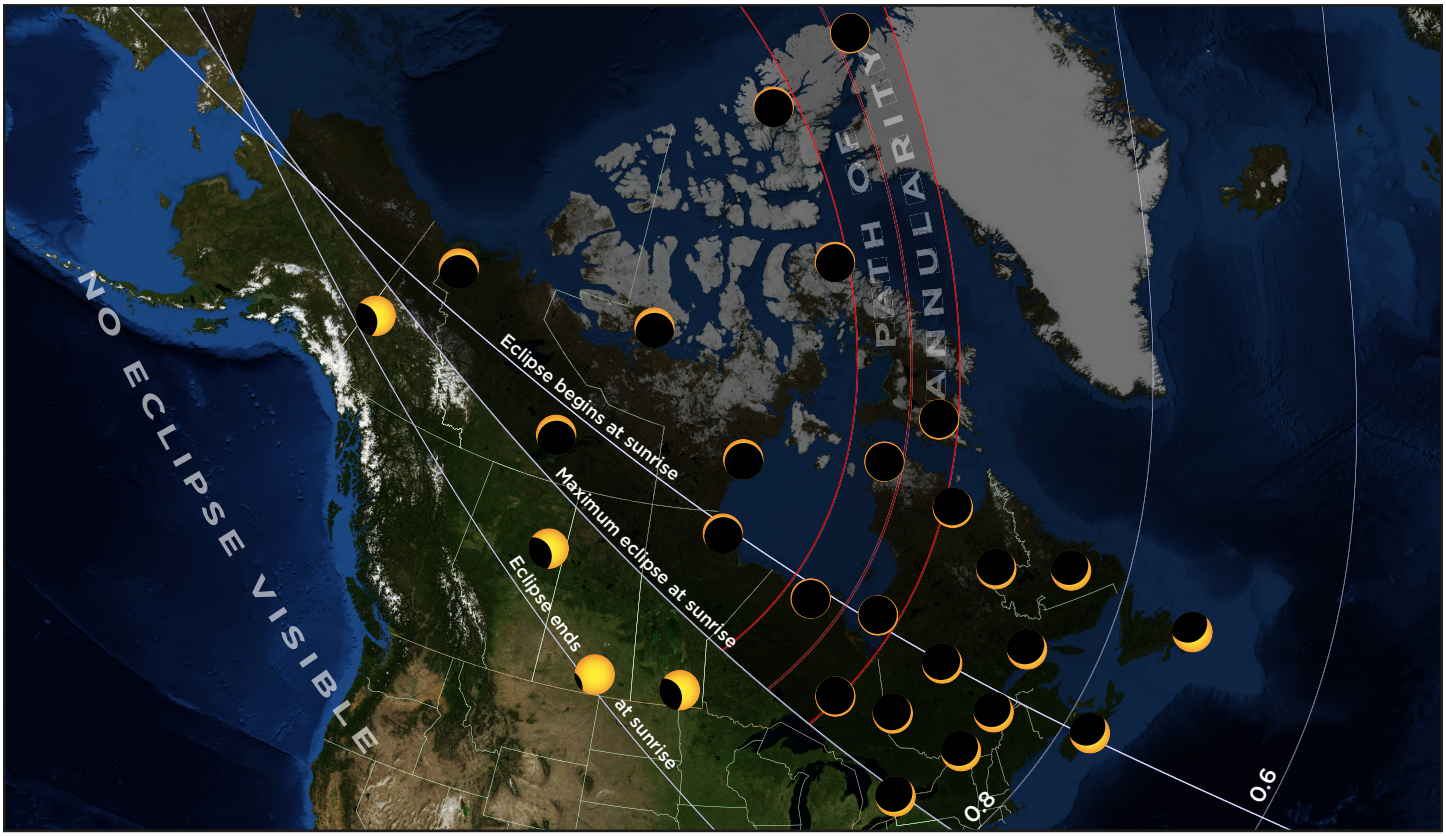
An Annular Eclipse of the Sun

The Sun has a meet-up with the Moon on June 10...
and part of the show will play out in the sky above Quebec!



The appearance of the June 10, 2021 Solar Eclipse from various locations across Canada. Numbered lines indicate the magnitude of the eclipses, which decreases away from the path of annularity. (Calculations and plotting: Rio Tinto Alcan Planetarium/ Marc Jobin; Earth background texture: NASA)

Solar eclipses are due to a remarkable coincidence of nature: The Sun is about 400 times larger than the Moon, but it is also about 400 times farther from Earth. That's why these two celestial bodies have nearly the same apparent size in the sky—about half a degree. When the alignment is favourable, the Moon completely covers the dazzling surface of our star during what's called a total eclipse of the Sun and reveals its mysterious and mesmerizing atmosphere, the corona.

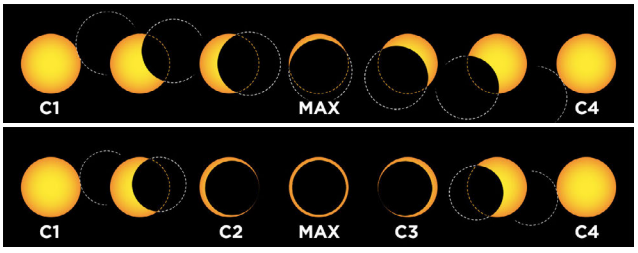
An annular eclipse occurs when the Moon is too far away from the Earth to completely cover the solar disc. At maximum eclipse, the Moon's dark silhouette is surrounded by a bright ring—or annulus—of light, after which the phenomenon is named. That's the show that awaits us on June 10, 2021: The solar disc will be 31.51 arc minutes in diameter, whereas the Moon will be only 29.56 arc minutes wide.

The zone in which the June 10 eclipse will truly be annular resembles a long band that sweeps across the top of the Earth. This "path of annularity" begins at sunrise in northern Ontario and quickly travels over James Bay and Hudson Bay, heading north over the western part of Nunavik. After crossing the Hudson Strait, the band of totality passes through several Canadian Arctic islands (Baffin, Ellesmere) in Nunavut, as well as the northwestern tip of Greenland. The band of totality continues on to cover the North Pole and then races southward before making landfall again in eastern Siberia, where the annular eclipse finally ends at sunset. On either side of the path of annularity, there are larger zones where the eclipse is partial to some degree, incrementally decreasing the farther you get from the edge of the path.

Within the path of annularity

In Quebec, several Cree and Inuit communities will find themselves inside the path of annularity: Northward from Wemindji, all the villages located along the coasts of James Bay and Hudson Bay will be treated to an annular eclipse. The same will be true for communities along Hudson Strait, including those located in the northwestern part of Ungava Bay down to Kangirsuk.

Very few Quebec towns accessible by land will get to observe an annular eclipse on June 10. However, one Cree village—**Chisasibi** (53.8°N, 78.9°W)—will be located deep within the path of annularity, at the end of James Bay Road, 1,400 kilometres from Montreal and downstream from the La Grande-1 power station. The Sun rises there at 4:51 a.m. (EDT); first contact **(C1),** which marks the beginning of the partial phases, occurs a few minutes later, at 4:56:52 a.m. (EDT). The Moon's silhouette gradually appears from the right, at the "2 o'clock" position on the Sun's disc. The eclipse becomes annular at second contact **(C2),** expected at 5:52:51 a.m., when the edge of the Moon touches the inside edge of the solar disc. The annular



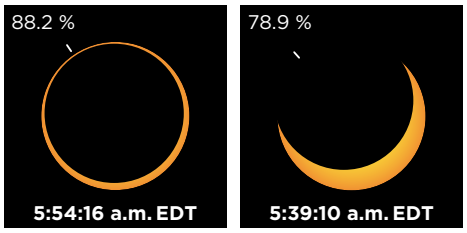
*The diagram at right shows the major steps of a typical partial solar eclipse (top) or an annular eclipse (bottom). **Contacts** (identified from C1 to C4) mark the beginning or end of the main stages of an eclipse. (PRTA/Marc Jobin)*

phase lasts 2 minutes and 49 seconds and ends with third contact **(C3)** at 5:55:41 a.m. The annular eclipse reaches its **maximum** at 5:54:16 a.m., with the Moon covering 88.2% of the Sun's surface. The Sun-Moon duo will stand only 7 degrees above the east-northeastern horizon (azimuth 61°). Fourth contact **(C4)** occurs at 6:55:07 a.m. and marks the end of the eclipse.

Partial eclipse elsewhere

Elsewhere in Quebec, the eclipse will be partial and increasingly shallower the further we move away from the path of annularity. In the area southwest of a line running from the middle of the eastern shore of James Bay and passing through Mistassini Lake, the mouth of the Saguenay River and Lake Témiscouata, the eclipse begins before sunrise; this means that when the Sun finally appears above the horizon, it will already be partially eclipsed, making for some eye-catching scenes. This will be the case in Quebec's major urban centres.

For example, in **Montreal** (45.5°N, 73.5°W), first contact **(C1)** occurs at 4:43:15 a.m. (EDT), making this a "virtual" eclipse, since the Sun has not yet risen. When the Sun breaks free of the horizon, at around 5:10 a.m., it will appear as a thick crescent, with 35% of its surface already hidden by the Moon. The partial eclipse will reach its **maximum** at 5:39:10 a.m., with the Moon covering 78.9% of the surface of the Sun, which hangs a mere 4 degrees above the east-northeastern horizon (azimuth 61°). The eclipse ends with fourth contact **(C4),** at 6:38:58 a.m.



Chisasibi QC **Montréal QC**

Appearance of the Sun at maximum eclipse in Chisasibi and Montréal. (Rio Tinto Alcan Planetarium/ Marc Jobin)

Don't forget those filters!

Whether you're observing an annular or partial eclipse, the precautions are the same: Since the object of interest is the Sun, **the use of appropriate, approved filters is a must in order to protect your eyes and optical instruments.** But the situation may be somewhat more complicated due to the particular circumstances of this eclipse. Since the Sun will be very low on the horizon, its light will have to travel much farther through the Earth's atmosphere. The presence of haze, dust, smoke, and other aerosols will greatly reduce the Sun's intensity, but the infrared radiation still presents a serious danger to our retinas. Even if the Sun appears too dark through filters specifically designed for solar observations, whether it be with the naked eye, through an instrument, or in a camera viewfinder, you must not remove them. The easiest way to protect your vision is by using projection methods or by looking at the eclipse indirectly, for example, on your digital camera's display.

Admittedly, an annular eclipse does not elicit the same level of excitement as a total eclipse does with its "night" in broad daylight and the almost magical appearance of the solar corona. But don't underestimate the beauty of a "ring of fire," especially when observed so close to the horizon, as will be the case with this eclipse from several locations. The crescent-shaped Sun rising skyward will offer an equally unique sight—one that is just as worthy of our attention. In short, there's a lot for photographers to get excited about.

To learn more about the eclipse, including maps and timings, check out the detailed information at

espacepourlavie.ca/en/eclipse2021

SEASONAL MILESTONES

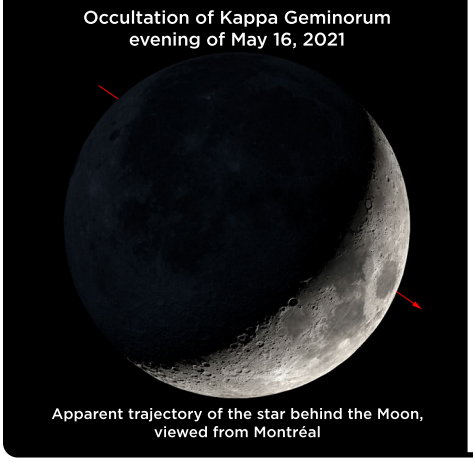
The **spring equinox** occurs on March 20, 2021 at 5:37 a.m. EDT, and the **summer solstice** on June 20 at 11:32 p.m. Spring 2020 will last exactly 92 days 17 hours 55 minutes.

PHASES OF THE MOON

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

New moon	First quarter
March 13 at 5:21*	March 21 at 10:40
April 11 at 22:31	April 20 at 2:59
May 11 at 15:00	May 19 at 15:13
June 10 at 6:53	June 17 at 23:54
Full moon	**Last quarter**
March 28 at 14:48	April 4 at 6:02
April 26 at 23:31	May 3 at 15:50
May 26 at 7:14	June 2 at 3:24
June 24 at 14:40	July 1 at 17:11

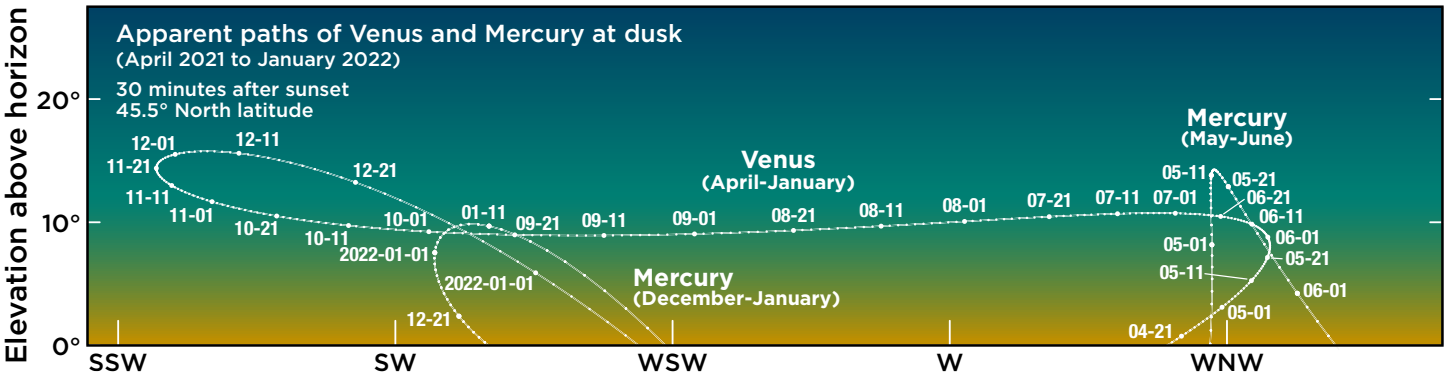
A FINE LUNAR OCCULTATION



Lunar occultations of relatively bright stars don't occur very often, even less so under favourable conditions. This one's a must-see, especially if you have never had the chance to observe such a phenomenon. **On the evening of May 16,** a 23%-illuminated, five-day-old crescent Moon passes in front of Kappa Geminorum, a giant yellow star of magnitude +3.6 located below Pollux in the constellation Gemini.

In Montreal, the star is expected to disappear behind the Moon's dark limb at 9:29:23 p.m. EDT; the phenomenon takes place 32 degrees above the western horizon. When the star reappears on the illuminated side of the crescent one hour later, at 10:30:26 p.m., the two celestial bodies will be only 22 degrees high. (Take note: The exact timing of a star's disappearance and reappearance depends on the observer's geographical location and is provided here for reference only.) Aim your telescope at the star and look for the approaching lunar disc, faintly illuminated by earthshine. Feel free to zoom in on the star!

The most surprising part of an occultation is how quickly a star disappears or reappears: Everything happens in a split second, literally in the blink of an eye. Kappa Geminorum is in fact a binary star system located about 140 light-years from Earth, but its companion (at magnitude +9) is very difficult to observe due to the difference in brightness and its proximity to the primary component.



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

The Sky This Spring

Mars remains visible in the evening sky as it continues to flee from the Sun this spring. And while Venus makes a timid entrance, Mercury puts in a fine appearance at twilight. Saturn and Jupiter rise increasingly earlier and shine brightly at night's end.

Mars's gradual decline

Last fall's stunning Martian opposition is now only a distant memory. The Red Planet is receding from Earth, shrinking ever smaller in our telescopes. Look skyward and you'll notice its brightness fade from week to week as it dashes eastward through the constellations. As spring arrives, **Mars** can be found shining among the stars of Taurus, after which it enters Gemini on April 24 and crosses into Cancer on June 8. This journey allows the planet to maintain some distance from the Sun and to remain quite high in the sky at nightfall: By the end of March, Mars can still be seen about 50 degrees above the west-southwestern horizon, slightly higher than the Hyades star cluster and the orange star Aldebaran, after which it sets in the northwest past 1 a.m. But as the season progresses and the Sun catches up to the Red Planet, the gap between the two narrows, with Mars appearing lower and lower in the early evening. At the beginning of May, the Red Planet shines at magnitude +1.6, about 40 degrees above the western horizon as twilight comes on, and sets at half-past midnight. By mid-June, it stands only some twenty degrees high at nightfall and sets around 11 p.m. Mars disappears from view later in the summer.

During the **evening of April 16,** the gibbous Moon gradually comes to within 4½ degrees below Mars; at twilight the next day, on April 17, the crescent Moon can be found 5 degrees to the upper left of the Red Planet. **On May 15 at twilight,** the thin crescent Moon lies a mere 2½ degrees to the lower right of Mars and moves to within just 1½ degrees during the evening; note the twin stars, Castor and Pollux, shining above. **On June 13 at twilight,** low on the western horizon, the thin crescent Moon hangs 2½ degrees above the Red Planet; notice how Castor and Pollux have now moved to the right of the Moon-Mars duo.

Mercury at dusk

Mercury makes its best appearance in the evening sky this spring. **From April 24 to May 28,** look for the tiny planet above the west-northwestern horizon 30 to 45 minutes after sunset. **(See the diagram at bottom of page 3.)** It reaches its greatest elongation 22 degrees east of our star, the Sun, on May 17. Mercury is considerably brighter at the start of this viewing window and quickly dims after May 20 as it falls back toward the Sun's glare. In fact, viewing conditions will be optimal between April 30 and May 21, with Mercury being too low in the sky before and too faint after this period. On May 13 at twilight, the very thin lunar crescent lies 3 degrees to the left of Mercury.

Venus emerges at twilight

On March 26, **Venus** arrives at superior conjunction, meaning it is on the far side of the Sun from us. It then officially re-enters the evening sky, though it will be several weeks before the lovely planet pulls away from the Sun's glare and emerges at twilight: It will only become visible again around the third week of April, very low above the west-northwestern horizon, 15 or so minutes after sunset. Luckily, Venus is so bright that it pierces the glow of twilight. But as the planet finally drifts away from the Sun in May, the angle between the ecliptic and the western horizon becomes much shallower: By mid-June, Venus stops gaining altitude and peaks at less than 10 degrees above the west-northwestern horizon at the end of civil twilight. Unfortunately, this is just the beginning of a very poor apparition, as Venus will stay very low practically until the end of the year. **(See the diagram at bottom of page 3.)**

This spring, Venus appears minuscule through a telescope, since it's at its furthest from the Earth. The planet's disc has an apparent diameter of about only 11 arc seconds, and is illuminated virtually straight-on.

On the evening of April 24-25, Mercury (magnitude –1.7) crosses paths with Venus (magnitude –3.9) less than 1½ degrees apart: Despite their brightness, this conjunction won't be easy to see, as it occurs very low on the west-northwestern horizon, only 15 minutes after the Sun sets. On the evening of May 12, the very thin crescent Moon lies less than 1 degree to the left of Venus; once again, this encounter will be difficult to see since it takes place very low in the west-northwest 30 minutes after sunset, at just 12 degrees from the Sun. **On the evening of June 11,** the very thin crescent Moon lies 3 degrees to the lower right of Venus, low in the west-northwest 45 minutes after sunset. The next evening, on June 12, the lunar crescent swings 8 degrees to the upper left of Venus.

Saturn and Jupiter in the morning sky

Of the five planets easily visible to the naked eye, **Saturn** is the farthest and slowest-moving planet around the Sun; it spends the whole year in the constellation Capricornus. By late March, the ringed planet emerges in the east-southeast at the end of the night and rises only about 10 degrees above the southeastern horizon at dawn. But as the weeks go by, Saturn rises earlier and appears higher as dawn paints the sky above: In early May, the planet shows up after 2:30 a.m. and reaches a height of about 20 degrees at dawn; by mid-June, Saturn rises just before midnight, still in the east-southeast, and culminates over 26 degrees high in the south. The ringed planet goes retrograde on May 23 and, for several weeks, will appear to travel backward (westward or to the right) compared to the background stars.

The season kicks off with **Jupiter** in the eastern part of Capricornus—look for the very bright object visible at first dawn, a dozen degrees to the left of Saturn. As it gets pulled along with the rest of the celestial vault by Earth's rotation, Jupiter can be spotted following Saturn, rising in the east-southeast about 30 minutes after the ringed planet. Since Jupiter orbits the Sun at a much faster speed (orbital period of 12 years versus nearly 30 for Saturn), the gap between the two planets widens from week to week; Jupiter even crosses into Aquarius on April 25. The gap grows to 15 degrees at the beginning of May and reaches 20 degrees by mid-June; at that point, Jupiter rises nearly 45 minutes after Saturn and climbs over 30 degrees above the south-southeastern horizon at dawn.

Despite the growing distance between Saturn and Jupiter, their relative proximity in the sky allows for some interesting configurations when the Moon joins them. **The morning of April 6,** 45 minutes before sunrise, the waning Moon hangs 4½ degrees below Saturn, low in the southeast; **the next day, April 7,** 30 minutes before sunrise, the lunar crescent swings 5 degrees below Jupiter, forming a long triangle with Saturn, 12 degrees further west. On May 3 at dawn, one hour before sunrise, the last quarter Moon shines 8 degrees to the lower right of Saturn, low in the southeast; the next morning, May 4, the waning Moon forms a large triangle with Jupiter, 9 degrees higher and to the left, and with Saturn, 9 degrees higher and to the right; the day after that, May 5, the waning Moon can be found 7 degrees to the lower left of Jupiter. **The morning of May 31,** at the end of the night and at dawn, the waning gibbous Moon lies 5½ degrees below Saturn in the south-southeast; **the next day, June 1,** also at the end of the night and at dawn, the Moon lies 5½ degrees below Jupiter in the southeast.

Clear skies!

Research and text: **Marc Jobin**

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